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IAEE Energy Forum

CONTENTS

Editor: David L.Williams

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IAEE International Association for ENERGY ECONOMICS

PRESIDENT'S MESSAGE

I begin by reporting on our transition to a new Association Management Company (AMC). After an exhaustive search, we have contracted with Talley Management Group (TMG) to be our next AMC. The transfer of our physical and electronic records should be complete well before the end of the year.

IAEE has been extremely well-served by its AMC for more than 30 years, Administrative Management Services (AMS), headquartered in Cleveland, Ohio, and its Executive Director, Dave Williams. Many IAEE members were dismayed to hear that Dave would be retiring when the current contract with AMS expires at the end of 2022. Not only was the Association used to extraordinarily responsive service. Dave also had extensive knowledge of the history of IAEE and key players not only in IAEE but also the energy industry more generally. He also had very valuable contacts in the AMC and international conference organizing industries.

IAEE Council formed an AMC Vetting Committee, headed by former IAEE President Christophe Bonnery, to work with AMS to produce an RFP for AMC's interested in taking over from AMS, and to vet the applications. The vetting committee has worked diligently for more than six months on behalf of IAEE members to find the very best replacement AMC for our needs consistent with our budget.

Vetting Committee members independently scored the written responses to our RFP; the answers to questions at several online sessions with candidate AMCs; and presentations, questions and answers, and informal discussions with representatives of three finalists invited to our recent international conference in Tokyo. We evaluated the AMC's on a wide range of criteria: general headquarters support, executive director support, financial management reporting and procedures, and support in the functional categories of membership and subscription, communications, publications, technology and conferences. I am pleased to report that, among five semi-finalists, TMG was ranked highest in all but one category, and only slightly lower than the highest ranked candidate in the remaining category.

We also are very pleased that Rebecca Lilley is going to transition from AMS to TMG to continue working with IAEE. Rebecca has a wealth of knowledge about our history, past procedures, and key players in IAEE. The continuity that she can bring to the new operations greatly reduces the risks of the transition for IAEE.

Since our last newsletter, we held a very successful 2022 International Conference in Tokyo, with simultaneous participation online by many members around the world. We are extremely grateful to the National Graduate Institute for Policy Studies (GRIPS) for allowing us to use their facilities, to the Institute for Energy Economics, Japan (IEEJ) for organizing the program and providing many of the excellent speakers and audience members, and the many sponsors who supported the

(continued on page 2)

President's Message (continued)

conference financially while also providing excellent presenters. I would like to especially thank Past President of IAEE Yukari Yamashita for her tireless efforts, and for handling with equanimity difficulties associated with unexpected travel restrictions imposed because of the coronavirus pandemic.

IAEE Council is also very grateful to the Hellenic Association for Energy Economics for hosting the 17th European Conference in Athens from September 21–24, and the US Association for Energy Economics for hosting the 39th North American Conference in Houston from October 23-26. Both conferences are taking IAEE back to normal with full in-person sessions and a full schedule of student events including PhD days, poster sessions and best student paper competitions. The North American Conference is also featuring a Case Study competition and Student Mentoring Breakfast. The IAEE is also assisting our Latin American Members in hosting the 8th ELAEE conference in Bogota, November 20-22.

As you can see from the above examples, IAEE is very much getting back to normal conference business. I urge those of you who have been yearning to catch up with old friends, and meet new colleagues, but have been anxious about international travel, to come join us. Your next opportunity will be our 44th International Conference to be held February 4-9, 2023 in Riyadh. It will be hosted on the campus of the King Abdullah Petroleum Studies and Research Center (KAPSARC). Many of you may not have caught up with recent reforms in Saudi Arabia that have relaxed rules for foreign visitors, including opening many unusual and interesting sights to foreign tourists. The Saudi delegation presented a very exciting video to the closing session of the Tokyo Conference and announced at the end of it, to great applause, that Registration at the Riyadh conference would be complimentary.

Last, but no means least, as this is my last newsletter as IAEE President, I would like to end by welcoming Jean-Michel Glachant as our incoming President for 2023. Jean-Michel is well-known to many of you as the founding editor of the Economics of Energy and Environmental Policy, a frequent and insightful contributor at our conferences, an avid user of social media who has done much to promote IAEE in that medium, and, of course, a well-regarded academic economist. He also is an enthusiastic supporter of IAEE, and we look forward to him taking us to new horizons in cooperation with TMG.

Peter Hartley
IAEE President, 2022

Careers, Energy Education and Scholarships Online Databases

IAEE is pleased to highlight our online careers database, with special focus on graduate positions. Please visit http://www.iaee.org/en/students/student_careers.asp for a listing of employment opportunities.

Employers are invited to use this database, at no cost, to advertise their graduate, senior graduate or seasoned professional positions to the IAEE membership and visitors to the IAEE website seeking employment assistance.

The IAEE is also pleased to highlight the Energy Economics Education database available at http://www.iaee.org/en/students/eee.aspx Members from academia are kindly invited to list, at no cost, graduate, postgraduate and research programs as well as their university and research centers in this online database. For students and interested individuals looking to enhance their knowledge within the field of energy and economics, this is a valuable database to reference.

Further, IAEE has also launched a Scholarship Database, open at no cost to different grants and scholarship providers in Energy Economics and related fields. This is available at http://www.iaee.org/en/students/ListScholarships.aspx.

We look forward to your participation in these new initiatives.

Dave Williams Retiring from IAEE

Dear IAEE Family,

First and foremost, I hope that you all are safe and sound. We have certainly been through a lot with regard to the pandemic, natural disasters and turbulence of our precious energy industries over the past few years. I feel for all of you and thank you for your pledge to the energy economics community to provide thoughtful energy research that effects policy and business decision making processes.

Two years ago, I announced my retirement plans from IAEE as your Executive Director and overall association management company. Having served the association for 30+ years, it was a bitter-sweet decision. For me, I will be looking forward to spending more time with family, on the boats, in the garden and woodworking. Ahh, sounds so nice.

IAEE President Peter Hartley graciously permitted me to write this farewell note to you all. IAEE has been so fortunate to have had such outstanding presidents and councils. All have fervently led our organization through outstanding growth in regard to our membership, conferences and publications.

On the conference front, we have grown from 2 to 5 cornerstone conferences along with a rich history of energy symposiums and workshops. I thank our Affiliates, large and small (as well as university hosts), for raising their hands in support of this growth that keeps our energy community engaged and together.

On the membership front, we have explored the globe carrying the IAEE flag. We consistently waver between a membership base of representatives from 125 – 140 countries. I thank our members for sharing the word of IAEE and our products and services. You in your own right help every day to provide a solid reference point for IAEE. I so appreciate your ambassadorship.

On the publication side, the *Energy Journal* has grown from 125 pages to over 300 pages and from 4 to 6 issues annually. The quality of papers we produce are second to none for which we enjoy a strong impact factor. My hat is off to Editor-in-Chief Adonis Yatchew for his years of support and for overseeing such great growth of our flagship publication. I will miss working with Adonis very much. In 2008, Einar Hope pledged IAEE funds and manpower to develop *the Economics of Energy & Environmental Policy*. As independent publishers, IAEE set the course to develop from scratch a new sister journal focusing on policy and environmental matters that embrace the energy industries. I'm so grateful for the leadership of Jean-Michel Glachant, Michael Pollitt and Paul Joskow for bringing EEEP to fruition.

There is a long list of individuals to thank, so many that it would fill the rest of this issue of the *Energy Forum*. This said, there are a few I would like to call out. First and foremost are my wife Julie and daughter Lindsay. Both have been so incredibly supportive for the past three decades. Countless anniversaries, birthdays and family holidays missed with both of their understanding that often this job came with hours of travel that kept me away. Thank you!

My parents, of course. You cannot forget your mother and father who brought you into his world, nurtured and reinforced your values and beliefs.

I would also like to thank John Jimison, IAEE's legal counsel. I'm so fortunate to have had John by IAEE's side since the day we became IAEE's association management team. John has successfully navigated IAEE through unchartered territories and sometimes rough waters, always with a level head and always, always with IAEE first in his mind. Thank you, John.

A solid thank you also goes to Rebecca Lilley for her over 20 years of support to IAEE. Rebecca is everything technical to IAEE and a solid 2nd in command at IAEE Headquarters. I'm very grateful to report that Rebecca will continue with IAEE working for Talley Management Group who has been engaged to be IAEE's 3rd Association Management Company on record.

One of the most rewarding aspects of working with IAEE has been with you, our members. Seeing our students, then young professionals, who eventually grow into seasoned professionals, is reassuring for our future. I suspect I know the majority of our membership base on a first name basis. This transcends the daily work of managing the association. I take great pride in seeing our members grow and for allowing IAEE to be a part of their success stories.

For the past 30 years I've had the greatest show on earth. I've loved my experiences with IAEE more than I can explain. The things we have done, the places we have gone, the products and services we have developed – have all been outstanding. The people I have had the privilege to meet and the memories we have made together will last a lifetime.

A warm thank you to those in Tokyo, Athens and Houston for their on-stage gratitude to me, as well as those at Administrative Management Services. You all have truly shown your appreciation. I am most grateful.

I wish to thank you for the opportunity to serve,and beyond all, thank our members, the real owners of IAEE, for making the organization what it is today and where it will go tomorrow.

I look forward to staying in touch and seeing you around!

Dave Williams
Executive Director – 1992-2022
dwilliams@admgt.com

Editor's Notes

We close out 2022 with a discussion of the energy market impacts of the Russia-Ukraine War, including supply disruption, inflation, and the resulting potential real economic downturn. We are most grateful for our reader response on this timely topic. We round out the issue with some general topics of interest to our audience.

Tatsuya Terazawa relays seven key takeaways from the 43rd IAEE Tokyo International Conference. Many issues were identified, but not necessarily resolved. Members will continue thinking about these issues to be further discussed at the next IAEE conference which will be hosted by KAPSARC in Riyadh, Saudi Arabia, next February.

Jeff Combs discusses the impact that Russia's war on Ukraine has had on the outlook for nuclear energy. The war's repercussions for natural gas prices and availability have caused Western European countries and others to rethink the operations of their nuclear power plants, especially those that sought to curtail or shutter their nuclear power programs following the Fukushima accident.

Anas Abuzayed explains that an import embargo of Russian fuel is being increasingly discussed. He shows a way in which the electricity system in Germany can manage low energy imports in the short term and which measures are necessary to still meet the climate protection targets.

David Bourghelle, Fredj Jawadi, Philippe Rozin, and David Verstraetea analyse the impact of the war in Ukraine on the commodities market in Europe and discuss some projections about commodities in the future.

Ewa Lazarczyk and Chloé Le Coq discuss the feasibility and the effects of weaponizing electricity. They focus on the consequences on Europe's energy security of Russia using electricity as a weapon, either by stopping electricity trade, as with Finland in May 2022, or by disconnecting some countries from the grid, e.g., prematurely cutting off the Baltics from the BRELL network.

Marc-Olivier Metais, Rémi Lauvergne, and Christophe Bonnery provide highlights from EVER Monaco 2022. The EVER Monaco 2022 Symposium was the place to share, test and study new opportunities for electromobility, with a perspective from academics, industry and politicians' view points.

Roberto Cardinale states that the war in Ukraine is fueling the energy crisis in the EU, sparking concern for economic growth and political stability worldwide. However, war is not the only driver of the energy crisis. Its long-term causes originate in structural changes of world energy markets and the policy response to them.

Carl Grekou, Emmanuel Hache, Frédéric Lantz, Olivier Massol, Valérie Mignon, and Lionel Ragot write that the tragic conflict in Ukraine has profound and wide-ranging implications on many issues, including international relations, military alliances, commodity markets, and macroeconomics. Among them, the disruption of Russia's natural gas supplies to Europe, its repercussions on the power markets, and the slowdown of the European economies certainly get the utmost attention. They focus on the European policy responses implemented to alleviate the energy crisis and broaden policy perspectives.

Philippe Benoit, James Glynn, and Anne-Sophie Corbeau ask how are we doing in transitioning our energy system to meet our climate goals? They propose two metrics to track progress in implementing the needed energy transition.

Robert E. Brooks, Ning Lin, Ed O'Toole, and Jiaxin Yang summarize results from a set of scenarios regarding the future of Russian pipeline gas supplies into Europe which were presented at the 2022 USAEE Conference in Houston.

Tilak Doshi discusses BRICS in the new world energy order, their challenge to G7 developed countries, and BRICS as a geopolitical hedge.

Humphrey Oruwari investigates the factors influencing the optimum utilization of natural gas in Nigeria and recommend ways for policy decisions. Using literature review and case studies, the study findings revealed that provision of adequate infrastructure, diversification, liberalization and collaboration in terms of financing and formation of technical partners are some of the critical success factors.

Aaron Rabinowitz, Timothy C. Coburn, Thomas H. Bradley, and John G. Smart explain that a perceived barrier to widespread adoption of electric vehicles is the presumed inconvenience of charging them. Inconvenience has not been thoroughly addressed from an economic, policy, or operational perspective. We propose an inconvenience score that is location agnostic, does not depend on powertrain type, and takes itinerary specifics into account.

Huei-Chu Liao notes that beginning with the implementation of freezing the market price by two national energy companies, which did calm down Taiwan's economy, and reviewing some windfall tax literature, current energy liberalization systems should reconsider some mechanisms, such as freezing the market price to cope with sudden great impacts.

DLW

IAEE MISSION STATEMENT

IAEE's mission is to enhance and disseminate knowledge that furthers understanding of energy economics and informs best policies and practices in the utilization of energy sources.

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

- **Leading edge publications and electronic media**
- **International and regional conferences**
- **Networking among energy-concerned professionals**

Takeaways from the 43rd IAEE Tokyo International Conference

BY TATSUYA TERAZAWA

Mr. Tatsuya Terazawa is Chairman and CEO of the Institute of Energy Economics, Japan

Seven takeaways from the Conference

- The "First world energy crisis" & risk of diversion from the "1.5 degrees path"
- Continued importance of Natural Gas/LNG & the need for investment and finance
- High hopes for Hydrogen but challenges ahead: Market & Scale, transportation, infrastructure
- The importance of Critical Materials: circularity and supply chain
- Need to address intermittency of renewable energies: dispatchable power, market design
- Growing importance of nuclear energy
- Ensuring energy access and growth for the Emerging/Developing countries

It was a great honor for IEEJ to co-host the 43rd IAEE (International Association for Energy Economics) International Conference held in Tokyo between August 1 and 3. This year's Conference provided the first in-person meeting opportunity for the IAEE International Conference since 2019. We are pleased that 693 leaders and experts in the field participated, including 243 in-person attendance from overseas.

As we face the two challenges of tackling global warming and the energy crisis simultaneously, I believe that in the long history of IAEE international conferences, this year's conference was held at a most important and crucial moment.

I would like to thank our co-hosts, IAEE & GRIPS (National Graduate Institute of Policy Studies) and all the participants, organizers and sponsors who made this year's conference possible. In this month's Chairman's Message, I would like to share with you my 7 takeaways from the IAEE Tokyo conference, thanks to the insightful and stimulating discussions made by the participants.

First, there was a very strong sense of crisis. Dr. Fatih Birol, IEA's Executive Director, described the current situation as the "First world energy crisis". Compared with the two oil crises of the 70's, we are now facing crises of many forms of energies including oil, natural gas/LNG, and coal. Compared to the 70's, when the affected countries were limited to the advanced economies that were the major players/actors in the world economy, today's crisis is affecting the whole world from emerging/developing countries to advanced economies. The vast majority of the conference's participants shared the view that energy security has been greatly elevated in its importance.

Dr. Hoesung Lee, Chair of IPCC, sent a strong warning that we are diverting from the 1.5 degrees path, with the likelihood that the global temperature could rise to 3.2 degrees above the preindustrial level by 2100 based on the currently submitted Nationally Determined Commitments (NDCs). He stressed that local actions should be consistent with the global goals. Both Dr. Birol and Dr. Lee pointed out that investment to support the energy transition was grossly insufficient and a very serious problem.

Second, many participants were stressing the role and importance of natural gas/LNG as one of the major energies. They are needed to support the growth of the emerging and developing world, and will help in the transition away from coal. As the share of renewable energy rises, they will provide for dispatchable power to accommodate the intermittency of renewable energies which is growing in importance. Strong concerns were raised that with insufficient investment, we may experience a shortage of supply capacity for natural gas/LNG leading to another price hike in the future. In this regard, a number of participants pointed out that financing should be provided to enable investment especially for non-Russian natural gas/LNG. The resource development of natural gas/LNG should be aligned with our long-term goal of carbon neutrality. As such, the production of hydrogen/ammonia from gas, with CCS, is considered as an important mean to ensure the alignment.

Third, there were very strong expectations for hydrogen and its derivatives including ammonia to support the transition. They were considered as keys to decarbonize the hard-to-abate sectors and through co-firing with coal, they reduce the carbon emission of coal fired power plants, especially for the young fleet currently in Asia.

But cautions were pointed out against too much premature hype. There remains a number of challenges. In particular, the lack of market and the absence of scale were pointed out by many. Transportation and the necessary infrastructure investments were also recognized as challenges. To overcome this "chicken and egg" problem, government policies and public-private partnership were deemed essential.

To realize the potential of hydrogen, it was clear that we cannot make it happen overnight. We have to develop the market, realize the scale and prepare the infrastructure in stages. On this point, it was widely recognized that "blue hydrogen/ammonia" produced from fossil fuels could be the practical first step before "green hydrogen/ammonia" becomes more competitive through the cost reduction of electrolysis and with a more abundant availability of renewable energies.

Fourth, as we expand the use of renewable energies, EVs and batteries, there was a consensus that the availability and access of more critical materials will be extremely important. The clean energy transition will lead us to less energy density and higher material density. A substantial increase in the supply of critical materials will definitely be required. Many participants were concerned about the emerging energy security challenge resulting from the dependence on China for the supply of those critical materials. Concerted efforts to diversify the sources were strongly advocated.

Dr. Lee of IPCC claimed the energy transition to be in fact a materials transition. He stressed the vital importance of the circularity of materials which should not be sacrificed in the realization of carbon neutrality. To address his concern, we need to develop technologies to enhance our resource efficiency, develop alternative materials and strengthen our recycling activities.

Fifth, with the wider introduction of renewable energies, the issue of intermittency was recognized as growing in importance. Many participants stressed the necessity of batteries, but high cost and reliance on critical materials were pointed out as their challenges. The development of transmission lines connecting different regions facing different weather conditions was also mentioned, but this requires substantial additional investment to the need to develop distribution grids.

A number of participants mentioned that dispatchable power sources, such as gas, are becoming more essential. Unfortunately, the current liberalized electricity markets discourage investment in dispatchable power. While we expect the wholesale market will be dominated by renewable energies with very low marginal costs, it will become harder for thermal power generation, which could provide dispatchable power, to recover the necessary investment. The current liberalized electricity markets were developed when gas powered power plants were the expected new entrants while renewable energies were still expensive and with little penetration which kept the issue of intermittency negligible. Now under very different conditions, it is time to redesign the electricity markets to ensure investment for dispatchable power.

Sixth, many participants expressed the view that nuclear energy is required to help realize the long-term goal of carbon neutrality as well as enhance energy security. To deal with the intermittency of renewable energies and the need to replace coal, it was widely argued that nuclear was the essential missing piece to decarbonize the energy system. Nuclear can provide heat as well as produce hydrogen. The invasion of Ukraine has created the additional momentum to push for nuclear in order to reduce dependency on Russian fossil fuels. In addition, Dr. Birol of IEA referred to Prime Minister Kishida's comment to restart 9 nuclear units in Japan as helping to ease the global LNG supply and demand balance in the time of energy crisis. There were some even claiming the "Renaissance of Nuclear".

At the same time, challenges were identified, including the need for streamlined regulation, availability of finance, better market design and the enhancement of competitiveness of Western technology providers.

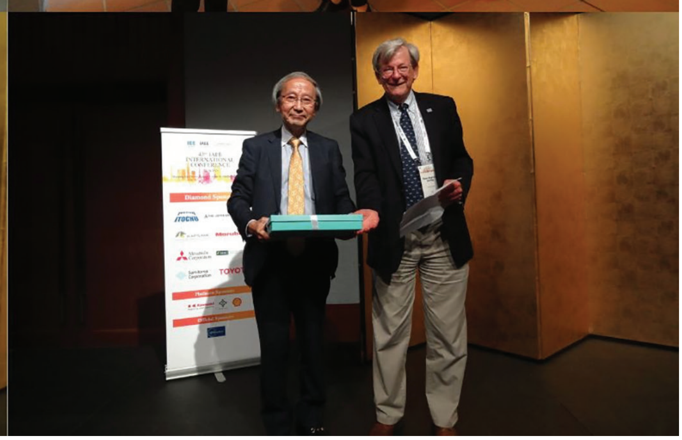
Seventh, finally, but not the least, we were reminded that by 2050, three more billion people will need to gain access to modern energy, and many others would like to improve their living standards. The need to address the necessities of the emerging/developing countries, which aspire to grow, was also stressed by a large number of participants. The fleet of coal fired power plants of the developing countries is very young and hard to retire early. These countries are more exposed to the record high energy prices and they face the difficulties of accessing the global energy markets when the advanced economies are paying more in their rush to secure their own energy needs.

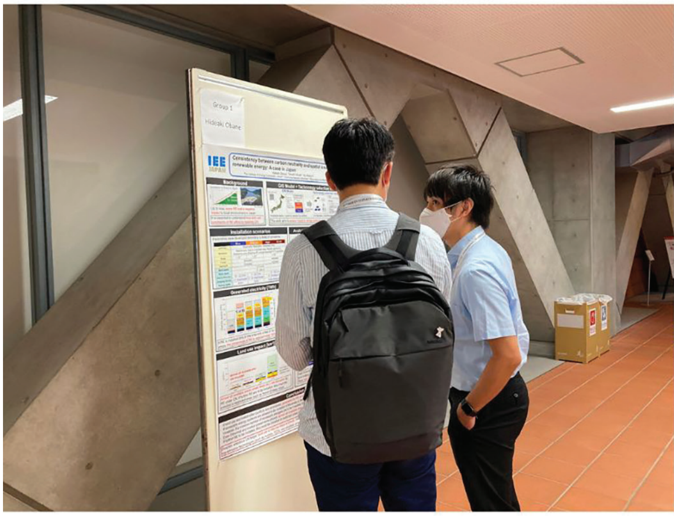
It was stressed that the necessities and the realities of the emerging/developing countries require different paths for decarbonization. Indeed, there should be "different colors of energy policies" depending on the situations of each country. One size does not fit all. The emerging/developing countries will undoubtedly promote renewable energies but they need to secure the financing for them. To meet their strong growth, they will have to introduce other energy sources such as natural gas/LNG which provides dispatchable power. They will continue using their younger coal fired power plants to ensure a sufficient supply of energy at affordable prices. We must find ways to enable the continued use of coal while reducing the CO2 emission as much as possible. In this regard, co-firing with low carbon ammonia could provide a practical path.

I hope this summary provides a sense of the discussions that took place at the IAEE Tokyo Conference. Many issues were identified, but not necessarily resolved. It was confirmed at the end of the conference that the members will continue thinking about these issues to be further discussed at the next IAEE conference which will be hosted by KAPSARC in Riyadh, Saudi Arabia, next February.

We at IEEJ are also committed to tackle with these issues.

Scenes from the 43rd IAEE International Conference July 31 - August 4, 2022 Tokyo, Japan



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Fahad Alajlan
President,
KAPSARC
Christophe Bonnery
IAEE President 2019,
Programme Director,
Paris School of Economics
Peter Hartley

Paul Tempest (14 August 1936–6 March 2022)

The IAEE and the BIEE have much cause to remember and thank Paul Tempest for his contributions to the development of both organisations. He served as President of the IAEE in 1984 and was Vice President of the BIEE from 2001 to 2009. He most certainly fostered the development of what is the UK branch of the IAEE but with its own distinctive features including the annual BIEE conference. As an example of his enduring organisational work, he edited a substantial book entitled *International Energy Markets* published in 1983 on the full proceedings of the joint IAEE/BIEE conference at the University of Cambridge. The papers in this volume are of enduring value to both academics and policy makers in the energy sector.

I had many personal dealings with Paul on the occasion of the IAEE conference at Aberdeen in June 2002 which I had the privilege to chair. Paul was appointed as Programme Co-Chair. I recall his diligence and unfailing good humour in scrutinising the many submissions of papers for presentation at the conference. His wide range of knowledge of the energy sector, reflecting his personal career in diverse aspects of energy, were very evident.

In sum, we should all remember with gratitude his contributions to the health and growth of the IAEE and BIEE.

Professor Alex Kemp
University of Aberdeen

Impact of Russia's Invasion of Ukraine on Nuclear Energy

BY JEFF COMBS

Jeff Combs is owner and Chairman of UxC, LLC (UxC) and is a leading expert in the nuclear fuel market. He can be reached at jeff.combs@uxc.com

Introduction

Russia's war on Ukraine has had a notable impact on the outlook for nuclear energy, both in the short term and likely for the foreseeable future, as the attack has created lingering questions about the future reliability of Russian energy supplies. The war's repercussions for natural gas prices and availability have caused Western European countries and others to rethink the operations of their nuclear power plants, especially those that sought to curtail or shutter their nuclear power programs following the Fukushima accident. In addition, the invasion is causing some countries to consider expanding their existing nuclear fleets.

While the invasion has created more demand for nuclear power as countries seek to move away from Russian natural gas supplies, it has also impacted the supply side of the nuclear equation. Russia is both a major supplier of nuclear reactors and nuclear fuel. With respect to nuclear fuel, its position is as strong or stronger than its supply of fossil fuels. Because of both these supply and demand impacts, Russia's invasion of Ukraine is complicating the future picture for nuclear energy.

Demand Developments

European countries, which have been the hardest hit by Russia's natural gas policies, have reconsidered the operations of existing nuclear power plants. Belgium has reached a preliminary accord with the utility ENGIE for ten-year extensions of two reactors that were previously scheduled to shut down in 2025. The German government has agreed to place two of its units on standby as it seeks to negotiate a difficult winter with reduced natural gas supplies. France is looking to shore up operations of its nuclear reactor fleet and prepare for a new reactor construction program by fully nationalizing EDF.

The renewed interest in nuclear power in Europe extends beyond delaying the shutdown of existing operating reactors and the restart of idled units. Developments in the Netherlands could lead to future new builds. France, which had its first big push into nuclear power during the 1970s Arab oil embargo and is dependent on nuclear for most of its electricity generation, is looking to build upwards of six large reactors. The United Kingdom is also planning to add to its nuclear capacity as it seeks to replace its rapidly aging gas-cooled reactor fleet. Nations in Eastern Europe, including Poland, Czechia, Romania, and Bulgaria, are also all accelerating plans for new reactor projects as they seek to increase their energy security.

The impacts are not just limited to Europe. Japan has also seen increasing pressure to restart idled reactors. Fumio Kishida, its Prime Minister, is seeking to have nine units in operation this winter and a total of 17 running by next summer. While this may be an ambitious plan given Japan's strict safety regime, it does indicate a desire for nuclear to regain an important role in Japan's energy mix in the aftermath of the Fukushima accident. In another notable development in Canada, Ontario's provincial government has asked for Ontario Power Generation to evaluate the viability of a refurbishment program could allow the Pickering B nuclear power station to operate for another 30 years.

The demand picture stemming from Russia's invasion is not completely positive, however. The first nuclear project to fall victim was in Finland, which canceled a new Russian-led reactor at Hanhikivi soon after the war broke out. Before the war, Ukraine was in discussions with Westinghouse to construct two new reactors, but these plans have been set back due to the war.[1] Ukraine has a large nuclear power program and currently operates Europe's largest nuclear power plant at Zaporizhzhia which has six reactors. This plant has been the subject of much attention as it is occupied by Russia's military and has been at the frontlines of fierce fighting. If the plant were severely damaged, not only would it be taken out of operation, but it would likely deal a blow to broader aspirations for new plants in Ukraine and perhaps Europe as well as elsewhere. Also, if Russia's economy slows down or collapses due to the war, its need for nuclear power would decline along with its ability to construct reactors. Russia recently announced plans to build up to 16 new reactors by 2045, increasing nuclear's share of electricity generation there from 20% to 25%.

Climate Change Considerations

The Russian invasion of Ukraine has come at a time of growing concern about climate change. This summer, the European Union accepted nuclear energy into its green taxonomy along with natural gas. With availability of natural gas now questionable in Europe, the green taxonomy designation has served to further boost interest in nuclear energy to meet climate goals. At the same time, the realization that renewable energy alone is unable to allow California to reach its climate goals has resulted in a change in policy to prolong the life of the Diablo Canyon nuclear power plant at least until 2030.

The overall political climate has also become more positive toward nuclear energy, largely separate from the impacts of Russia's invasion, and due more to a change in leadership in some countries, coupled with a concern over climate change. Leadership changes in South Korea and Sweden herald a more favorable disposition toward nuclear energy. The United States has also supported maintaining and expanding its nuclear power capacity and massive new funding in recently passed major legislation is now aimed at the development of small modular and advanced reactors.

Because of the concerns over climate change and energy security, the International Atomic Energy Agency (IAEA) has increased its outlook for nuclear power growth for the second year in a row.[2] The IAEA raised its high case scenario by 10%, and now sees its most optimistic scenario reaching 873 GWe of nuclear capacity by 2050, which is more than double the current level of 390 GWe.

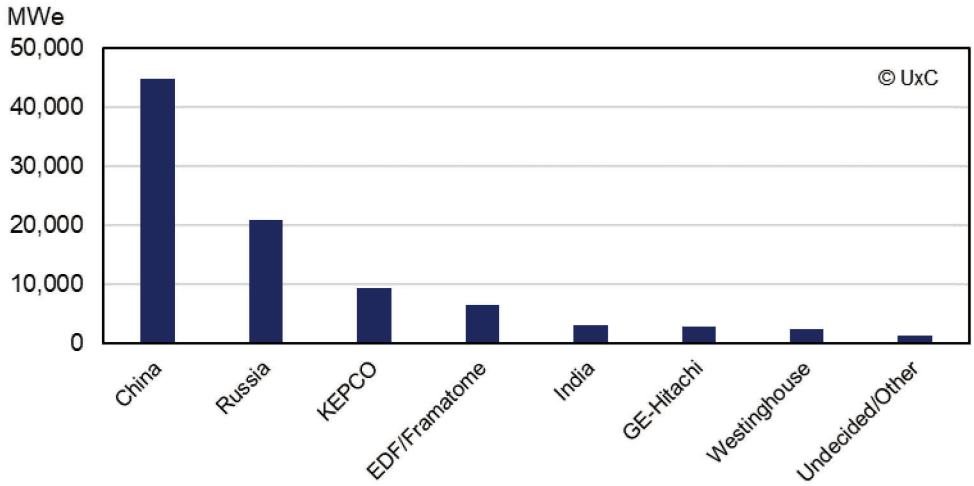

Figure 1. New Reactor Vendor Selections through 2030

Supply Issues: Russia's Role as a Nuclear Reactor and Fuel Supplier

While Russia's invasion has clearly boosted the desire to keep reactors operating and to construct new ones, it has also greatly complicated the picture for nuclear energy due to Russia's role on the supply side. As shown in Figure 1, Russia is one of the world's largest suppliers of reactors, with projects underway in Bangladesh, Belarus, China, Egypt, India, Iran, and Turkey as well as domestically in Russia. Russia's invasion of Ukraine and occupation of the Zaporizhzhia plant has not yet derailed this work but could still do so as well as impact plans for other new reactors.

Paradoxically, the rise in fossil fuel prices stemming from Russia's invasion of Ukraine can continue to fund Russian reactor construction around the world, if countries desire to look to Russia for their reactor needs. Thus, if nuclear power continues to grow due to higher natural gas and oil prices, Russia could be a beneficiary of this growth. One example of this is that Hungary is continuing to move forward with a plan to build two large Russian reactors at its Paks site, despite opposition by its EU neighbors.

Russia's status as a major nuclear fuel supplier also complicates the outlook for nuclear power. As shown in Figure 2, Russia through its state-controlled company Rosatom, accounts for around 40% of the world's uranium enrichment capacity, far greater than its share of world natural gas and oil supplies. It also accounts for a similar share of uranium conversion, which is another crucial step in the nuclear fuel cycle. Since most reactors are of the light water variety that require enriched uranium to operate, a stable enrichment and conversion supply is critical to future of nuclear power operations. Russia is also a major supplier of nuclear fuel assembly fabrication services for the VVER-type reactors that it has supplied and is building around the world.

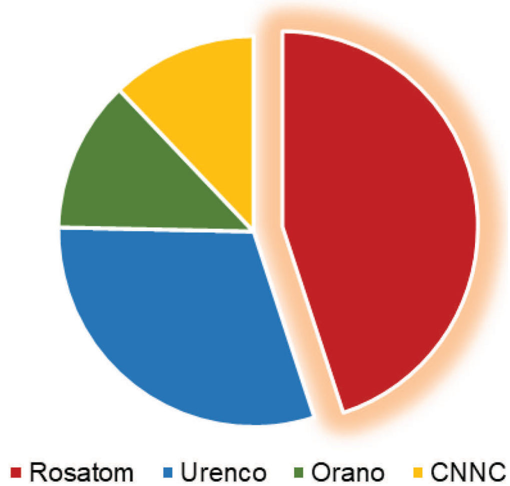

Figure 2. Global Enrichment Shares by Supplier Capacity

Concerns about Russia's role as an enrichment supplier have already had a marked impact on enrichment (or separative work unit – SWU) prices, as shown in Figure 3. Since the invasion, both the spot and long-term contract prices of non-Russian origin enrichment have increased notably. As of this writing, there are no restrictions on the importation of Russian nuclear fuel in the United States or Europe. However, individual utilities have opted to move away from Russian supplies. As most enrichment is sold under long-term contracts, prices for non-Russian supplies have risen dramatically as utilities have sought to secure long-term supplies from other Western suppliers. Uranium and conversion prices have also risen, and Russia is losing ground in the VVER fuel fabrication market.

Neither Russia nor Ukraine is a major source of uranium resources or production. However, Russia produces large amounts of uranium by underfeeding its enrichment plants (substituting enrichment for uranium in the make-up of the enriched product) and by enriching depleted uranium. Angarsk, one of its four enrichment plants, is devoted to enriching depleted uranium, and basically operates as a uranium mine.

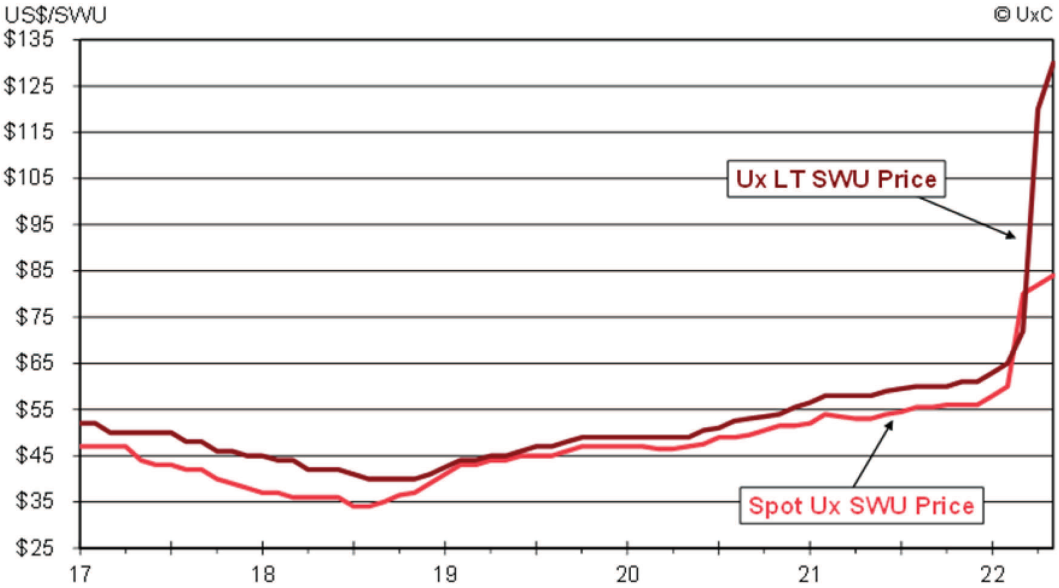

Figure 3. Spot and Long-Term Contract Enrichment Prices ($/SWU)

Perhaps more important to the uranium supply question is the fact that Kazakhstan, which accounts for 40% of the world's uranium production, is located next to Russia. The primary route to transport Kazakh uranium goes through Russia, although there is also an alternative route through the Caspian and Black Seas. Thus, it is possible that logistical issues caused by Kazakhstan's links with Russia could complicate international uranium shipments in the future.

Future Considerations

For nuclear power to grow robustly, Russia will need to continue as a nuclear reactor and fuel supplier, at least in the short to medium term. A bifurcated market has already developed in enrichment, conversion, and fuel fabrication and could develop in the sale of reactors. It may be the case that certain countries will continue to look to Russia for nuclear power plants and fuel in the future, and this could support a certain amount of growth. However, in the longer term, Russia risks losing market share in reactor and fuel sales as the war with Ukraine drags on.

To support timely nuclear power growth in the rest of the world, additional enrichment capacity must be added. The United States has already announced steps to make it independent of Russian nuclear fuel supplies by having the government augment market demand to stimulate new domestic production capability.[3] In addition, the U.S. Congress is considering legislation that would ban imports of Russian nuclear fuel. The United Kingdom is also taking steps to augment its domestic nuclear fuel supply.

If Russia is not seen as a reliable supplier of enrichment and other nations with enrichment plants do not expand their capacity, then countries embarking on nuclear power programs may feel compelled to pursue their own domestic enrichment programs for supply security reasons. This consideration would slow down the expansion of nuclear energy as it would take time for countries to develop and construct enrichment facilities, if this were even possible. It would also raise proliferation concerns as more countries would be developing enrichment capacity, making it more difficult to monitor and safeguard enrichment activities.

Stable sources of enrichment supply thus must be made available as a prerequisite to a robust expansion of nuclear energy worldwide, especially if the high levels currently forecast by the likes of the IAEA are to be realized. Expansion beyond current capacity is needed even if Russia's current capacity is fully utilized. With less reliance on Russia, which is anticipated, even more expansion of non-Russian enrichment capacity will be necessary, along with uranium and conversion capacity to support this. Countries, such as France and the United States that currently have enrichment facilities and seek to make reactor sales must look to build capacity sufficient not for just their own needs, but to support additional nuclear power growth worldwide. Importantly, enrichment is also a resource hedge, as enrichment and uranium are substitutes, so expansion of enrichment capacity using more advanced and efficient technology can underpin nuclear fuel supplies and support the introduction of advanced reactors whose fuel requires higher enrichments.[4]

Conclusion

Because of its invasion of Ukraine and the resulting reactions, Russia's role in the nuclear energy space is likely to decline in the future, especially when it comes to nuclear fuel. This decline is likely to be more dramatic if the war is protracted and/or if damage is done to Ukrainian reactors. Over the short to medium term, Russia will likely continue to supply nuclear fuel to Western countries, as no restrictions currently exist and Russia has not threatened to withhold supplies. However, if restrictions are placed on Russian nuclear fuel, or if Russia decides to stop supplying the United States and/or Europe, nuclear fuel prices would rise dramatically. This reaction could create the kind of fuel uncertainty that could undermine the expansion of nuclear power worldwide. Under any scenario, Western countries will need to expand enrichment capacity to ensure adequate supplies for nuclear power growth, particularly where this growth is in the form of advanced reactors that require higher levels of enrichment to operate. Conversion and uranium supplies must also expand and remain sufficiently diverse to assure nuclear fuel supply security.

Footnotes

[1] Before the invasion, Ukraine had decided to move away from Russia as a supplier of nuclear reactors and fuel.

[2] International Atomic Energy Agency. IAEA Projections for Nuclear Power Growth Increase for Second Year Amid Climate, Energy Security Concerns. September 22, 2022.

[3] Bloomberg News. US Redoubles Efforts to End Dependence on Russian Nuclear Fuel, September 28, 2022.

[4] The importance of enrichment to nuclear fuel supplies is discussed more fully in Hsieh and Combs (2021). Enrichment's Critical Role in Nuclear Fuel Supplies. IAEE Energy Forum, First Quarter 2021, 44-47.

James Smith receives the IAEE Past President Award in Houston, Texas at the USAEE/IAEE North American Conference
Photo by Eric Hittinger

Avoiding the Next Energy Crisis in Germany: Impacts of a Fuel Embargo on German Electricity Sector

BY ANAS ABUZAYED AND NIKLAS HARTMANN

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Abstract

An import embargo of Russian fuel is being increasingly discussed. We want to support the discussion by showing a way how the electricity system in Germany can manage low energy imports in the short term and which measures are necessary to still meet the climate protection targets.

Introduction

Russia is the main supplier for Germany's fossil fuel needs, with more than 50% of its primary energy consumption (Figure 1). Recent events showed, however, that this addiction led to explosive energy prices, which will at one point, the least, lead to an energy crisis. In 2020, Germany imported 94 % of its natural gas, half of which was further exported [1]. Within Germany, gas is used in four main consumption sectors. The largest share is used in the household and commercial, trade and services (CTS) sectors for space heating and hot water, and in the industry to provide process heat [2] [3]. Mineral oil in the chart includes crude oil (crude), crude gasoline, heating oil (light and heavy), liquid gas, refinery gas, gasoline, diesel and jet fuel. As of 2020, about 98 % of Germany's oil is imported, 19 % of which is re-exported [4]. One-third of oil imports comes from Russia. Oil is mainly used in the transport sector and for the provision of space heating, hot water and process heat [5]. Since 2018, Germany is importing all hard coal, the main customers being hard coal-fired power plants and the steel industry [6] [7] [8].

Scenarios Development

Four scenarios are investigated in this study. Common to all scenarios is the assumption that fuel imports from Russia will be stopped at the end of 2022. Most recently, Russian supplies of natural gas through the MEGAL and Nord Stream 1 pipelines were decreased by around 70 % of their previous daily transmission capacities before being completely shut down beginning of September [9] [10]. An import stop must reduce, above all, the demand for oil and the demand for gas in at least one of the demand sectors, therefore, we want to investigate how the electricity sector ("power sector") can compensate for a sudden abandonment of energy source imports from Russia as shown in Figure 2. With a priority given to heat supply, both oil and gas in 2023 will not be available for use in the electricity sector, and hard coal will only be available at 30% of the consumption volume in 2020.

With the establishment of new relationships and contracts for energy imports from other countries, it is assumed that hard coal and oil will have limited availability for 2 years until their availability is raised again to business as usual situation. For the import of natural gas, liquified natural gas (LNG) terminals have to be built. Here it is assumed that after 5 years the availability of natural gas also increases. The electrical demand is expected to increase rapidly in the coming years, either from the higher shares of electric mobility [11], or the potential of electrification in other consumption sectors, i.e. the industrial sector [12] [13], as well as the heating sector [14]. Therefore, an annual increase of 1 % is applied to the electrical demand so that partial electrification of other sectors is represented.

Scarcity of the energy supplies caused a historical rapid increase in the oil and gas prices. Currently, the prices spikes are more affecting in the short-term, but could also affect the long-term energy policies and sustainability goals [15]. The scenarios discussed in this study will differ in the prices for the energy sources gas and oil. Prices for hard coal remain unaffected from the price increase. Two different cost assumptions will be followed as shown in Figure 3.

With the continuous developments in Ukraine and the gas shortages in supply and storage facilities in Germany, many discussions are addressing the ability and robustness of the energy sector in Germany within the next winter, and which compensation measures will be implemented. The federal government announced at the end of 2021 a preponed phase-out date of coal and lignite fired power plants by 2030 [16]. However, recent warnings showed that the serious situation of gas supplies might lead to ramp up coal power plants again [17], especially in winter, as well as holding the ongoing phase-out by 2030 [18]. The feasibility of turning back to using coal fired power plants and prolonging their existence in the German electricity market will be studied throughout the scenarios, where the previous and new coal phase-out dates will be further analysed.

Results and Discussion

Following a scenario-based analysis [19], the studied scenarios showed some interesting aspects. Firstly, the earlier decommissioning of coal and lignite power plants by 2030 yielded higher investments in renewables, especially in offshore wind technologies, along with short and long-term storage technologies (Figure 4). The complete shut-down of power coming from gas power plants, along with the lack of adequate flexibility in the system, together incentivised the investments in renewables to nearly double the previous known

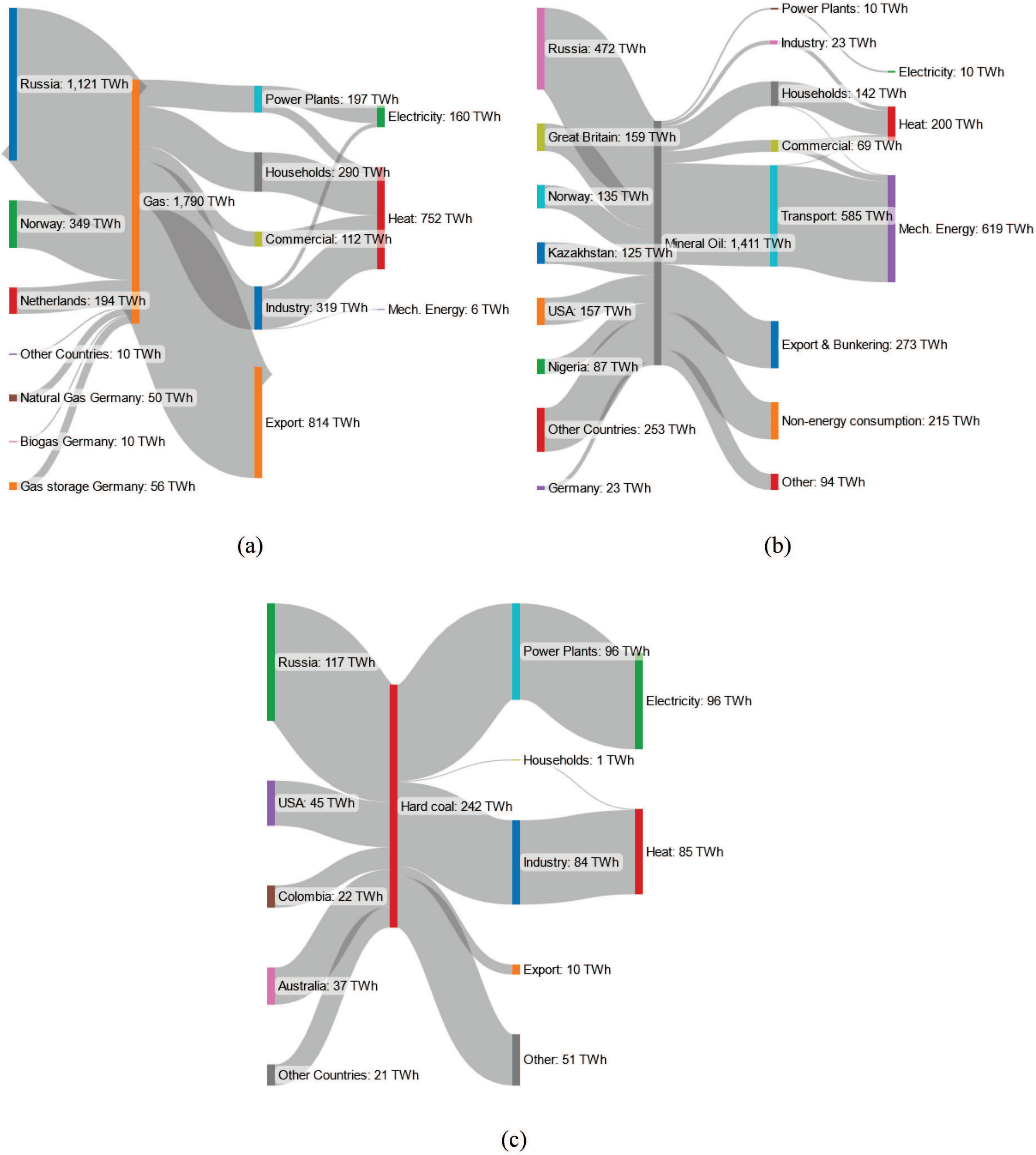

Figure 1: Imports and exports of the energy sources (a) natural gas, (b) mineral oil and (c) hard coal in 2020; the unit TWh indicates the energy content of the respective energy sources. [1-8]

installed rates in the country. With limited flexibility within the system, complete shortage of gas and oil, the system will face huge load shedding by 2023 of nearly 40 GWh if the ongoing coal phase-out by 2030 is still carried out.

After gas is reintroduced into the system, the grid will already have sufficient renewable generation capacity and enough flexible storage technologies, gas use in the energy mix experiences an almost complete decline and used to a small extent to provide flexibility and system security. If gas prices go back to normal values, the gas fired power plants utilization is higher, especially with the earlier phase-out of coal, with a share of 8 % of the energy mix (56 TWh). However, with higher gas prices, nearly 1.5% of the energy mix will come from gas-fired power plants. Oil-fired power plants are barely used in the electricity sector due to their high cost and emissions.

The huge investments in renewables and storage technologies led not only to less dependence on fuel import, but to less utilization of conventional power. This was translated into the system emissions in Figure 5, where all scenarios except the price-wave-2037 stayed in line with the 1.5 °C target of Germany.

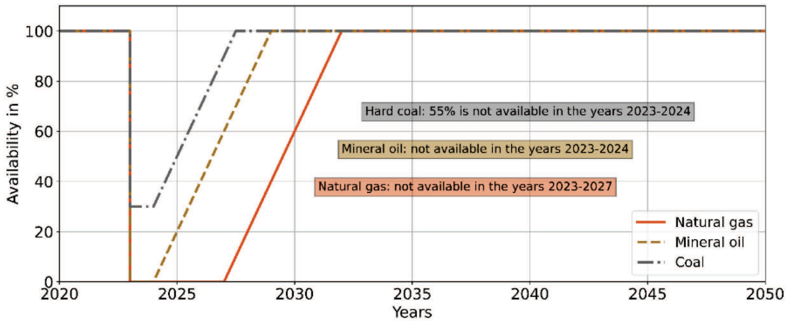

Figure 2: Scenarios availability of the energy sources hard coal, oil and gas in Germany's electricity system.

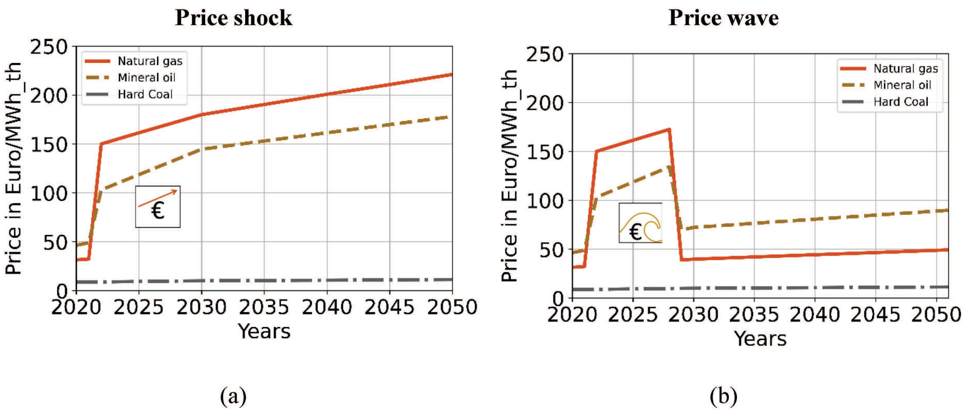

Figure 3: Model costs assumptions for the two main scenarios (a) "Price shock" and (b) "Price wave)

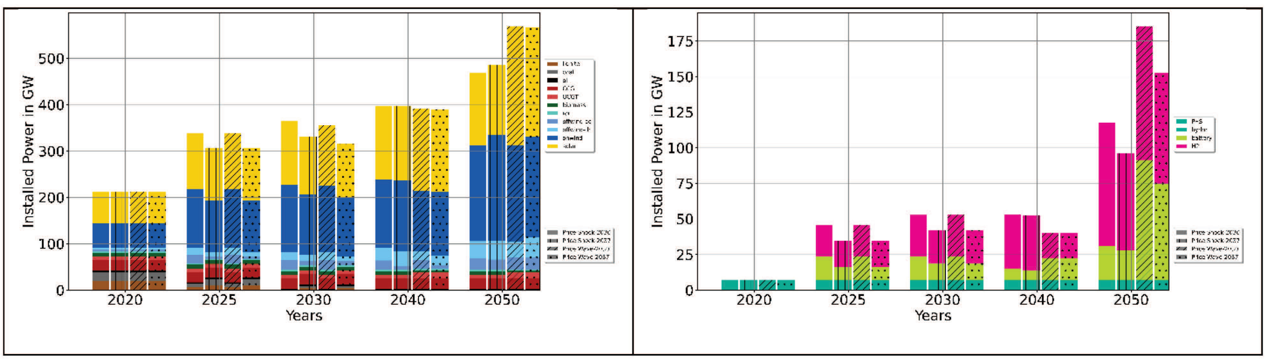

Figure 4: Scenarios Installations of Renewables and Storage Technologies.

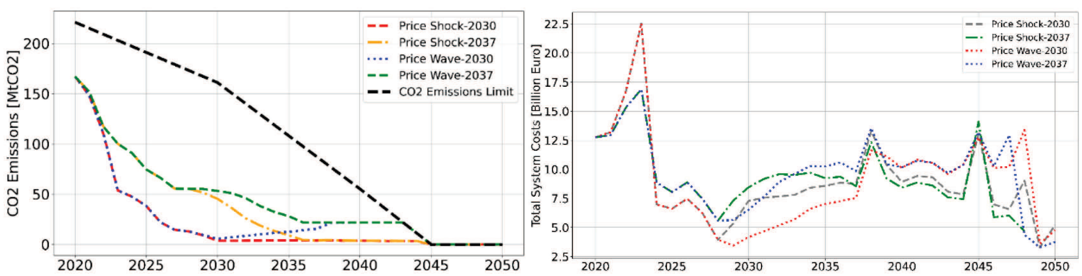

Figure 5: Scenarios emissions and total system costs.

The phase-out of coal and lignite by 2037 helped the system in terms of adequate flexibility from conventional sources, where in the 2030 scenarios these sources were compensated by using storage technologies. In terms of total transition cost, all systems had nearly close numbers. However, systems with a later coal phase-out dates were in average more expensive on the longer run, let alone the nearly-double emissions.

Conclusion

It can be summarized that an early phase-out of conventional energy sources and an expansion of renewables pave the way to a low-carbon electricity system. The short-term reduction in fossil fuel imports leads to enormous investments in renewable energy in all scenarios, almost twice as high as the investments in the previous years, in addition to enormous investments in storage. However, many positive aspects can also be taken from the scenarios. For example, the early expansion of storage facilities means that not only in the short term, but also in the medium and long term, there is no need for significant quantities of natural gas in the electricity system. Moreover, the climate targets of the German government are met and, more importantly, the available CO_2 budget in the electricity system is undercut in all scenarios and the 1.5-degree target is achieved in three of them [20]. This will most certainly have a great advantage in the long-run and will allow for a rapid transition towards a carbon-neutral electrical system.

The results showed that it would be possible after 2028 to run the electrical system without the gas-fired power plants, meaning that it is more important to focus on higher renewables and storage investments rather than building LNG gasification stations to replace gas pipelines. Other sources of flexibility within the system can be further analysed and their potential along with the storage facilities should be adequate to run a secure system with 100 % renewables and not depend heavily on fuel imports.

Stopping the gas, coal and oil imports can be very challenging, but not necessarily impossible. Moreover, great obstacles must be resolved in order to develop and achieve a 100 % self-sufficient energy strategy. Finally, as Russia already manipulated the market once and cannot exhaust this option again, any political decision must be taken while keeping in mind that Russia cannot hurt you through energy again.

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Commodity Price Dynamics and Geopolitical Tensions: Further Evidence of Multiple Shocks

BY DAVID BOURGHELLE, FREDJ JAWADI, PHILIPPE ROZIN, AND DAVID VERSTRAETE

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Abstract

This note analyses the dynamics of the commodities market in the context of high inflation and the Russia-Ukraine war. To this end, we first analyze the dynamics of the commodities market in the aftermath of COVID-19 in relation to two types of shocks: a demand-side sock and a policy shock. Second, we discuss the impact of the Russia-Ukraine war on commodities with reference to a supply-side shock. Third, we comment on the consequences of the present geopolitical instability on the real economy. We then analyse the challenges associated with the ongoing sanctions imposed on Russia by the US and the EU. Finally, we discuss current central bank policies and put forward some projections.

1. Commodity Price Dynamics in the Context of COVID-19: A dual shock

The coronavirus pandemic had a significant impact on several developed and emerging economies and led to a number of commodity disruptions, resulting in a serious economic contraction in 2020. Even some oil exporting developing countries were impacted by the downturn in oil prices. The benchmark price for US crude oil, the West Texas Intermediate, for instance, briefly turned negative for the first time in history in April 2020. The impact of COVID-19 on commodity markets was exacerbated by two shocks. On the one hand, there was a demand shock as the pandemic led to a fall in international demand for oil, which was magnified in 2020 with the decline in demand for oil by China, resulting in a massive fall of around 85% of oil consumption. Indeed, most people travelled less often and used their cars less, while energy intensive industries cut production, etc. On the other hand, there was also a political shock triggered by at least two factors; first, the failure of the meeting between Russia and Saudi Arabia to unanimously cut oil production, pushing both countries to increase their output and to flood the international crude oil market. Second, the imposition of multiple lockdowns, restrictions, and secure distancing measures reduced demand for oil, again causing oil prices to drop and collapse.

2. The Russia-Ukraine War and Commodity Prices: A Supply Shock

In February 2022, Vladimir Poutine decided to invade Ukraine, triggering a war between the two countries that has been headline news for nearly eight months now. The ongoing war has led to considerable geopolitical instability and significant market instability, with serious consequences for commodity prices, like metals and foodstuffs. Indeed, while Russia is not only a major gas producer, but also one of the top three crude oil producers in the world, competing with Saudi Arabia and the United States, Ukraine is a leading producer of wheat. Accordingly, the war in Ukraine has profoundly disrupted grain deliveries, energy sectors, and even metals such as palladium or nickel (https://www.oecd.org/ukraine-hub/policy-responses/the-supply-of-critical-raw-materials-endangered-by-russia-s-war-on-ukraine-e01ac7be/).

In this case, it has prompted a supply shock, leading to massive energy inflation (in March 2022, the two main oil benchmarks, WTI and Brent, rose above $110), although this remains dependent on the commodity under consideration. In effect, the oil market is more of a global market that can absorb such a supply shock (Hamilton, 2022). For instance, even if Russia decided to reduce its oil production, it might not seriously impact oil price as such a cutback could be absorbed if Saudi Arabia decided to increase its output.

However, the gas market is more of a local market; it differs from the oil market, not only because its transportation is a delicate operation, but also because Russia is the world's second largest producer of natural gas, just behind the United States, and it has the largest gas reserves in the world. Indeed, according to the latest data available in 2021, Russia produced 762 billion m3 of natural gas and exported about 210 billion m3 via various pipelines. Accordingly, the supply shock caused by the reduction in Russian gas led to excessive volatility in gas prices in Europe. Indeed, in September 2022, following the Russian company Gazprom's decision to cut gas deliveries to European countries via the Nord Stream 1[1] pipeline, gas prices abruptly rose exponentially, reaching 140€/MWh against 20€/MWh before the war. As a result, natural gas prices in Europe have risen by about 127.6% in the six months since the start of the Russia-Ukraine war.[2] Interestingly, the reduction in Russian gas might have serious consequences on countries such as Moldova, Finland, and Estonia which get 100% of their gas supplies from Russia, not to mention Germany whose dependence on Russian gas is around 54%. Indirectly, as we saw recently with the incidents on the North-Stream undersea facilities, geopolitical threats can occur very quickly and cause serious disruptions to infrastructures (https://www.washingtonpost.com/world/2022/09/28/nord-stream-russia-methane-leak-baltic-sea/). Indeed, if Russia totally cut off its gas supply, it could lead to a rapid and serious economic recession for Germany among other countries.

3. The Impact of the Russia-Ukraine War on European Economies

It is important to remember that most European economies had just begun to recover from a serious economic contraction caused by COVID-19. Their public finances are highly vulnerable, with moderate economic growth expected, high public deficits, and an extremely high level of public debt. The unexpected war in Ukraine has affected European economies on several levels. First, it led to a severe global problem of shortages of various commodities and metals and a rapid rise in commodity prices, especially gas, resulting in a sharp drop in purchasing power for householders and significant treasury problems for small and middle-sized businesses due to the increase in production costs and real supply shortages. Consequently, by December 2021, the rate of inflation had jumped to different levels in many European countries: Poland (+8%), Ireland (+6%), Estonia (+12%), Spain (+6%), France (+4%), and Germany (+6%). These inflation rates have continued to increase rapidly in 2022, largely driven by the energy sector. Indeed, according to the European Commission, energy inflation contributed negatively to around 42% of the headline inflation. Europe is also particularly vulnerable with respect to its mechanization infrastructures (https://www.consilium.europa.eu/en/infographics/lng-infrastructure-in-the-eu/).

Second, this high inflation, especially if it lasts, could lead to a reduction in consumption and investment, which would negatively impact economic growth, as the European commissioner for the Economy Paolo Gentiloni and Hamilton (2022) recently noted.

Third, the euro has not been spared by this war and the resulting geopolitical tension. Indeed, the euro has lost much of its value against the US dollar, recently reaching parity with the US dollar, which was its exchange value twenty years ago. Consequently, the ECB needs to take effective action now more than ever, as is expected by some analysts.

4. The Challenge of Sanctions on Russia and the ongoing Central Bank policies

In order to fight against commodity price volatility, various actions have first been implemented with various social measures being introduced by the different governments. For example, from mid-October, France will export gas to Germany and import electricity to help both countries avoid a hard winter. The European Commission has also negotiated alternative plans with other gas producing countries to limit dependency on Russian gas. On March 1, 2022, IEA member countries committed to releasing 62.7 million barrels of emergency oil stocks. Shortly thereafter, on April 1, they agreed to make an additional 120 million barrels available from emergency reserves. Accordingly, diversifying supply sources has become a key strategic issue; even it is not always easy.

Second, to force Russia to stop the war, various economic sanctions have been levied by the US and the European Union. For example, the European Commission published its plan to cut Russian gas imports by about two-thirds by the end of the year. While these sanctions might be helpful, there is still much uncertainty and ambiguity about their real impact. Indeed, following the embargo on Russian fossil fuels imposed by the US and European countries, uncertainty surrounding Russian oil production (and with it, whether or not the OPEC+ group will increase its output) have caused oil prices to rise by an average of $45 per barrel over the past six months. Brent crude hit its highest level since July 2008 on March 3, reaching $139.13 before falling back to $91.50 on August 17. WTI crude oil was trading at $130.50 on March 7, although it had fallen to $85.75 on August 16. This is particularly relevant taking into the recent decision of Saudi Arabia and its allies on Wednesday 05th October 2022 to cut its oil production.

However, it is important to note that sanctions might not be enough and may even be risky. For example, Russia might increase its business with China and India, cancelling out the impact of the economic sanctions. Further, if the European Union fails to find substitutes for Russian gas, it would result in serious provision issues. Further, economic sanctions can only work if they are unanimously accepted by all European countries, and this is still an ongoing struggle. In fact, while EU states agreed to ban the transport of oil by sea, they had to partially exempt oil by pipeline from the embargo. Some member states, including Hungary, were particularly opposed to the ban on importing oil via the Druzhba pipeline which carries Russian oil to refineries in Poland, Germany, Hungary, Slovakia, and the Czech Republic.

Third, following Fed policy, the ECB decided to introduce an aggressive policy to fight inflation, reducing its financial asset purchasing programme and increasing interest rates several times, a policy that it is widely expected to pursue. While this policy should help the monetary authorities to reduce the rate of inflation and meet inflation targets in the coming years, it is important to note that this same monetary policy could provoke an economic recession and increase unemployment, capital costs, etc. Further, when looking at the inflation decomposition, the causes of inflation in Europe and the US do not seem to be similar, therefore it less obvious to expect that the same rate policy would provide the same result in the US and Europe.

5. Which Projections for the Future?

The future is particularly difficult to predict given the high level of uncertainty about the war in Ukraine, the effectiveness of the rate policy in fighting inflation and, above all, its economic and social cost. Further, the position of China with regard to Russia will be a crucial factor in this context. It is also important to note that while European countries have tried to identify relative solutions in the short term to attenuate the impact of gas and oil price volatility (in Italy, the government has reduced fuel taxes, in France, the government has temporarily implemented a 30 cent per litre rebate on gasoline and diesel, etc.), one solution would be to make a deal with the US to become the main provider of gas for European countries in the long term and thus to reduce dependence on Russia.

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Footnotes

[1] One of the most dramatic Russian decisions was the announcement by the Russian energy company Gazprom on June 14, 2022, that gas deliveries to Europe through the Nord Stream pipeline would be cut from 167 million cubic meters to 100 million cubic meters. On June 16, 2022, the company announced that only 67 million cubic meters of natural gas would be supplied daily through the pipeline. In a statement on July 27, the company said it would reduce the daily delivery of natural gas to Europe via the Nord Stream pipeline by 20 percent. As a final blow, on August 19, Gazprom confirmed that natural gas deliveries through the said line would be under maintenance and would not operate between August 31 and September 2.

[2] The phenomenon is also reflected in coal. Before the war, Russia's share of EU coal imports was about 45%. The price of coal has also risen on the futures markets, The price of the March API2 contract traded in Rotterdam on February 24 was $192.35, but it reached $376.95 on Wednesday, an increase of 96% in six months.

Changing Human Behavior: The Optimal Solution for Long-term Energy Security

BY KESHAV RAJ PANTHEE

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Abstract

Will the energy security threat end at some point in time? Not sure. Growing energy demand and geopolitics around the world will keep this issue always uncertain. Efficient use of energy and implementation of energy efficiency practices could only help to find the optimal solution for long-term energy security.

The world has already witnessed and experienced the socio-economic impact of great wars as well as conflict between countries like India and Pakistan, Iraq and Iran, China and Taiwan, Russia-Ukraine, etc. Even after the first and second World Wars, it is difficult to find a year without no any type of war or conflict between countries. All these incidents and their background indicate that power, political influence, national security, and resource ownership are the main reasons behind such wars and conflicts. The ripple effect of such war is determined by the level of connectivity of the countries with the countries participating in the war. The magnitude of the impact of such war and conflict has increased these days along with the speed of globalization. Globalization has increased the level of interdependence between countries and promoted specialization in products. But it has become a curse for countries these days mainly after the spread of the Covid-19 pandemic. In the recovery phase of the economy damaged by Covid-19, the Russia-Ukraine war (started on Feb 24, 2022) has created an additional tense environment for the local and global economy due to the disturbance in the global supply chain.

Supply chain disturbance during the war is not a new phenomenon. It had been taken as the major weapon by the countries participating in war from the ancient time period in both the eastern and western countries. Only the difference lies in the degree and level of impact. The market impact of the Russia-Ukraine war of 2022 at present is quite high due to the nature of commodities that both countries supply in the world market. According to bp- Statistical Review-2022 Russia is the world's 2nd largest oil-producing country and 4th largest natural gas liquids-producing country. In this background, war affected the energy supply mechanism in the world. Europe which used to import around 30 percent of crude oil from Russia was hard hit by it. So, the energy price increased from 10.4 percent in April 2021 to 28.6 percent in January 2022 which further led to inflation in Europe to double digits (source: tradingeconomics.com). It has also increased the cost of living in Europe. Ukraine, being one of the top exporters of wheat, corn, sunflower, barley and soya in the world market was unable to regularly supply these food items in the market and hence the price of such agro products increased almost everywhere. Now, energy and food-led inflation is traveling from Europe to Asia and all over the world.

Besides oil world has developed different forms of energy like natural gas, coal, solar, and so forth. International trade has facilitated the flow of energy products from one country to another country and supported the social and industrial development of respective countries. But, disturbances in the supply chain of energy products is creating energy crisis time and again. The oil crisis of 1970s was the first energy crisis and now the Russia-Ukraine war of 2022 has created another world energy crisis. However, the recent energy crisis is termed as the real global energy crisis as it has disrupted massively used energy sources like oil, natural gas, and coal. So, Fatih Birol, executive director of IEA has rightly said in a panel discussion of 2022 at Davos, Switzerland (Energy Outlook: Overcoming the Crisis) that we are in the middle of the first global energy crisis and energy security is a priority for many governments.

At first, the Russia-Ukraine war raised major concerns for energy security mainly in Europe. Thereafter it was of great concern for growing countries like India, China as well as other developed countries. Member countries in Europe at present are initiating various measures to fulfill the energy gap. Setting gas levy on consumers and reduction of the sales tax on gas by Germany, decision for utilizing nuclear power plant by Slovakia, cutting VAT on gas by Spain, investment plan for power production by Hungary, energy aid package by Italy, coal-based energy production and priority for renewable energy in different countries, etc. are some of the initiations taken in Eurozone to combat against the adverse impact of energy supply disruption caused by the war. This situation has also raised the issue of energy source diversification as well as energy transition.

Will the energy security threat end at some point in time? Not sure. Growing energy demand and geopolitics around the world will keep this issue always uncertain. The only solution for energy security lies in human behavior. Long-term energy security can not be achieved without changing human behavior. Efficient use of energy and implementation of energy efficiency practices could only help to find the optimal solution for long-term energy security. But governments even in advanced countries are not found serious about energy efficiency practices in real terms though it is mentioned in their plans and policies. The type of house structure, electricity supply mechanism, type of personal devices used, people's behavior with electricity-using devices at their workplace and home massively affects the energy consumption behavior. Such facts are mainly limited to research papers and reports. So, it demands a massive campaign for energy literacy. Furthermore, people's living style has to be changed and too much dependency on machines have to be gradually reduced for energy saving and protection of the environment. Structure of the society and family could also work to some extent. Till today, joint family structure has become fruitful for coping with every type of crisis in South Asia.

In the end, human being itself is the creator and destructor of the different scenarios in the world. So, without changing human behavior long-term peace and security can not be expected. In the present context of global energy supply disruption, changing human behavior is the only optimal solution for long-term energy security. Personal attempts made by European people at present for reducing energy bills could be applied in the coming days also for a better future.

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The Weaponization of Electricity: The Case of Electricity Trade between Russia and European Union

BY EWA LAZARCZYK AND CHLOÉ LE COQ

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Abstract

This article discusses the feasibility and the effects of weaponizing electricity. We focus on the consequences on Europe's energy security of Russia using electricity as a weapon, either by stopping electricity trade, as with Finland in May 2022, or by disconnecting some countries from the grid, e.g., prematurely cutting off the Baltics from the BRELL network.

The extremely high prices of natural gas and oil, the halted supplies through gas pipelines, and the security of fuel supplies are discussed at length, especially regarding Europe's energy security. In many instances, Russia was accused of using gas and oil as energy weapons. Still, the Russian electricity supply to some of its neighbouring European countries has not been perceived as a threat. It is primarily due to the modest share of Russian supply in the total EU's electricity consumption. However, in this short article, we argue that the weaponization of electricity is happening and could have severe consequences for some EU member states. We analyse the effects on Europe's energy security of Russia using electricity as a weapon, either by stopping trade (e.g., with a full electricity stop delivery with Finland in May 2022) or by disconnecting some countries from its grid (e.g., prematurely cutting-off the Baltic region from the BRELL network).

Energy security and Electricity trade. The EU-Russia gas relations have been studied in depth. Energy supply security through imports has been a significant concern since the 70's oil crises. At the beginning of the twenty-first century, when Russia temporarily stopped gas supplies to Eastern Europe, gas supply availability became a significant concern again (e.g., Le Coq and Paltseva, 2012).

Electricity is crucial for a country's development. And just like other commodities, when about missing, it severely damages the economy. For example, Georgia being cut off from the Russian grid in 2006 has caused massive blackouts (Newnham, 2015). Nevertheless, electricity is largely ignored by these energy security analyses.

There is an intensification of the electricity trade with an increased integration of electricity markets (Pollitt, 2019). With the growing reliance across countries on electricity exchange, the issue of the weaponization of electricity needs to be looked at more closely.

Stopping the electricity trade. The Russian electricity export is relatively limited as compared to the country´s main energy exports: oil, gas and even coal. In 2019 Inter RAO´s total revenue from electricity trading amounted to 77 billion rubbles (Juoazaitis, 2021) about $862 million while the same year the income from oil amounted to $123 billion, gas $26.3 billion and coal at $17.6 billion[1]. As illustrated in table below, within EU, Finland and Lithuania used to import Russian electricity the most.

Indicator	2019	+/-	2018	2017	2016	2015	2014
Export, billion kWh	**19.338**	**+15.7%**	**16.711**	**+15.7%**	**17.002**	**17.492**	**14.044**
Finland	7.023	+1.7%	6.903	+1.7%	5.2816	3.383	2.995
China	3.099	-0.3%	3.109	-0.3%	3.320	3.299	3.376
Lithuania	6.286	+42.4%	4.415	+42.4%	3.019	2.995	3.216
Belarus	0.031	-3.7%	0.049	-3.7%	3.181	2.815	1.425
Kazakhstan	1.437	+6.7%	1.347	+6.7%	1.164	1.542	1.644
Georgia	0.525	+154%	0.206	+154%	0.369	0.511	0.607
Mongolia	0.372	-10.5%	0.416	-10.5%	0.3	0.284	0.39
Azerbaijan	0.091	+19.3%	0.076	+19.3%	0.0596	0.055	0.053
Other	0.474	149%	0.19	149%	0.2716	2.608	0.318

Table 1. Russian electricity export 2014 – 2019. Source: Inter RAO after Juozaitis (2021).

However, on May 14th, 2022, Russia announced a full stop of electricity export to Finland and all flows from Russia were stopped the day later. Although yearly imports from Russia constituted at most 10 percent of Finnish yearly consumption, the sudden withdraw of trade flows from the Eastern neighbor impacted the Nord Pool region as whole.[2] The Nord Pool's day-ahead electricity prices were much more volatile after 15th of May, see for example the case of Finland (Figure 1). In addition, extreme prices have been observed in the Baltics – on the 17th of August 2022, prices reached the Nord Pool cap of 4000€/MW, the highest ever level in the region.

Although Nord Pool as an electricity market continued to function well after the discontinuation of power imports from Russia, more severe consequences could happen.

Disconnecting countries from the grid. The Baltics´ power system is part of the large Russian operating synchronous electricity system BRELL, which connects the electricity transmission systems of Belarus, Russia, Estonia, Latvia, and Lithuania (Figure 2). The potential desynchronization from the Moscow-op-

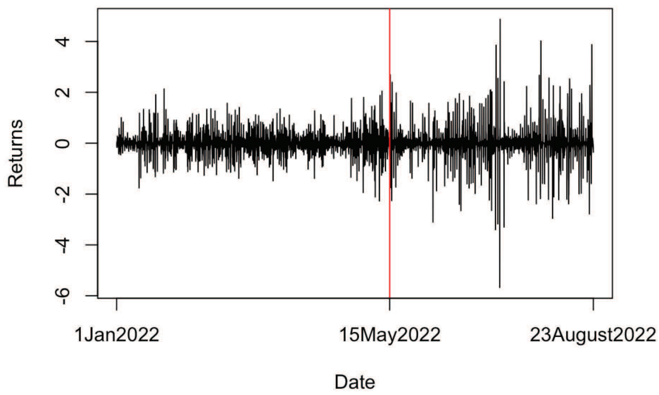

Figure 1. Volatility in Finland

Source: Lazarczyk and Le Coq (2022)

Figure 2. The BRELL power ring

Source: Brinkis et al., 2011

erated power grid and the joining of the European grid have been discussed since 2007 when Baltic States' Prime Ministers have declared the desynchronization as the region's strategic priority. In 2018 the decision to join the Continental European Synchronous Area through the connection with Poland was reached, and massive investment were decided to ensure adequate infrastructure.

Desynchronisation of the Baltics from the BRELL network, foreseen for 2025, means that there will be no connection with Russia and Belarus and no possibility of trade between the two countries and the region. This will be a big disadvantage for Ostrovietz nuclear power plant[3], whose main purpose was to expand trade with the Nordics, as Belarus has had overcapacity since 2018. At the same time, the desynchronization and the withdrawal from trade with Belarus would limit further dependence on Russian electricity.

An issue not to be overlooked is that although Russia has been opposing the Baltics decision to synchronize with continental Europe, it has moved quickly to improve its infrastructure and might be ready to “cut the cables” earlier than the Baltics. As a result, Russia can now credibly threaten to prematurely cut the Baltics from the BRELL network, either within the framework of the BRELL agreement, which is at six months' notice or by surprise. If Baltics are not ready to disconnect, this could result in severe blackouts. It is worth noting that a sudden disconnection from BRELL could be harmful to Kaliningrad if it comes too early. Kaliningrad conducted three successful exercises of operating in an island mode, with the longest one of 72 hours. Still, it is unclear whether the region is ready for complete island mode operations. Moreover, the two tests scheduled for 2022 have been cancelled. If the region is not prepared for total disconnection, it will need to rely on power flows from Poland or Lithuania, a situation that might be politically difficult for Russia to accept.

The current situation. Natural gas has been previously used as a political weapon, and multiple studies have focused on Russia-EU gas relations. Still, the weaponization of electricity until now has not been a focus of significant analysis. In this article, we analyse two ways electricity trade can be used strategically: either by directly stopping electricity delivery, and/or indirectly impacting the electricity system balance. The most recent developments in Ukraine illustrate additional way electricity can be used as a weapon. As a result of the latest attacks and damages to the electrical infrastructure, on the 11th of October Ukraine stopped electricity exports[4]. This led not only to missing revenues for Ukraine but also impacted the East EU region as less electricity is available, especially now when gas prices are high (co-occurrence of less electricity and less gas). The threat of massive blackouts if the more electrical infrastructure is damaged is not to be overlooked.

Acknowledgments

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Footnotes

[1] https://www.weforum.org/agenda/2022/03/russia-gas-oil-exports-sanctions/

[2] Which includes the national electricity markets of Norway, Sweden, Finland, Denmark and, the Baltic States.

[3] Ostrovietz constructed in Belarus, 20 km from the Lithuanian border, started operations in November 2020.

[4] https://www.reuters.com/business/energy/ukrainian-energy-ministry-halts-energy-exports-due-russian-missile-strikes-2022-10-10/

Highlights from EVER Monaco 2022

BY MARC-OLIVIER METAIS, RÉMI LAUVERGNE AND CHRISTOPHE BONNERY

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The EVER[1] Monaco 2022 Symposium was the place to share, test and study new opportunities for electromobility, with a perspective from academics, industry and politicians view points.

Thanks to an agreement with the International Association of Energy Economics (IAEE), and in collaboration with the FNCCR, the Renewable Energies Association (SER), AVERE France and the CCI Nice Côte d'Azur, the EVER 2022 symposium will be a space of dialogue for researchers, decision makers and industry partners. This symposium was structured over 2 days (May 27 & 28, 2022). Five round tables and two lunch debates will give the floor to renowned speakers.

The Programme can be viewed at: https://www.faee.fr/en/89-conferences.html#/conf/278

The global decarbonization of our economy is one of the major challenges of the 21th century, while our current lifestyles are the cause of the emission of more than 10 tons of CO2 per person, largely due to the use of fossil fuels. As underlined by **Laura Cozzi** , International Energy Agency, during the opening remarks, the 2020s should therefore be years of massive clean energy expansion, with, for the first time ever, decreasing our CO2 emissions while ensuring global economic growth.

In this context of urgent reduction of greenhouse gas emissions, EVER Monaco and the International Association of Energy Economists have brought together, under the patronage of His Serene Highness Prince Albert II of Monaco, public, industrial and academic actors to discuss the decarbonization of transport systems, which alone account for nearly a quarter of global CO2 emissions.

These round tables, which were held in the Club House of A.S Monaco, dealt with a variety of subjects relating to electromobility and the territories:

- Infrastructure deployment
- Grid services
- Heavy mobility
- Economy, accessibility and employment

Charging infrastructure: From rational decision to local feedback

In order to electrify our mobility ecosystem, it is essential to deploy a charging infrastructure that allows for the serene use of electric vehicles. But as explained by **Mr. Jean-Paul Faure,** President of AVEM, deploying a charging infrastructure is not that simple: there is a need for charging stations for drivers to switch to electric vehicles, but there is a need for electric vehicles for it to be interesting to build charging stations. There is a major problem of visibility and management of infrastructure deployment planning, which can be solved with an intelligent allocation of resources and by considering the needs of users first, according to **Marc-Olivier Metais,** researcher at Institut Vedecom. **Mr. Jean-Noel Loury,** President of the FNCCR**,** emphasized that local authorities have a very important role to play in this deployment, while in France 60% of public charging stations are installed under the impulse of these authorities. **Ms. Virginie Haché Vincenot,** from the Mission for Energy Transition**,** confirms this vision by underlining the important investments made by the Principality of Monaco in the field of energy transition, and in particular in the field of electric mobility: no

place in the principality is more than 200m away from a charging station.

She also notes that two-wheelers seem to be driving the electromobility market upwards, and that it is important that they also have access to public charging infrastructures.

Vehicle-to-grid (V2G): Assessment of experiments and possible development paths

The arrival of hundreds of thousands of electric vehicles over the next few years represents a major upheaval in the energy sector. It is both a challenge, since these vehicles must be supplied with electric energy, but also a great opportunity to rethink our access to energy. Indeed, as **Professor Yannick Perez,** of University of Paris-Saclay, explains, electric vehicles store much more energy than is needed for everyday use. Parked electric vehicles, as is the case 95% of the time on average for a vehicle according to **Philippe Adam** of ABB Group, therefore represent a resource to contribute to the flexibility of the electricity network, via Distributed Storage Services, under the essential condition of cooperation between car manufacturers and energy sector players. In a long-term impact study on the development of such services, led by EDF in the Occitanie region, Ms **Virginie Monnier-Mang** confirms the interest of such a device, allowing in their test case to reduce the capping of the production of renewable energies by 90% thanks to load management and energy storage in a fleet of electric vehicles, in addition to allowing to further reduce the share of fossil fuels in our electricity mix.

Economy and accessibility of mobility solutions for consumers

As Mr. **Jean-Noël Loury**, vice-president FNCCR, points out, many initiatives in favor of new means of mobility are very focused on specific territories, rural or urban, but few unite the different types of territories. Mr. **Stéphane Semeria**, president of FFAUVE, explains that the emphasis placed on the deployment of new mobility solutions can bring economic growth and attractiveness to the territories, as well as the strengthening of already existing solutions such as carpooling,

a practice that Mr. **François Fantin**, regional development director at Klaxit, encourages to develop by introducing a financial reward system in order to develop this still marginal practice

EV coupling - Photovoltaic production: Assessment of possible options and tests

In the same vein as V2G, the advent of electric mobility can help to integrate photovoltaic production into the current energy mix, which is currently complicated, thanks to the coupling of electric vehicles and photovoltaic energy production. According to **Olivier Bechu** of Sun and Go, two parking spaces in southeastern France receive the equivalent of the energy needed to drive 30,000 kilometers a year, or twice the average annual mileage of a car. This decentralized production can have a strong positive impact on the network. Provided there is a good EV/PV synergy, which necessarily requires a global communication protocol valid for all charging stations, according to **Gerald Seiler** of ChargeAngels, it can considerably reduce the number of additional transformers that need to be added to the network to be able to accommodate new electric vehicles.

To open the second day of round tables, H.E. **Bernard Fautrier**, Plenipotentiary Minister Monaco, reminded the audience of Monaco's commitment to the

electrification of mobility, in particular through incentives such as a strong network of charging stations as well as the free use of part of the local public charging network, which allows the recharging of Monegasques, but also of tourists and French and Italian workers. For the future, the electrification of other segments than light mobility are to be planned to continue to decarbonize the transport sector.

The Plenipotentiary Minister, as well as Mr. **Christophe Bonnery**, IAEE President 2019, also underlined the interest of organizing events bringing together industrials, politicians and academics, while welcoming the diversity of topics on the program of the roundtable sessions.

Electric trucks and public transport, the expectations of communities for what uses?

This session, dedicated to the development of alternative solutions to oil for heavy mobility (buses and trucks), provided an opportunity to hear both academic, industrial and political views on this topic. To begin with, Mr. **Rémi Lauvergne**, PhD student at CentraleSupelec and RTE presented the variety of interactions between transport and electric system, identifying that the electric transport sector can represent up to 12% of the total electric consumption by 2050, and that the recharging of these vehicles constitutes a good solution of demand-side flexibility. The value of this flexibility depends on various parameters, including the marginal thermal production costs of the electrical system, the charging mode adopted (tariff, smart charging or V2G) and the connection frequency. Although light vehicles seems to be the vehicles for which charging is the most flexible, there is also a potential for flexibility for buses and trucks, depending on the charging modes adopted (at the depot or by pantograph during the journey). Then, Mr. **Alain Gaggero**, in charge of the Enedis electric mobility mission and deputy mayor of Cagnes-Sur-Mer, underlined that for freight transport, even if there are still uncertainties about the technologies that will be deployed (battery electric, hydrogen or biofuels), master plans with bans on the circulation of trucks powered by fossil fuels are under discussion in some areas of southern France. It was also pointed out that it is important to match trucks charging with regulatory rest for drivers. Finally, for Enedis, the reuse of vehicle batteries in second life is also seen as a potential static storage for the network. Afterwards, Mr. **Jérôme Flassayer**, Director of Electromobility at Volvo Trucks, reminded the audience that the number of trucks on the road in France has been constantly growing over the last decades, and therefore it seems unrealistic to reach the emission reduction targets for heavy mobility without developing alternative solutions to fossil fuels.

Different technologies seem to be suitable for different areas of road transport: all-electric for local distribution and utility vehicles, biofuels and hydrogen for very long distance, and a mix of technologies (as well as hybrids) for regional transport. Volvo Trucks is already marketing electric trucks equipped with 540 kWh batteries and is the European market leader for electric trucks, and has ambitions to develop hydrogen trucks in the 2030s. To close this round table, Mr. **Jean-Luc Dupont**, mayor of Chinon, president of the SIEL (Syndicat d'énergie Indre-et-Loire) and vice-president of the FNCCR indicated that the role of local authorities is to build master plans for the installation of charging stations in order to ensure the objectives of development of charging stations set by the Ministry. By 2022, the sum of publicly accessible EV charging points reaches 1.5 GW. However, the model is still very loss-making and requires subsidies (from ADEME and local authorities), but the aim is to achieve budgetary balance in the medium term.

Acceptability: adaptation of technologies and users

The session on acceptability and the evolution of uses began with the intervention of Ms. **Maeva Tholance**, head of the transport and mobility department at ADEME, who presented the 4 scenarios of the last prospective study of this institute.

Opinion polls indicate that a proportion of French people are ready to reduce their use of the car, through carpooling, public transport and cycling. To this end, the different stages of a change in behavior (contemplation, preparation, action and maintenance) for a modal shift were described, as well as the initiatives of ADEME to support them, whether financial (sustainable mobility package) or not ('label employeur pro vélo', mobility challenge ...). Afterwards, Mr. **Gilles Bernard**, president of AFIREV, presented the monitoring center for the reliability of charging stations built by his asso-

ciation, based on the fact that a majority of EV users have already encountered an out of order charging station. This platform allows users to report directly on the points of the territory requiring a better quality of service for the charging infrastructure. From the users' point of view, the main areas for improvement are better interoperability and more clarity on the charging tariffs. To conclude the session, Ms. **Laurence Vanin**, holder of the smart-city, philosophy and ethics chair at the University of Nice, presented from a philosophical point of view the attachment of users to their objects and what are the mechanisms used to increase the acceptability to change behavior and object. For manufacturers, planned obsolescence is a key element to push to change objects. Industrialization and robotization have caused an increased distancing between objects and users, due to the fact that objects become more abstract and almost never manufactured by the user himself.

Employment and training to boost the energy and mobility transition

This roundtable session focused on the theme of employment in the energy transition and the transition to low-carbon mobility. First, Mr. **Adrien Fourmon**, lawyer at Jeantet indicated that from a regulatory point of view, the governmental orientations of the energy and mobility sector (through the 'PPE' at the French level and the guidelines on state aid for climate at the European level) give quite strong growth and employment perspectives. In the case of mobility, there is a wide variety of professions involved (from charging stations to batteries, including vehicles and networks), which also require a reorientation in terms of training and candidates that has not yet been fully achieved. Finally, Mr. Fourmon argues that not only the job net balance matters, but also the positive and negative consequences, which require professional reorientation. Afterwards, Ms. **Nathalie Nieson**, president of the SDED Territoire d'énergie Drôme and vice-president of the FNCCR presented the plan for 100,000 charging stations in France of the FNCCR and the associated ministries, which would make the FNCCR the first project owner in France for charging stations for electric vehicles. In agreement with the previous speaker, it was also noted that there is a gap between the job offers in the energy transition professions and the training of young people, particularly on the subject of the installation and maintenance of charging stations.

Mr. **Cyril Carabot**, Secretary General of the French Renewable Energies Union (SER), completed these interventions by noting that the objectives in France for the development of renewable energies to at least 50% of the production requires around 100,000 jobs to be created in order to achieve the objectives of the PPE. Offshore wind energy is also identified as a sector with recruitment difficulties, because very few training courses are adapted to it. To conclude this session, Mr. **Jens Bicking**, founder and director of the recruitment firm ELATOS shared the observation of the other speakers of a strong growth in recruitment for the energy transition professions, all along the value chain, with sometimes a shortage of candidates, which can imply an increase in salary expectations. In addition, only 24% of managers in the energy transition are women in 2022. Finally, the development of training adapted to the energy transition professions, in particular through work-study programs, seems to be the solution to this lack of candidates.

The economic impact of switching from thermal towards electric vehicles

First, Mr. **Johan Ransquin**, Director of Adaptation, Development and Low Carbon Trajectories at ADEME, presented the evolutions in the field of transport of the 4 prospective scenarios of the 'Transitions 2050' study. These scenarios were then broken down according to the different parameters of the Kaya identity applied to transport (transport demand, modal shift, occupancy rate, energy efficiency and carbon intensity of energy), as well as in terms of resource consumption. Two calls for projects have been launched by ADEME on the electrification of transport: the financing of electric trucks and the financing of charging stations. Next, Ms. **Alexandra Le Ny** spoke as vice-president of the Morbihan Energies union, whose role is to develop the distribution network and the installation of charging stations for electric vehicles. With more than 200 charging stations today (nearly one per commune in the area), the primary objective is limit range anxiety for electric vehicle owners. In the particular case of a tourism zone such as Morbihan, the question of the variation in the need for charging stations between the tourist season and the off-season arises. To try to answer this question, Morbihan Energies is studying the installation of mobile charging stations, if proven financially attractive.

To complete the analyses of the other panelists on the French case, Mr. **Jan-Olaf Willums**, co-founder of ZEM and Nordic batteries, then presented the development of electromobility in Norway, a leading country in terms of sales of electric vehicles (95% of sales of full-electric or hybrid light vehicles in 2022). Norwegian public policies have been based on strong incentives to develop EVs such as tax exemption for vehicle

purchase, tolls and parking fees, thanks to a consensus of all Norwegian political parties on these issues. Finally, after the end of the sale of thermal vehicles, set for 2025, Norway also plans to convert to electricity, hydrogen or biogas trucks, buses and some boats in the next decade. To conclude this last round table session, Mr. **Daniel Kovacs**, E-mobility_expert consultant, presented the multitude of study topics on electric vehicles, in particular on corporate vehicles. Incentives for the electrification of the latter also have an effect on the private car fleet via the second-hand market with a delay of a few years. However, it should be borne in mind that plug-in hybrids in corporate vehicle fleets are still not used enough in electric mode (around 30%). Moreover, even if the total cost of ownership of electric vehicles is now lower than those of combustion vehicles (thanks to subsidies), the transition is not really happening, because of other barriers (habits, charging infrastructure, etc.).

Conclusion by Jean-Noel Loury and Christophe Bonnery

Footnotes

[1] EVER : Electric Vehicles & Renewable Energies

Scenes from the 17th IAEE European Energy Conference September 21-24, 2022 Athens, Greece


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Natural Gas: Prices in the EU are at Record Highs, But It is Not All About the War in Ukraine

BY ROBERTO CARDINALE

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Abstract

The war in Ukraine is fueling the energy crisis in the EU, sparking concern for economic growth and political stability worldwide. However, war is not the only driver of the energy crisis. Its long-term causes originate in structural changes of world energy markets and the policy response to them.

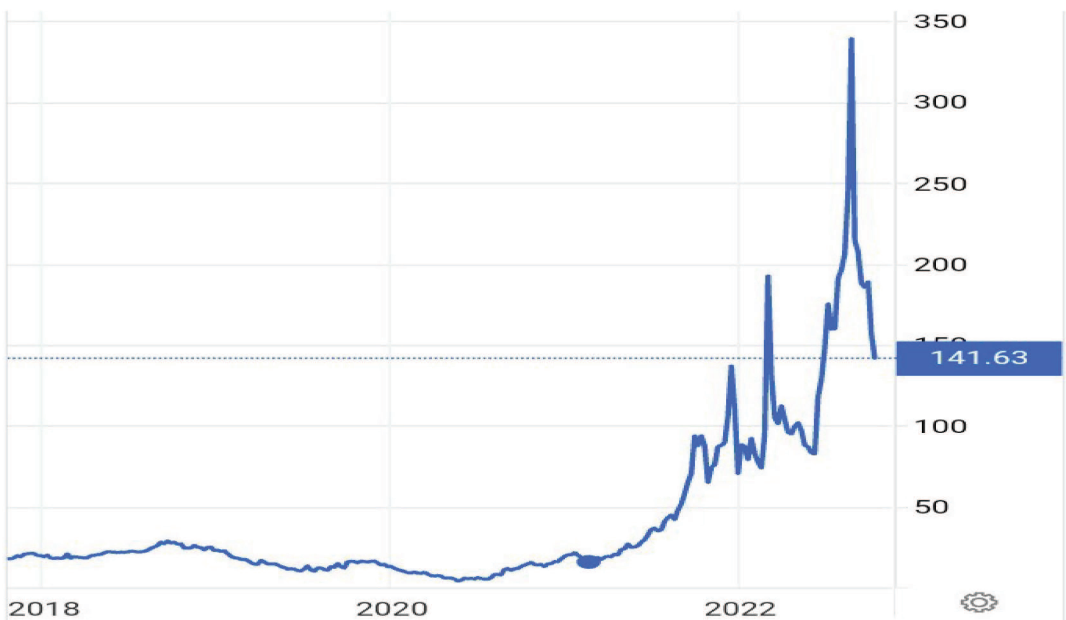
The latest sabotage on North Stream I and II shows that energy is a fundamental component in the war between the Russian Federation and Ukraine. Despite the main causes of the war are geopolitical, the battle is increasingly fought also in the energy sector. This happens for a very simple reason: energy has extensive leverage in the relations between Russia and Europe, having created a deep interdependence among them. Therefore, players in the war attempts to use this tool to acquire strategic advantages.

The EU started to be dependent from Russian gas during the period of the Soviet Union, when Western European countries encouraged the realization of pipelines connecting Russian wells to European end markets. Interdependence increased in the last decades as a result of the competitiveness of Russian gas vis-à-vis supplies from other producers. As 2021, 45% of the EU total imports of gas, equivalent to 155 billion cubic meters (bcm), were supplied by the Russian Federation (IEA, 2022). Key Member States such as Germany and Italy imported from Russia up to 66% and 40%, respectively. However, from July 2021 to July 2022, imports seem to be reduced by 70%.

Reduction in supplies to Europe resulted mainly from Gazprom's deliberate cuts to countries who did not accept to open an account at Gazprombank for the conversion of euros into rubles, the new mechanism put in place by Gazprom to overcome international sanctions. However, reductions in the gas flows have been experienced also by countries who adhered to the system of payment, either due to technical and maintenance problems caused by the sanctions, as argued by the Kremlin, or as a result of a deliberate strategy put forward by Moscow to induce EU governments to soften their diplomatic stance towards the Russian Federation in the ongoing conflict. As a result of progressive reduction of Russian gas supplies to the EU, price started to rise to unprecedented levels.

However, several elements suggest that the conflict between Russia and Ukraine is not the root cause of skyrocketing natural gas prices. The increase had already started in 2021, interrupting a long phase characterized by falling prices that culminated with prices at historic lows during the early stages of the pandemic. Already in mid-September 2021, prices in the Dutch hub TTF were around 70 € /MWh, while in October they exceeded 100€ /MWh. After a new record of € 180 / MWh at the end of December, the conflict undoubtedly contributed to new increases, with a new peaks of over € 200 /MWh and 300 /MWh between March and September 2022, before declining to about 100€ /MWh in October.

This suggests that there is an extreme volatility of prices, which does not reflect the real levels of supply and demand, showing the existence of a structural fragility that affects the supply chains and physical flows of gas to Europe.



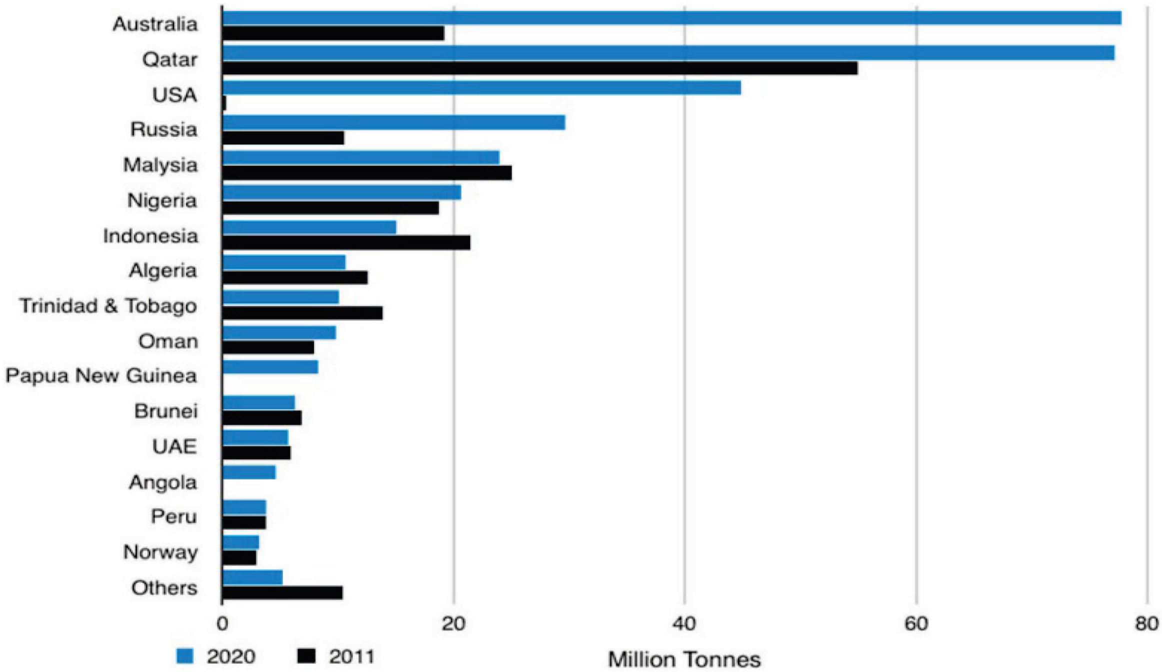
Spot natural gas price trend at the TTF in € / MWh
Source: Trading Economics

Two other factors contribute to explaining these trends. One is structural and concerns the evolution of the world gas market over the last 10-15 years. The other is attributable to the liberalization of the energy markets, which have reshuffled the previous European energy systems and their mechanisms of energy security and energy price stability.

The world gas markets have undergone important changes in the last decade, starting with a reduction in supply due to a drastic decrease in investments in oil and gas that began in 2014 and continued in subsequent years. The causes of this reduction in investments are attributable to a period of oversupply and low prices, caused also by the rise of the US as a major gas producer and exporter, but also to the policies of phase-out of hydrocarbons adopted by governments of many countries. Along with the reduction in supply, a new demand has gradually emerged, bringing together old and new consumers. The latter, particularly East Asian economies, have taken advantage of the cost reduction in the processing and transport of Liquefied Natural Gas (LNG) to meet their growing industrial consumption and diversify their energy sources.

In the face of growing international demand, EU policies have also incentivized investments in LNG, not so much to better compete with new consumers, but with the main objective of reducing dependence on current oligopolies, the Russian Federation above all, which historically supplies the EU via pipelines. In fact, while gas pipelines represent a binding bilateral commitment, LNG makes it possible to expand the diversification of suppliers. This would allow not only to increase competition between them, lowering the import price, but also to contribute to energy security.

However, while LNG mainly shows advantages in times of gas abundance, it also has some disadvantages in times of scarcity. For example, the increase in investments in LNG infrastructure in the EU and around the world has led, for obvious reasons, the producing countries to also invest in this emerging market. The graph shows the growth from 2011 to 2020 of LNG production by the main exporting countries.



LNG production by country, 2011-2020

Source: Sassi (2022)

Growing production has initially increased competition between gas suppliers, primarily between the Russian Federation and the United States, reducing import prices. However, in the current phase of scarcity, LNG offers suppliers more alternatives for export. As a result, exporters are currently benefiting from the premiums triggered by the newly emerged competition between European and East Asian countries. Therefore, supplies to the EU that were traditionally guaranteed by pipeline are being questioned, driving up prices.

The policy of physical (infrastructural) divestment from traditional supply links, which in the EU took place by reallocating public financing towards LNG (and renewables projects) to the detriment of gas pipelines, was accompanied by a similar policy of phase-out at the contractual level, and particularly of long-term import contracts. The transition to flexible contractual forms, initially supported by EU energy policy and opposed by major suppliers, has made decisive progress. Although short-term or spot contracts have increased competition within the EU market, they have also contributed to exposing EU countries to international competition for the procurement of gas supplies that long-term contracts instead helped to limit. Therefore, short-term or spot contracts have also contributed to rising prices.

In this moment of emergency, the LNG plants active in the EU are playing a fundamental role in compensating for any reduction or cut in supplies, especially Russian supplies. Their role will increase considering the political will to progressively phase-out from Russian gas. However, in the long term it is not certain that the prevalence of LNG supplies over those via pipeline (currently existing also from routes alternative to those from Russia) is the optimal solution. Because it is true that in times of oversupply the availability of LNG plants makes it possible to purchase volumes of gas at discounted prices in the spot markets. But it is equally true that in the event of a contraction in supply, as in the current period, LNG can contribute to erode advantageous positions acquired over time thanks to geographical proximity, industrial collaborations and energy diplomacy. This is the case of the EU countries, which, thanks to these factors, have traditionally benefited from security of supply and price stability downward (Cardinale, 2019), despite the scarcity of domestic production.

For this reason, it is important to have a portfolio of infrastructures and contracts that is diversified and that considers the sudden changes in international markets, triggered both by factors strictly connected to the energy sector but also to the broader geopolitical context that is currently in rapid evolution.

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Broadening Europe's Gas Policy, A Few Reflections

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Introduction

The tragic conflict in Ukraine has profound and wide-ranging implications on many issues, including international relations, military alliances, commodity markets, and macroeconomics. Among them, the disruption of Russia's natural gas supplies to Europe, its repercussions on the power markets, and the slowdown of the European economies certainly get the utmost attention.

Before the war started, the European energy system lacked safety buffers and was already particularly acute to disruptions. The purpose of this brief note is neither to deplore that unfortunate situation nor to discuss the root causes of the European Union (EU)'s growing dependency on Russian gas supplies, as these topics have already been extensively discussed (see, e.g., Grekou et al., 2022). Instead, we intend to focus on the European policy responses implemented to alleviate the energy crisis and broaden policy perspectives.

In response to the war, the European Commission unveiled in March 2022 a new action plan, *REPOWEREU*, followed by a host of measures aimed at sharing the burden of possible shortages. Some of these policy decisions have relatively short-term horizons. They typically aim to improve energy security this winter (e.g., the decision to impose a minimum filling rate of 80% for underground gas storage by November 1, 2022, gas and electricity conservation campaigns, interfuel substitutions in power generation). Others (e.g., the strengthening of the EU's ambitious climate strategy or the diversification of energy supplies) *de facto* have long-lasting effects and will reveal their full potential over longer time horizons.

As is frequently the case in such circumstances, urgency is paramount, and omissions can occur in preparing those policy responses. In what follows, we identify and discuss four lines of supplementary measures that could enrich the European policymakers' toolbox. They respectively focus on: (i) the role assigned to competition policy, (ii) strategic stockpiling, (iii) the design of a European gas supply strategy, and (iv) the European presence in the Liquefied Natural Gas (LNG) trade.

1 - On the role of competition policy in tight energy markets

In times of shortages, careful monitoring of the oligopolistic behaviors that prevails in wholesale energy markets is crucial. As the short-run price elasticity is low, such a situation can exacerbate the firms' inclination to exert market power and reap large profits.

In Europe, the public policy debate on this issue has so far concentrated on these supranormal profits and whether some form of exceptional taxation of the energy sector should be imposed. Two related points are intensely discussed. The first one is the magnitude of the taxes and the need to delineate arbitrarily between "normal" and "extraordinary" profits. The second focuses on the implementation details that have profound implications. As taxation is imposed at the national level, some form of coordination among the EU member states is needed to prevent fiscal loopholes and preserve fair competition among rival firms competing in the internal energy market.

Surprisingly, the discussion on these profits has so far overlooked the role of competition policy, despite its ability to provide power instruments to moderate market power and ensure that the observed profits solely reflect the effects of scarcity pricing and not anti-competitive behaviors. At least two instruments can be utilized to preserve the surplus yielded by European consumers. First, the European subsidiaries of foreign gas producers operating in the internal gas and electricity markets deserve some form of close monitoring. As the upstream operations of these vertically integrated firms are located outside the EU's jurisdiction, one should prevent their downstream operations from strategically exacerbating the high prices observed on the EU internal market.

Second, competition and regulatory authorities must prevent a possible fragmentation of the internal energy market by ensuring the efficient utilization of the existing infrastructure. In particular, special attention is needed regarding the efficiency of the so-called "Use it or Lose it" rules stipulated in third-party access provisions. By design, these measures are aimed at preventing capacity hoarding. They impose traders to resell their unused access rights in secondary markets. As usual, implementation details (e.g., timing, access conditions, penalties) matter, and it is appropriate to verify whether the released rights can effectively be purchased and used by other traders. Particular attention is needed in the case of transnational infrastructure (Carcanague and Hache, 2017) because spatial arbitrages already showed signs of market power before the crisis (Massol and Banal-Estañol, 2018).

2 - On strategic stockpiles

So far, the discussion on storage has focused on seasonal considerations related to the preparations for the coming winters. However, a persistent issue in energy policy analysis is how to prepare for disruptions in unstable global gas markets. Given the very high cost associated with a sudden shortfall in supply, it can be opportune for the EU to consider the creation of a strategic stockpile of natural gas that is aimed at providing a source of gas during a disruption. Similar stockpiles already exist for oil. A range of questions must be addressed in creating such a strategic reserve. How large should that inventory be? What principles should govern its use? How large is the associated cost, and is that cost commensurate with the benefits? The development of underground gas storage needs an adapted geological endowment, which some EU member states lack. Because of this asymmetric geological endowment, a strategic stockpiling policy must be designed at the EU level, which calls for an appropriate sharing of the costs and benefits. That sharing must preserve the cohesion between EU countries and prevent free-riding. Indeed, a strategic reserve can create a free-rider problem because the benefits of lowered European gas prices from a reserve drawdown would be felt in all member states, not just in the country where the gas is stored (Hogan, 1983). Another issue is that such a stockpile must be built up gradually without exacerbating the shortages that are currently observed.

3 – Designing a common supply policy?

The crisis has shed light on the lack of European strategic planning for natural gas supplies and calls for adopting a common supply strategy for the EU. From the recent series of European leaders' visits to gas-rich nations, one might wonder whether member states cooperate or compete to secure gas resources.

Beyond that competition, the lack of coordination at the EU level also has profound repercussions on the geography of future European supplies. Absent a common strategy, the new LNG plants that will supply Europe will most likely be constructed in areas endowed with abundant capital and gas resources: in North America and the Middle East (Qatar). A significant portion of US LNG exports are based on shale resources whereas fracking is widely banned across the EU because of environmental concerns. Regarding the Gulf region, one can wonder about the effects of that "laissez-faire" approach that consists of abandoning the Russian risk for a geopolitical bet on the Strait of Hormuz.

Interestingly, significant gas resources are also present in countries not currently exporting gas to Europe. They are located in Eastern Mediterranean (Cyprus, Israel, Lebanon), Africa (Mozambique, Senegal, Mauritania), and South America (Argentina). The deployment of these new exports requires a reallocation of EU import strategies (and the associated carbon budget) and some proactive supporting policies to help finance these assets.

Incidentally, this crisis has prompted the resurgence of an old idea: creating a European purchasing structure. In essence, such a structure would be similar to the approach retained by the EU to purchase vaccines during the COVID pandemic. Such a measure could reinforce the EU's bargaining power. As usual with cooperation, it must provide member states with an incentive to cooperate. The conditions for stable and incentive-compatible participation are yet to be analyzed. That identification must account for the profound differences in the member nations' energy mixes, making the case more complex than the vaccine one when all European countries faced a similar problem.

4 – The European presence in the LNG trade

The crisis has also highlighted the profound microeconomic transformations affecting LNG trade. Historically, that trade was governed by long-term contracts, as they were needed to finance expensive liquefaction plants. Under that old model, LNG vessels were shuttling between a liquefication plant and regas one, which led to inefficient transportation at the global level (Tchung-Ming and Massol, 2010). Following the liberalization reforms, the contractual logic evolved to allow spatial arbitrage based on market prices (e.g., Baba et al., 2020). If the spatial price spread between two destinations becomes large enough, re-routing or re-exports from the region with low prices to the area under stress could occur.

Contrary to the case of oil, the spatial integration of global gas markets is not perfect (Grekou et al., 2022), and significant regional price differentials can persist. Studies of Qatar's shipments to Japan and the United Kingdom (Ritz, 2014) show that, under imperfect competition, an LNG exporter may find it profitable to maintain discriminatory prices by strategically limiting the extent of spatial arbitrage. For Europe, it is difficult to counter such strategies decided by foreign producers, as competition law is ineffective against non-European producers.

That said, the evolution of the business models of European petroleum multinationals is a source of hope. These companies have developed significant LNG intermediation activities. Their financial strength allows them to acquire destination-free volumes from liquefaction project developers via long-term contracts. The firm then aggregates these volumes, conducts a logistic streamlining, and allocates them to different markets. These midstream activities encourage investment in LNG supply. As these companies are headquartered in Europe, the EU competition policy can be used as a threat to prevent possible tariff discrimination.

Conclusion

While the crisis certainly reinforces Europe's determination to accelerate its energy transition, the current energy scene calls for a powerful reappraisal of the EU's contemporary approach to natural gas. By nature, this brief note is an complete analysis of that complex topic. Our intention is more modest and aims at providing policymakers with a broadened perspective that can usefully enrich the public policy debate on natural gas.

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ENERGY ECONOMICS

How are we Doing with the Energy Transition? Two Simple Metrics to Understand and Track Progress

BY PHILIPPE BENOIT, JAMES GLYNN, AND ANNE-SOPHIE CORBEAU

Transitioning our energy system to meet the emissions reductions requirements of our climate change goals is a complex process that will touch all parts of our society and all corners of the world because energy is fundamental to most of what we do, day in and day out. It is an integral part of people's daily lives, whether rich or poor; it supports the most basic needs such as cooking, to less accessible ones such as air travel, as well as all levels of economic activity, from a shop to a steel factory. By design or disorder, the energy transition will change the forms in which, and how and for what, we use energy.

So, how are we doing in transitioning our energy system to meet our climate goals?

What are the goals?

The Paris Agreement, by its terms, speaks of two climate goals limiting global temperature increase. The first is "well below 2ºC."[1] The second, is "pursuing efforts …to 1.5ºC," a more ambitious goal designed, among other things, to limit the sea rise that threatens various island states and the hundreds of millions living in low-lying areas (particularly in numerous poorer developing countries).

Energy sector emissions constitute the vast majority of global greenhouse gas emissions (e.g., 75 percent in 2019[2]). Accordingly, we focus on how to understand and assess the transition specifically of the energy sector and the related evolution in its emissions relative to our climate goals.

Although there is much discussion about whether we are adequately transforming our energy system (e.g., from the global carbon project[3] or the UN Emissions Gap report[4]), there remains an absence of easily accessible metrics to help measure our progress. We know we need to dramatically reduce emissions; but how are we doing in changing our energy system to effect that reduction, particularly as compared to modelled pathways designed to achieve our climate goals?

To support a broader understanding of this issue, we propose two simple metrics to help measure how we are doing in advancing the energy transition. We hope in this way to make the complex energy transition more easily accessible to a wide range of stakeholders – all of whom, as noted above, will as energy users not only be touched by, but will also influence to some extent, the transition itself.

How do we measure progress? Two metrics

Energy emissions are the product of two factors: (i) the carbon intensity of the energy we use -- namely, how much carbon is emitted per unit of energy consumed, and (ii) the total amount of energy used. Building off these two factors, we propose two metrics to track progress in implementing the needed energy transition.

i. The first metric assesses the carbon intensity of system-wide energy consumption ("CISEC"). We will measure total CO_2 emissions from energy combusted or otherwise consumed as part of industrial processes, relative to the total amount of energy used system wide (i.e., emissions divided by energy consumption, expressed as tons of CO_2 per terajoules (TJ) of total energy supply). This includes:
   - in the numerator, CO_2 emissions from all fossil fuels and non-renewable waste, such as gasoline used in cars, natural gas used for heating, and coal consumed in power plants to produce electricity or used in the chemical processes to manufacture cement and other products;[5] and
   - in the denominator regarding system-wide consumption, we use total supply energy figures as generated by the IEA, which includes, for example, natural gas used either for heating (which generates emissions) or as feedstock in petrochemical production (which has no direct combustion emissions), as well as energy produced from other fossil fuels, nuclear, hydropower and renewables as well as traditional use of biomass.

ii. The second metric tracks the level of and changes in system-wide energy consumption ("SEC"). The metric is the same as the denominator used in the CISEC (expressed as TJ of total energy supply). The volume of energy consumed, and particularly of fossil fuels, is the second lever that affects total emissions. The definitions and measures of SEC can vary from one institution to another,[6] and we have chosen the commonly accepted approach of IEA supply data.

To calculate and illustrate the proposed metrics, the following three climate scenarios from the IEA's World Energy Outlook 2021[7] have been used: (i) the Sustainable Development Scenario ("SDS-2021") designed to meet the Paris Agreement goal of keeping tempera-

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tures "well below 2°C"; (ii) the Net Zero Emissions by 2050 scenario ("NZE"), which captures the more ambitious 1.5°C target of the Paris Agreement; and (iii) the Stated Policies Scenario (STEPS-2021), which uses each country's stated policies – not Paris-related pledges -- to forecast the current trajectory of the energy system.

The analysis focuses on global-level metrics, in part because it is global level emissions that drive temperature change. At the same time, the largest energy systems are responsible for the majority of energy emissions, notably China, the US, the European Union, and India. Given that much of climate and energy policy is made by governments at the country-level (taking the European Union as a single unit for these purposes), it is also useful to look at these metrics at this level in addition to global figures.

How have we done on carbon intensity and where do we need to go

Before looking into the future, it is useful to assess our past and how these metrics have evolved over time, both at a global level and country/regional levels.

It is sobering among the current rhetoric of ambitious net-zero targets that the data shows there has been little improvement over the last several decades in decarbonizing our energy system at a global level. In fact, the consistency of the global CISEC is striking, having dropped less than 2 percent when comparing 2019 to 1990.

Having looked at the past, now we explore where the CISEC would need to go over the next 30 years, through 2050, to meet our climate goals. What is notable is that in contrast to the largely unchanged historical CISEC of the last 30 years, we will need to see dramatic reductions going forward. Some of that reduction has already started to occur, as reflected in the slight but visible downward slope of the CISEC since 2015 (NB, following the Paris Agreement), as reflected in figure 1. This trend continues under the STEPS-2021 scenario. But a much larger reduction is needed to achieve the "well below 2°C" (cf. the SDS-2021 scenario in figure 1), let alone the more ambitious 1.5°C threshold (cf. the NZE scenario).[8]

Looking more closely at the world's largest emitters, figure 2 shows the type of change in carbon intensity China, the EU, the US, and India would need to achieve to meet the "well below 2oC" temperature goal of the Paris Agreement. Once again, the data indicates that the current levels of carbon intensity would have to accelerate substantially. For example, while China's CISEC declined by 0.8 percent between 2015 and 2020, the SDS-2021 scenario requires an acceleration of that decline. Specifically, under the SDS-2021 scenario, the annual drop in China's carbon intensity would have to top 2.2 percent per year by 2030, and then accelerate further through 2050. The US and EU would need to double the decline rate of their CISEC by 2030 to -3.9 percent and -4.4 percent, respectively, under this same scenario.[9]

What has happened with energy use and where do we need to go

While global energy carbon intensity has remained fairly flat over the last 30 years, energy consumption has grown by 65 percent, led by significant growth from emerging economies such as China (over 250 percent).

Looking ahead, the SEC is projected to rise by over 25 percent by 2050 under the STEPS-2021 scenario.

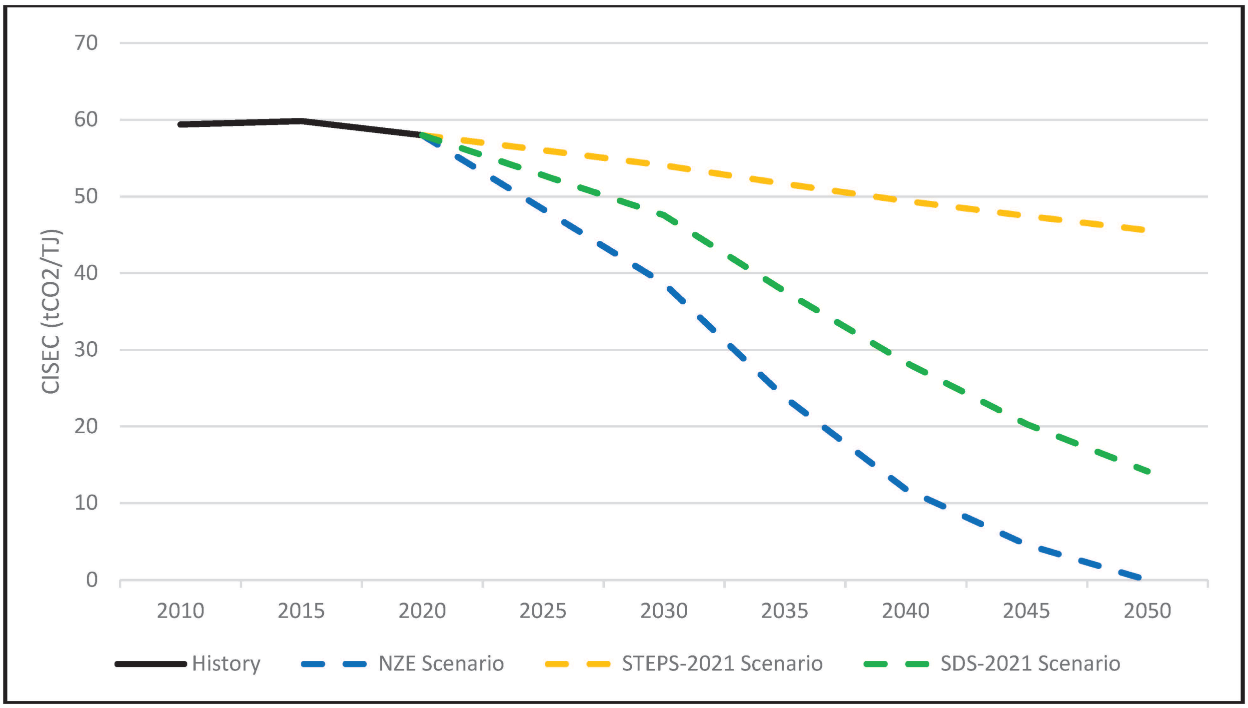

Figure 1: Where the World CISEC is now and needs to go to meet the Paris climate goals
Data source: IEA World Energy Outlook 2021 Extended Data set

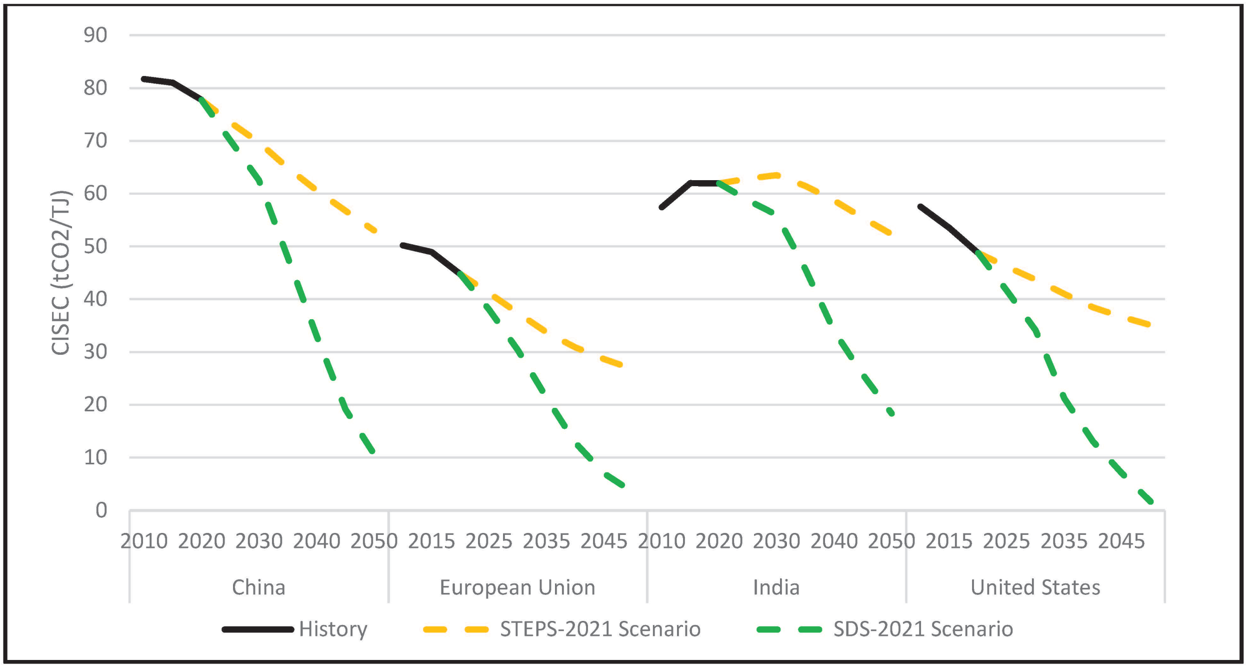

Figure 2: Carbon intensity pathways for key countries
Data source: IEA World Energy Outlook 2021 Extended Data set.

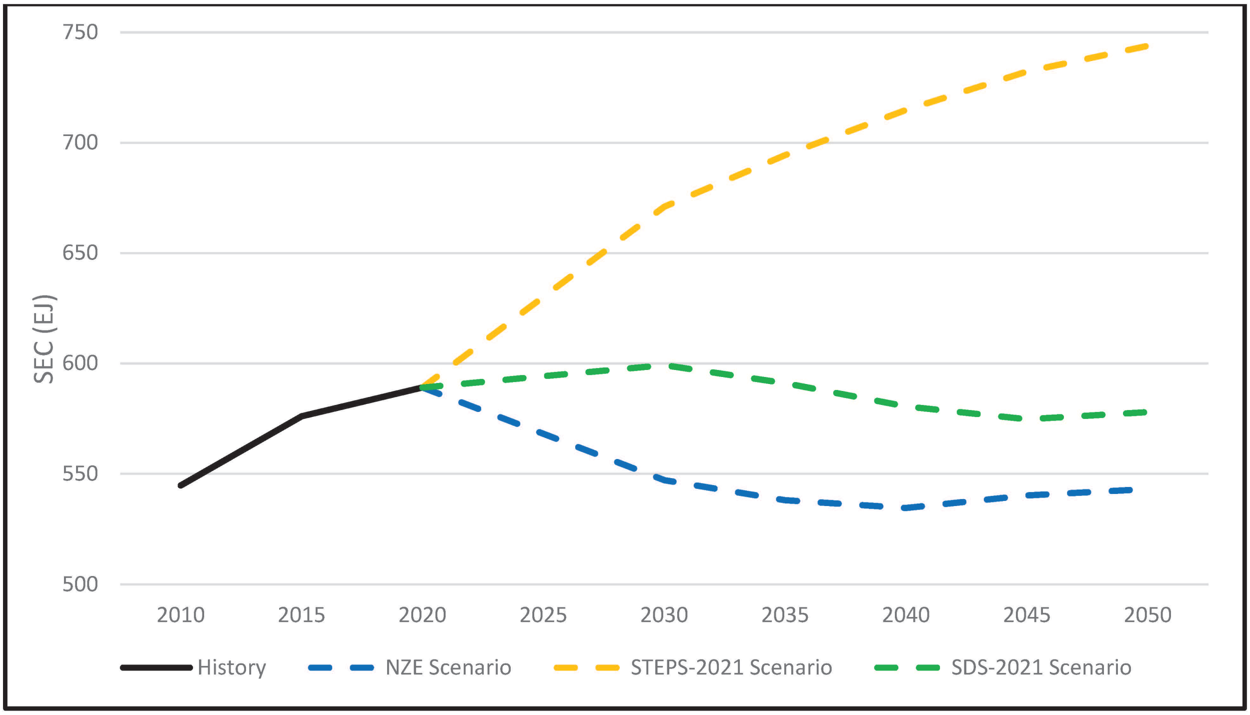

Figure 3: Where the World System-Wide Energy Consumption needs to go to meet Paris climate goals
Data source: IEA World Energy Outlook 2021 Extended Data set.

The climate scenarios require a significant break from both historical trends and the projections of the Stated Policies Scenario (figure 3). For example, under the SDS-2021 scenario designed to limit global temperature increase to "well below 2°C", the global SEC is essentially the same 30 years onwards. The 1.5°C goal embedded in the NZE scenario requires a drop of 8 percent as compared to current levels. The changes of the SEC under both these climate goals are substantially smaller than the decarbonization of the energy sector as reflected in the corresponding CISEC (figure 1). However, even those small changes in the SEC will require reversing the established upward trend in global energy demand and represent global energy demand levels in 2050 that are nearly 25 percent lower than that of the STEPS-2021 scenario.

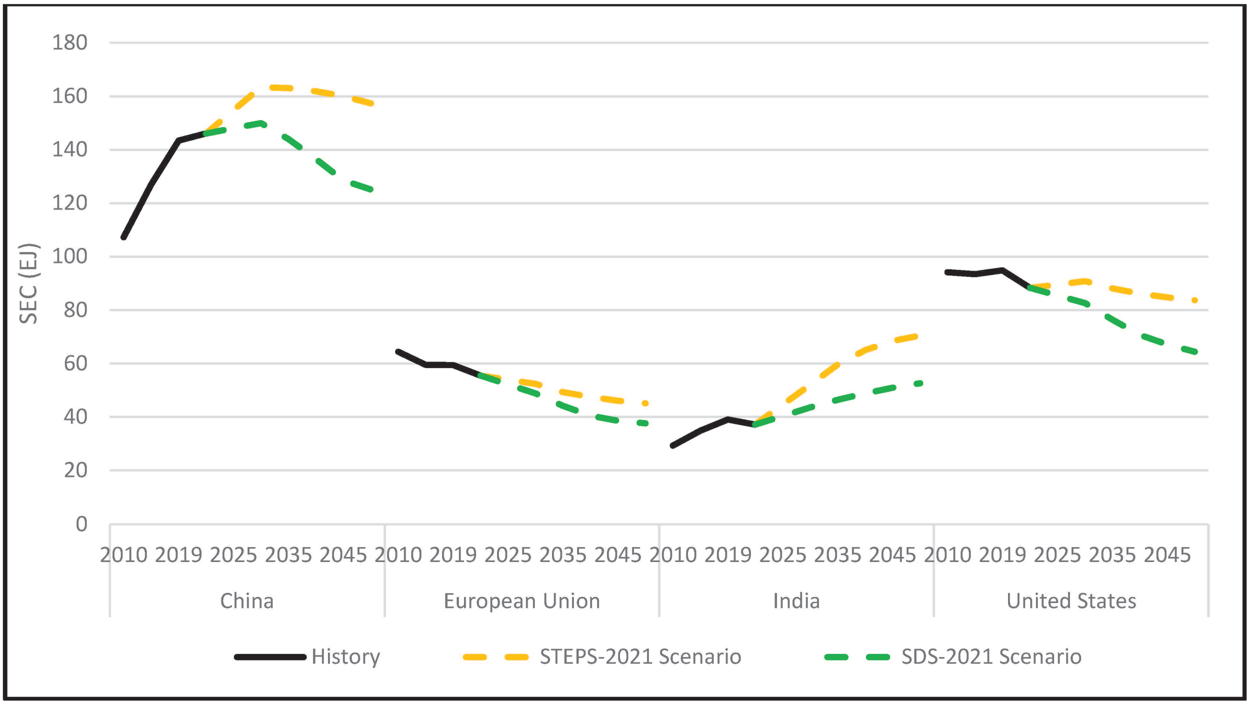

Figure 4: SEC pathways for key countries

Data source: IEA World Energy Outlook 2021 Extended Data set.

These smaller changes in SEC reflect in part a dynamic (arguably a recognition) of upward pressure on energy demand flowing from the growing populations across the developing world and their need to improve inadequate standards of living and generate further economic development.[10] Given the development status of these countries, their call for more housing, schools and hospitals, expanding infrastructure and various other similar energy intensive activities required to alleviate poverty and generate economic and social improvements will work against efforts to reduce energy consumption, in contrast to the ability of advanced economies to implement reduction targets.[11] Consequently, even stabilizing demand at a global level will require a massive effort.

Likewise, while the amount of emissions is the product of the CISEC and the SEC, it is the former that emerges under the climate scenarios as the dominant lever to effect the needed deep reductions in emissions at a global level.

Once again, it is also revealing to look at the type of effort that will be required by the world's largest energy systems (figure 4). The SEC under the SDS-2021 scenario is substantially lower than where countries are currently headed under their stated policies,[12] requiring investments in energy efficiency and other demand side management actions.[13] However, in contrast to the CISEC, not all countries move in the same direction under this scenario.

Notably, and in contrast to reductions in China, the EU and US, the SEC for India in the SDS-2021 scenario is higher in 2050 than the current level, albeit smaller than where its policies are projected to take consumption. This is consistent with the developing country dynamics described above, and also accommodates a rise in energy consumption per capita that is currently markedly below that of advanced economies or the global average (figure 5).

Identifying some of the dynamics affecting the metrics

It is also useful to identify some of the dynamics likely to drive changes in these metrics and related insights.

- There is an important lag with data availability, especially for many large energy consuming countries outside the OECD. As a result, the analysis will tend to capture where we recently stood, rather than where we currently stand. Unfortunately, efforts to estimate where we currently stand (or even to project how a year will turn out during the course of the year) can also prove to be inaccurate, as the disruptive impact of COVID-19 in 2020 or the current energy crisis unfolding since late 2021 demonstrate.
- A more complete CISEC would include other greenhouse gases from the energy system, notably methane emissions. As better data is produced (including through new satellite tracking systems), methane should be added to the CISEC calculation.
- The SEC can change without altering end-user energy service consumption patterns, notably through the substitution of thermal power generation with renewables (e.g., because of differences in efficiency and accounting methodologies). This becomes more significant given efforts to increase the weight of electricity in the energy mix, includ-

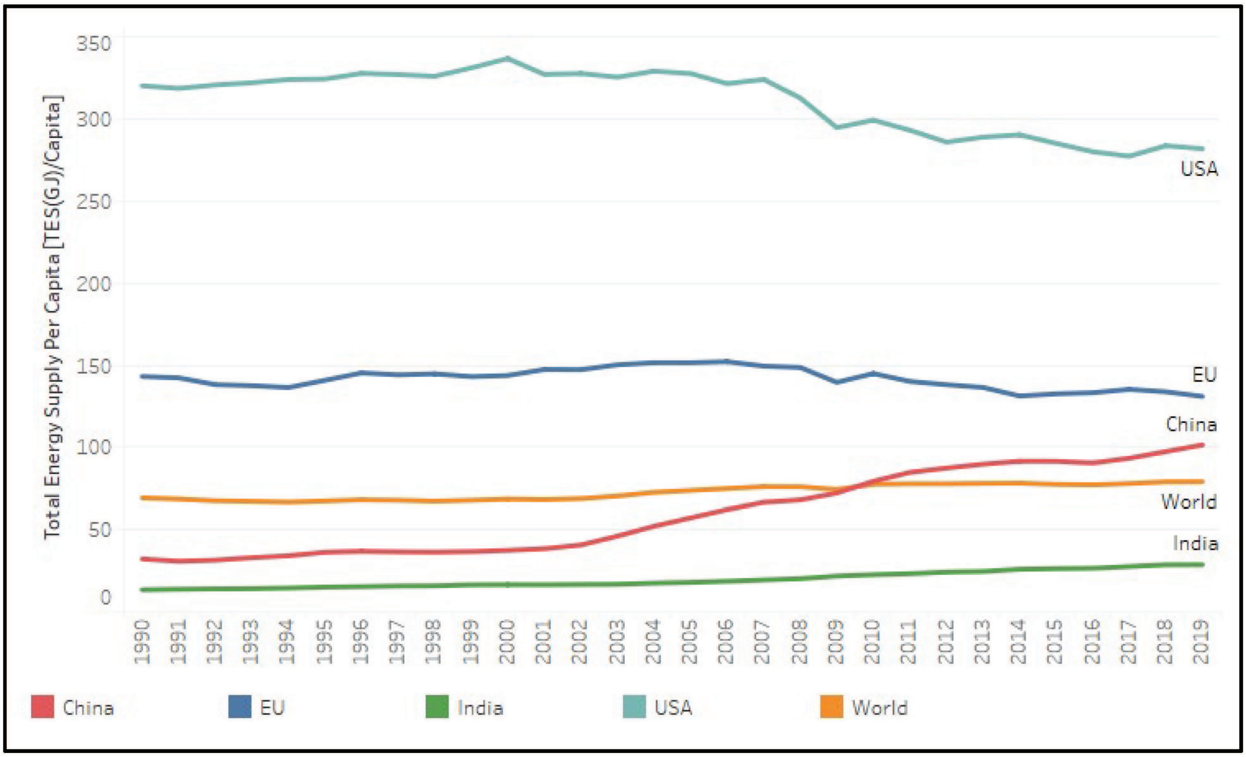

Figure 5: Total energy consumption per capita over time since 1990

Data source: IEA Energy Balance Indicators 2021

ing through electrification of end-use (e.g., electric vehicles). Under the methodology of the IEA and various other agencies, substituting renewables for thermal power lowers the SEC, all else being held equal. However, other analysts use a different approach in comparing thermal to renewables power generation, which could generate different SEC pathways to achieve the same climate goals.

- It is interesting and revealing to compare the relative impact of the CISEC and SEC metrics on overall emissions. As noted above, initial analysis seems to point to greater use of the carbon intensity lever than the demand one, and their relative contribution also seems to change over time. For example, as the CISEC nears low intensities consistent with net-zero emissions, changes in SEC have a smaller impact on emissions. Put another way, the SEC level loses weight to the extent we successfully decarbonize as we near net-zero emissions -- i.e., at an energy system that is near net-zero, the amount of energy consumed is less weighty in driving emissions than at higher levels of carbon intensity. Further analysis of the relative impacts of these two metrics over the energy transition would be revealing.
- The modelled differences in the contributions over time of the CISEC and SEC under the scenarios often will largely reflect the different costs of using each lever (e.g., cost of energy efficiency versus additional renewables generation). However, in deciding how to transition the energy sector, it may also be appropriate to consider other factors, such as differences in feasibility, geopolitical considerations, issues of equity (NB, the different per capita consumption levels presented in figure 5), and economic and developmental factors.
- Beyond metrics (including those presented in this article) that try to decompose, and thereby reveal, some of the dynamics driving emissions, the critical factor remains the cumulative level of emissions themselves. Accordingly, the carbon budgets used to drive the temperature scenarios are significant indices. For example, the 1.5°C target has a carbon budget that is about 750 $GtCO_2$ smaller than what the 2°C threshold (used prior to the Paris Agreement) can absorb.[14] At the end of the day, we are much more concerned about how much emissions we produce in total.
- Similarly, while “destination” targets (such as net-zero by a defined year) are important, the pathway of emissions in the intervening years (i.e., the “journey”) is just as, if not more, important. What matters is the aggregate level of emissions over a defined period. Maintaining emissions at 2020 levels and then dropping them to net-zero only in the target year is inconsistent with our climate goals (as reflected, for example, in the carbon budget concept). This is why tracking how the metrics evolve over time as compared to a defined scenario is critical to understanding and evaluating how we are doing in achieving our climate goals.

Tracking Progress in the Future

In many cases, scenarios and the corresponding emissions pathways are updated every year, as new historical information about the evolution of fuel demand and emissions for the previous year(s) becomes available. However, a side effect of updating historical data and the starting year for model runs is that it is difficult to analyze and evaluate how the energy system changed relative to the analysis from earlier years. This modeling setup moves the goalposts each year and it does not assess how far off track the energy system is relative to previous outlooks. To counter this, it would be useful to establish a frozen benchmark for historical tracking purposes, to assess how the global community has performed and signaling whether the world is moving towards a delayed and chaotic transition or moving on an orderly pathway consistent with the Paris Agreement goals.

Conclusions

Presenting information as to how our energy system is evolving, and how that evolution is impacting greenhouse gas emissions and the prospect for success in achieving our climate goals, is becoming increasingly important. The numerous extreme weather events (floods, heatwaves, etc.) that have marked 2022 are an indication that we need to do a better job at understanding what is happening and, importantly, in making both the ongoing and prospective evolution in energy system emissions accessible to more people. Better metrics can help. This article represents a small step in that effort.

Footnotes

[1] Paris Agreement, 2015, Article 2-1(a)

[2] https://www.climatewatchdata.org

[3] https://www.globalcarbonproject.org/

[4] https://www.unep.org/resources/emissions-gap-report-2021

[5] NB, given current data limitations, we are not including methane emissions from oil, gas, and coal-related activities. These emissions could be included in subsequent analyses depending on improvements in data availability, as discussed later.

[6] For example, different approaches to valuing the heat loss in thermal power generation that does not occur in the same way with renewables plants.

[7] For a more detailed definition of the IEA's climate scenarios, see the World Energy Outlook 2021, p. 327.

[8] Note that we have interpolated for intermediary years between 2020 and 2030 and during five-year segments thereafter using a straight-line approach. It is actually likely that the transition might follow more of a curved trajectory between points, accelerating in particular from 2020 into 2030 as countries take the time initially to ramp up the changes they require to advance their respective energy transitions.

[9] NB, we have not provided country-specific calculations for the NZE scenario as country-level figures are not available.

[10] See, e.g., figure C.3 in "Is China still a developing country and why it matters for energy and climate" which illustrates how energy consumption per capita increases with rising income per capita for all countries except high-income ones.

[11] For example, the EU and Japan have explicit energy consumption targets, including ones that predate the current European energy supply crisis.

[12] NB, country breakdowns of the SECs under the NZE Scenario have not been published and so are not analyzed in this article.

[13] See, e.g., IEA's Energy Efficiency 2020 and World Energy Investments 2021 reports.

[14] See, for example, the carbon budget estimates presented by the Mercator Research Institute on Global Commons and Climate Change (https://www.mcc-berlin.net/en/research/co2-budget.html).

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A European Future Without Russian Natural Gas?

BY ROBERT E. BROOKS, NING LIN, ED O'TOOLE, AND JIAXIN YANG

Dr. Robert Brooks is the Founder and CEO of RBAC, Inc. Dr. Ning Lin leads RBAC's Global Gas and LNG team. Jiaxin Yang and Ed O'Toole are lead analysts with that team.

Abstract

This report summarizes results from a set of scenarios regarding the future of Russian pipeline gas supplies into Europe which were presented at the 2022 USAEE Conference in Houston.

Overview

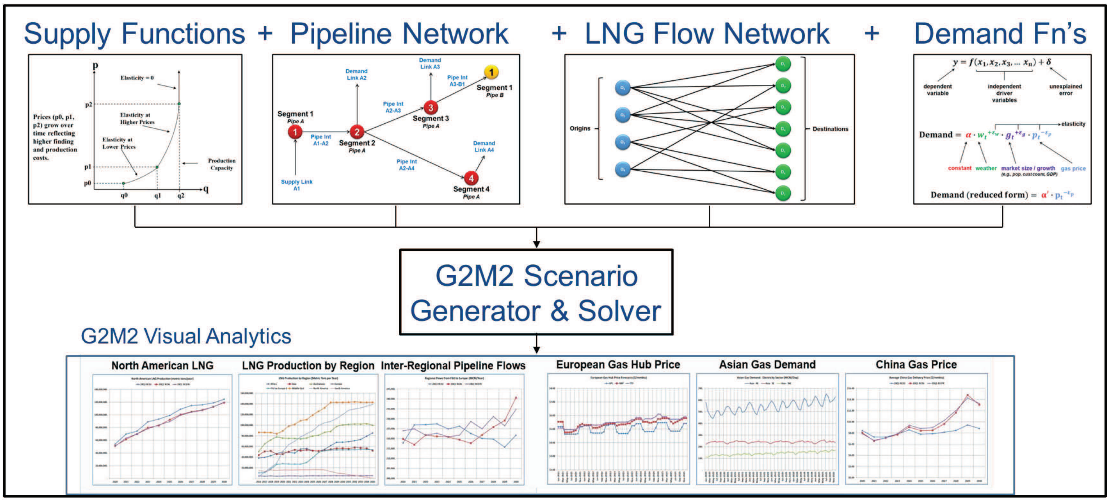
In the fall of 2021 Russia began mobilizing more than 100,000 troops to the Ukrainian border for "exercises" with Belarus. Gas traders in Europe and elsewhere began to get nervous due to low gas storage volumes after a hard European winter. Combined with the presence of the Russian troops near Ukraine, this nervousness began to drive gas prices at the TTF trading point in Northwest Europe higher and higher. Russia decided not to provide additional gas to quell this nervousness, choosing instead to send only the minimum volume required by its various contracts with European buyers and transit partners. Some believe this strategy was aimed at getting quick approval and startup of the newly completed Nord Stream 2 pipeline, but this did not happen.

On February 28, 2022, Russia invaded Ukraine. What some thought might be a quick victory has since turned into a quagmire. It has also turned most of Europe to adopt punitive economic sanctions against Russia including plans and actions to wean themselves off of Russian energy supplies, including natural gas, for good.

But is this possible? Russia was supplying about 40% of the gas that Europeans have been consuming over the past several years. Where could it get the gas it needs to make up for the loss of this supply source? It is time to update RBAC's 2016 presentation at the IAEE Conference in Baku to 2022 realities. At that time, one of us (Brooks), presented results from a study which examined alternative remedies Europe might adopt were Russia and Ukraine not able to reach a new deal when the Ukraine gas transit agreement expired at the end of 2019. This update is what we presented to the USAEE Houston Conference this October 2022.

Methods

RBAC used its G2M2 Market Simulator for Global Gas and LNG to develop scenarios and compute results addressing these questions. It consists of modules for supply, infrastructure, pipelines, and LNG flow.



G2M2 permits users to run a wide variety of scenarios under assumptions of their own choosing. G2M2 uses the AMPL language to express non-linear math programming models in mathematical form and then Gurobi to solve those models. G2M2 includes a detailed representation of natural gas supply, demand, pipelines, storage, and LNG exports, imports, and shipments for the entire world.

The scenarios generated are delineated below:

- 22Q3 USAEE 1
  - Assumes Russia-Ukraine peace achieved by Mar-Apr 2023
  - All Russian pipelines resume to normal operation
- 22Q3 USAEE 2
  - Return to normalcy Nov-2024 (winter 2024-2025)
- 22Q3 USAEE 3
  - Return to normalcy Nov-2029 (winter 2029-2030)
- 22Q3 USAEE 4
  - Never return to normalcy

Results

In the next few years, it will be very difficult for Europe to totally make up for the loss of Russian gas if the Ukraine and Poland transit links are completely severed and the Nord Stream and Nord Stream 2 pipelines are not repaired and brought back into service. Somewhat surprisingly, however, if a peaceful resolution is not obtained within the next several years, decreasing gas demand in Europe might make the point moot. We created several scenarios with widely different restrictions on Russian gas to Europe. Both European market prices, as represented by the Dutch TTF price, and gas deliveries to consumers tend toward convergence by 2030 and for the remainder of the forecast horizon (to 2050).

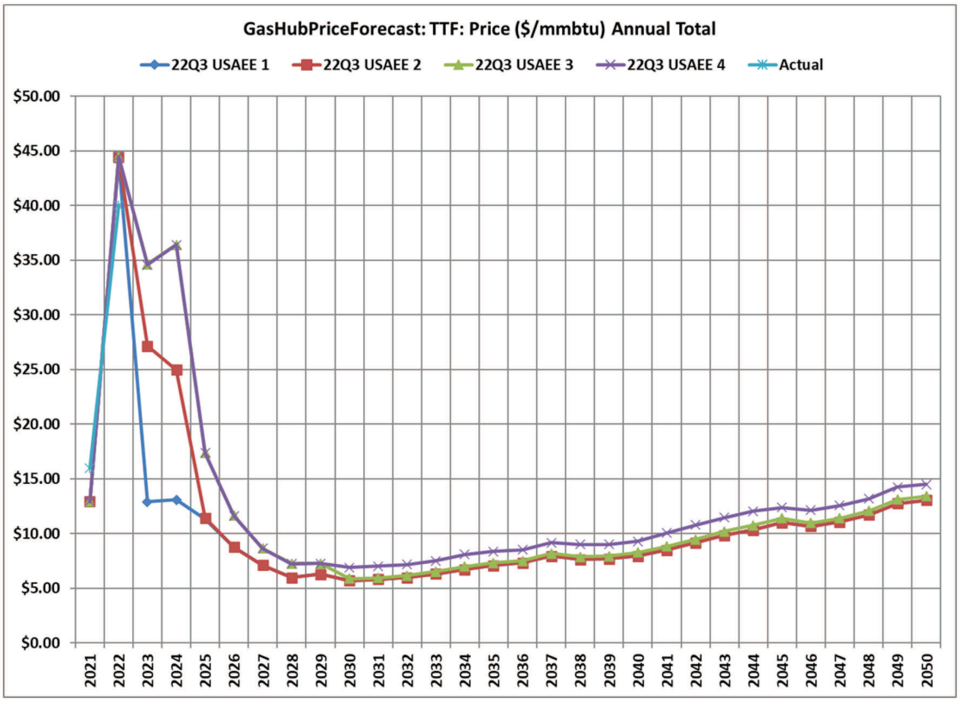


Figure 1: TTF Price Forecast for USAEE Scenarios vs Actual

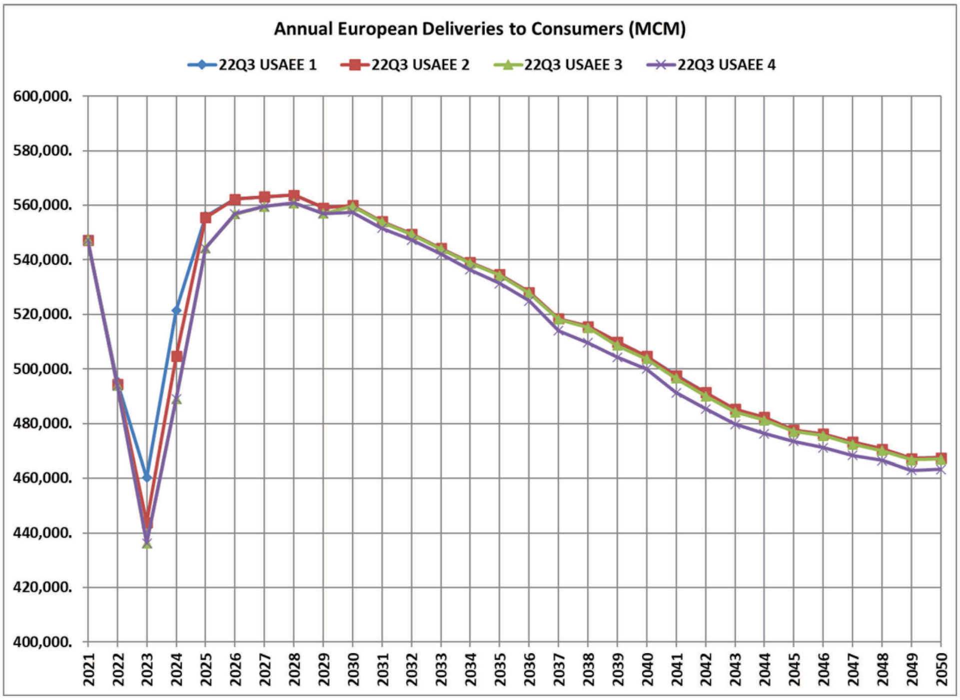


Figure 2: Total Annual Gas Deliveries to European Consumers by USAEE Scenario

Conclusions

- In the near term (2022-2025) European prices (TTF) are highly dependent on the extent and duration of the reduction of Russian gas supplies
- As shown in Figure 1 above, in the medium to long term (2030-2050), the price spread between the scenarios narrows to about $1.40 (15%)
- The only long-term difference is due to the fate of the Nord Stream pipelines
  - Scenarios 1, 2, and 3 are identical beginning Nov-2029
  – Scenario 4 is identical to 3 except it totally excludes the Nord Stream pipelines
- European gas production maintains current levels until 2031 when it begins a terminal decline in all scenarios
- LNG import growth makes up for nearly all lost pipeline gas after 2029
- LNG imports decrease in the long term due to lower European gas demand
- Pipeline imports increase when Russian imports resume until 2041 when they also begin a decline due to lower European gas demand

Implications for the Future in Europe

The results of these scenarios indicate that, in the long run, declining European demand for gas means that

- Russia needs to find other markets for its vast gas supplies
  - China is most obvious candidate
- Europe is unlikely to finance big new gas supply projects
  - Trans-Caspian Pipeline
  - East Med Pipeline
  - Trans-Africa Pipeline (Nigeria -> Niger -> Algeria)
  - Middle East to Europe Pipelines (from Iraq or Iran)

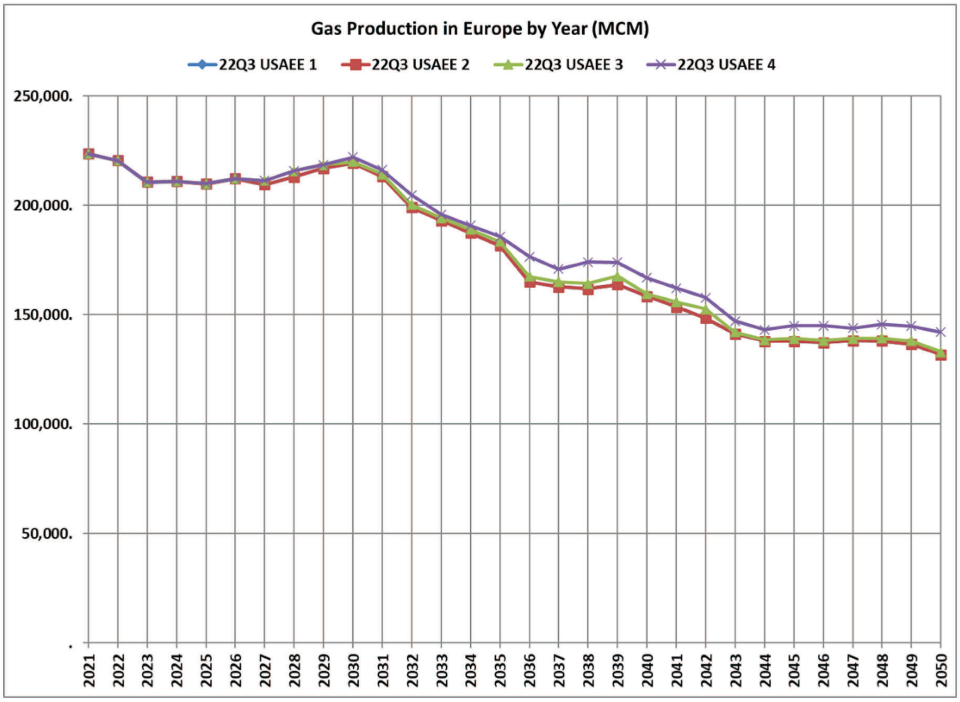


Figure 3: Total European Gas Production by USAEE Scenario

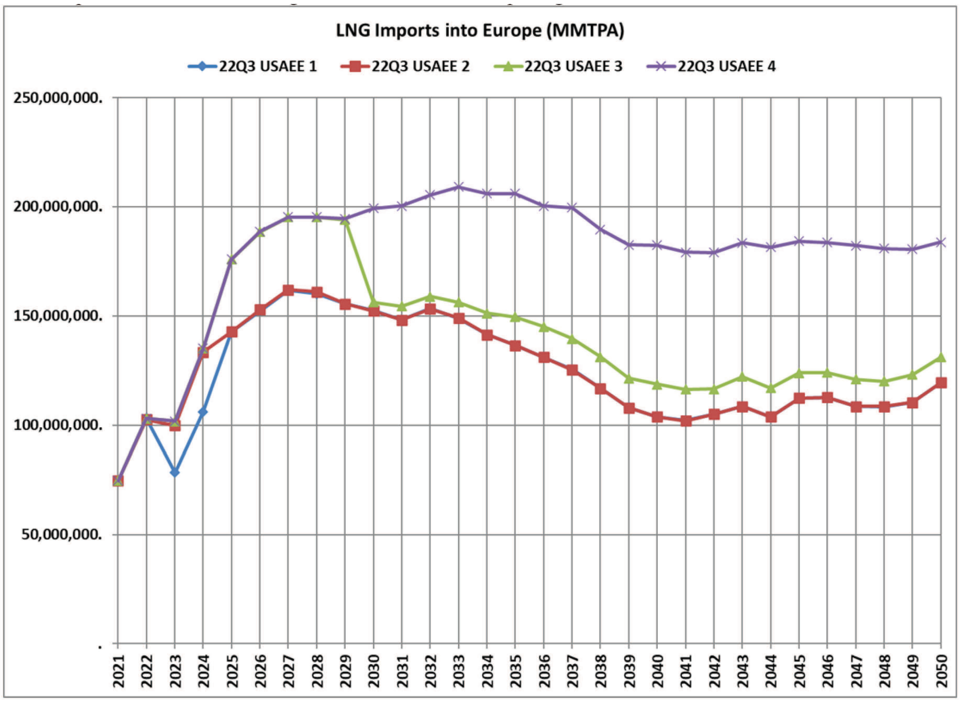


Figure 4: Total LNG Imports into Europe by USAEE Scenario

- LNG imports offers greater flexibility and security of supply
- Floating LNG can be leased for shorter times at lower cost

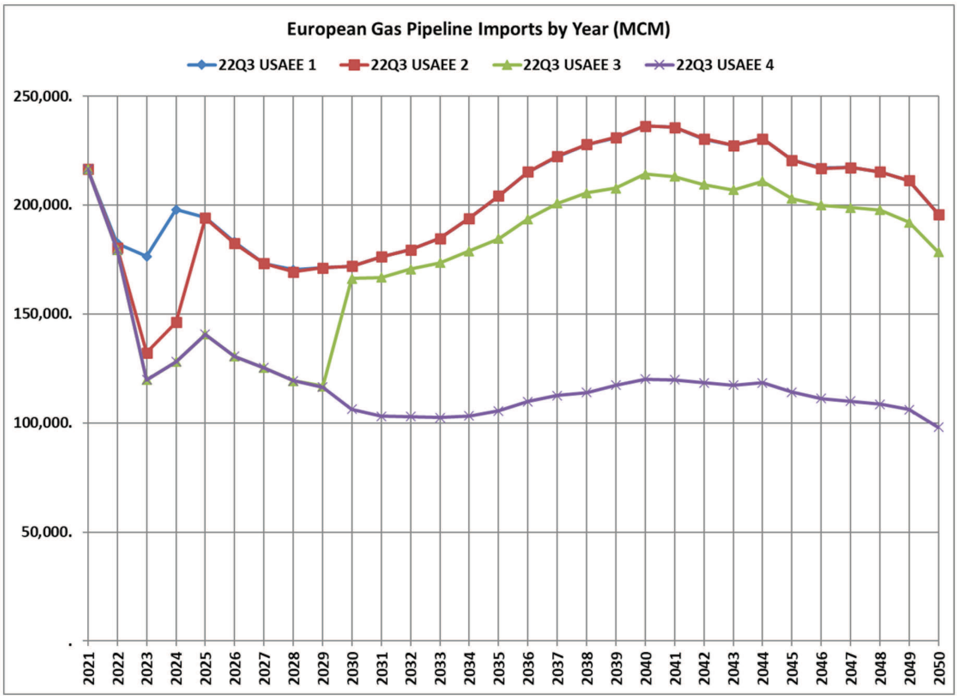


Figure 5: Total Pipeline Imports into Europe by USAEE Scenario

BRICS In The New World Energy Order: Hedging In Oil Geopolitics

BY DR. TILAK K. DOSHI

Dr. Doshi is a regular Forbes contributing author and Fellow, Global Research Institute, University of North Carolina. He can be reached at tilakdoshi@yahoo.com

President Biden's visit to Saudi Arabia during his trip to the Middle East last week has little to show for it.[1] Shortly after the Biden visit, the Kingdom made it clear that it would not act unilaterally outside of the OPEC+ group which includes Russia and allied smaller producers.[2] Saudi Arabia and its OPEC allies would continue to value the cohesion of the group, the views of Russia and the needs of global market stability in its production decisions.

Biden's trip was cast by Republican leaders as "begging for oil"[3] from the Saudis amidst high gasoline prices, the worst inflation in four decades at home and abysmal popularity polls for the president. That this happened while his administration wages a regulatory war on its own homegrown world-leading oil and gas industry is seen as particularly egregious.[4] Following the optics of last week's meeting, one of President Biden's critics found his attempt to "reset" relations with Saudi Arabia an "unequivocal display of a deeply weakened United States led by its exceedingly enfeebled president".

These opinions might be dismissed as partisan politics but it is notable that news of Saudi Arabia's interest in membership of the BRICS group came out in advance of President Biden's visit. And while President Biden was having his meeting with the kingdom's de facto ruler Crown Prince Mohammed Bin Salman in Jeddah, BRICS International Forum president Purnima Anand reported on the same day that three more countries — which included Egypt and Turkey along with Saudi Arabia — could join the BRICS group «very soon». This followed earlier announcements that Iran and Argentina had formally applied for membership with Chinese support.[5] The accession of new countries was discussed by Russia, India and China at the 14th BRICS summit held (virtually) last month.[6]

BRICS vs. G7

The acronym BRIC was coined by Goldman Sachs economist Jim O'Neill in 2001 to give an analytical lens to investors for a group of rapidly growing emerging markets (Brazil, Russia, India and China).[7] He believed that the BRICs would come to increasingly challenge the economic dominance of the developed economies of the G7. The first formal summit of the group was held in 2009, with South Africa joining in 2010 to constitute BRICS. The group accounts for 40% of the world's population and just over a quarter of global GDP. To put this in context, the G7 countries with a far smaller population base constitute just over 30% of global GDP on purchasing power parity.

The BRICS have been catapulted into a position of being the only constellation of forces that challenges the global economic dominance of the G7 developed countries bloc. This might seem a far-fetched notion especially since the organization includes both China and India which have had simmering border tensions boiling over into active lethal engagements over the past several decades. India is also a member of the Quad, along with US, Japan and Australia, motivated to contain Chinese influence in the Indo-Pacific. And now both Iran and Saudi Arabia — not the most amicable of neighbours and embroiled in proxy wars in Yemen and elsewhere — are potential BRICS members.

Intra-BRICS trade has not been of particular significance since its founding. But as the global energy order gets cleaved into two blocs – those supporting the Western sanctions on Russia and those that don't – intra-BRICS trade has suddenly gained a strategic role in oil geopolitics that is unprecedented. Western-sanctioned Russian crude oil exports, offered at discounted prices, has been re-directed to China, India and (less importantly) Brazil, as well as a range of mid-sized importers such as Egypt, Saudi Arabia, UAE and others. With elevated global energy prices, this has allowed Russia now to boast a current account surplus which more than tripled in the first quarter over the same period last year[8] and a rouble which traded at 7-year highs and has become the world›s best-performing currency this year.[9]

By June, India had imported five times the amount of all the Russian crude it bought in the whole of 2021 while China overtook Germany as the single largest importer of Russian crude oil.[10] Brazil relies heavily on Russian oil and fertilizer exports, and its foreign minister recently said that his country wanted to buy "as much diesel" as possible from Russia.[11] Saudi Arabia more than doubled Russian fuel oil imports in the second quarter to meet summer peak demand for power generation and free up the kingdom's own crude for export.[12] China, India, Brazil and Saudi Arabia share a compelling interest with all developing countries to access fuels, food and fertilizers – of which Russia is a major global exporter – at lowest prices.

BRICS As A Geopolitical Hedge

Most countries in Asia, Africa, Middle East and Latin America outside of the narrow "Western alliance" have not taken part in isolating Russia in support of NATO's agenda which to date seems to be to fight the proxy war with Russia to the last Ukrainian. China, for instance, is likely to perceive the war not merely as the West's attempt to "bleed Russia" but something as more directly consequential to its own national interests. NATO's "new strategic concept" document, released at its summit in Madrid last month, states that China's "stated ambitions and coercive policies challenge our interests, security and values" and warns of "the deepening strategic partnership between the People's Republic of China and the Russian Federation and their mutually reinforcing attempts to undercut the rules-based international order run counter to our values and interests."[13]

The "rules-based international order" espoused by NATO and its allies meant an all-out economic war on Russia.[14] This included the expropriation of half of the Russian Central Bank's foreign exchange reserves held offshore, blocked access to the SWIFT international payments system and bans (or announced plans to phase in bans, since immediate bans are impossible for the EU) on Russian energy exports. President Putin responded with the "roubles for gas" scheme for "non-friendly" countries (i.e. those participating in the sanctions), making clear that the scheme was the prototype to apply to all its major commodity exports.[15]

It is no surprise that both Moscow and Beijing are working on the creation of an international reserve currency and an integrated inter-bank payments system based on a basket of BRICS currencies to counter Western sanctions. For countries outside the US-led alliance, BRICs membership could serve as a hedge to the threat of secondary sanctions by the G7 or NATO.

China's invitation last month to thirteen countries including Indonesia, Kazakhstan, Nigeria, Senegal, Thailand and the UAE to apply for BRICS membership no doubt has this motivation between the lines. In his speech to BRICS forum invitees, President Xi Jinping gave a critique of the US-led sanctions regime for building "a small yard with high fences".[16] He reflected the posture of developing countries which seeks continued access to fossil fuels – especially at discounted prices — for resuscitating economic growth as they emerge out of the covid lockdowns.

A Dent on Dollar Hegemony?

An enlarged BRICS group may or may not include oil and gas heavyweights Iran and Saudi Arabia. But if intra-BRICS commodity trade were to be settled in a commodity-linked basket of currencies among members as well as willing non-members, it would constitute an effective end to the petrodollar, a key pillar of the G7-led global financial system. The tensions within an enlarged BRICS forum hosting members embroiled in regional rivalries may be outweighed by the common interests of countries outside of the Western alliance seeking to ensure their access to food, fuel and fertilizer imports on the best terms possible.

President Putin in his notable speech to the St. Petersburg International Economic Forum last month warned that "it is a mistake to suggest that one can wait out the times of turbulent change and that things will return to normal; that everything will be as it was. It will not."[17] For many developing countries critically dependent on imports of the 3Fs – fuels, food and fertilizers — membership of the BRICS group may well turn out to be the best geopolitical hedge in a world forever changed by the US-led financial sanctions on Russia.

(A version of this paper was first published in Forbes)

Footnotes

[1] https://www.reuters.com/world/middle-east/biden-ends-trip-with-us-saudi-relations-mend-few-other-wins-2022-07-16/

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Factors Influencing the Optimum Utilization of Natural Gas in Nigeria

BY HUMPHREY ORUWARI

ABSTRACT

The objective of the study was to investigate the factors influencing the optimum utilization of natural gas in Nigeria and recommend ways for policy decisions. Using literature review and case studies, the study finding revealed that provision of adequate infrastructure, diversification, liberalization and collaboration in terms of financing and formation of technical partners are some of the critical success factors.

Keywords: Energy transition, Sustainable development, cluster system, economic diversification, Natural gas, liberalization.

1.0 Background of study

Nations and industries are encouraged to specialise and concentrate rigorous efforts in their area of strength and advantage in other to be competitive. Without any doubt, Nigeria like other developing countries is an oil and gas producing nation. The Nigeria nation is blessed with abundant oil and gas resources. The abundant natural gas resources which is a by-product of oil exploration that can result in industrialization and economic prosperity for the nation, Nigeria is endowed with abundant Natural Gas; Nigeria's proven gas reserve is placed at 209.5 trillion cubic feet. The natural gas sector holds significant potential. Nigeria has the 7th largest reserves in the world with significant scope for growth. The gas quality is high particularly rich in liquid and low in Sulphur. Despite policy initiatives in promoting gas utilization and monetization, the utilization of natural gas has not been fully optimized. The main problem against the optimum utilization of natural gas in the country is the inadequate infrastructure and the huge fund required. As a long-term strategy for the utilization of natural gas in Nigeria, the Federal government of Nigeria has put in place the gas master plan policy frame work, this includes the Abuja Kaduna, kano gas pipeline network among other. There is urgent need to complete the pipeline system in order to supply natural gas to various parts of the country and Europe to generate revenue and also avoid energy crisis as a result of Russian disconnection of natural gas to Europe. The objectives of the study are to:

- Emphasis on the critical need of pipeline infrastructure to enhance the utilization of natural gas as an alternative energy source.
- Discuss the utilization of pipelines cluster system to transform natural gas development
- To identify social, economic, ecological/environmental and political factors that influence the sustainable development of natural gas
- Make recommendation to policy makers in Nigeria to drive the economy for industrial development and sustainability.

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Research questions

What do policy makers in Nigeria need to know about natural gas development that will produce development support strategies that is socially, economically, environmentally and politically effective for optimum utilization of natural gas in Nigeria?

2.0 Literature review

A. Natural gas : Inevitable Potential Component of Industrial Development in Nigeria.

Natural gas outputs , are not only good sources of energy components but also other industrial raw materials. The gas sector is therefore essential for the development of various industries and highly required for national development in Nigeria The industries and programs that can emerge from the natural gas utilization include:

- Energy for example Liquidfied Natural gas (LNG) and Compressed nautural gas (CNG)
- Petrochemical indusries
- Fertilizer industries
- Cement industries
- Electric power industry
- Product development and added value

Natural gas do not only provide energy services but also industrial feedstock. The industries and programs that can emerge from the output of natural gas are many. These include energy industry like gas processing companies, elecrticity power industry, cement industry, fertilizers industry and; and many others. The natural gas will serve as energy transition fuel and decarcarbonize the energy industry.

There is the need to focus on alternative energy and natural gas can serve this purposes other are especially solar, wind and other renewablw energy sources. Solar and wind energies are harvestable and convertible to electrical and heat energy for whatever applications. The natural gas industry, however require regular power supply, water supply and functional infrastruture network to operate efficiently.

Reason why natural gas is critical path of energy transition

- Natural gas is a reliable, affordable energy source which enables innovation.

- It acts as a bridge ingredient in the hydrogen revolution'
- It is a key tool in the fight against energy poverty for example power generation.
- Along with carbon capture and storage, it can transform the energy sector

B. Global Economy, Cluster and Competitiveness: Implications for Natural gas development

A cluster is a group of companies sharing local resources, using similar technologies and forming linkages and alliances. Clusters consist of dense networks of interrelated firms that arise in a region because of powerful externalities and spill over across the firms within the cluster. Cluster is not a new concept. It started naturally (organic cluster). It is also cultural or geographic in existence. But, natural cluster are traditional and not necessarily innovative. Innovative cluster adds value, improves efficiency and supports a liberalized economy.

Competitiveness and cluster-based initiatives are known to contribute to the world economy via increased production and productivity, reduced cost of unit production of commodities, optimized gain and improved healthy interactions between the various key players in the economic sector. Competitiveness has promoted the global liberalized economy and improved commerce and industry. It should be noted that competitiveness and innovative clusters are relatively new in Nigeria but offer opportunity for a rapid economic growth in the region , especially in the gas sector.

Adewumi (2012) reiterated that the possibility of Nigeria's gain in competitiveness and cluster-based initiatives could be a mirage because of some inherent socio-political factors which include lack of political stability, lack of stable policies, wasteful and over dependence cultures, poor infrastructures for industrial development (especially electricity and road) and weak linkage among the players of innovative clusters, to mention a few. He concluded that the reality of Nigeria benefiting from the gains of competitiveness and innovative clusters hangs on the sincerity and good will of the Government, re-orientation of the masses and adequate planning and policies.

Adewumi (2011) emphasized that innovative clusters and the concept of triple helix are essential tools for socio-economic development of any nation. Their applications to natural gas pipeline cluster development can translate a nation to a liberalized economy, and promote competitiveness and rapid industrialization. Investments on the the development of natural gas, especially in Niger Delta to refined products of high quality must sharply increase in order to promote economic growth. This shall provide a diversified economy and protect nations from relying only on petroleum resources as the major source of income and remove nations, like Nigeria, from the category of single commodity exporting country that relies heavily on crude petroleum as major source of foreign exchange.

C. Liberalization/deregulation

The underdeveloped gas industry in Nigerian petroleum downstream is a major factor hampering sustainable development in the nation. Ibibia (2002) opined that One vital ingredient that will aid the development of the downstream sector is economic liberalization or privatization. Privatization or liberalization aims to reduce the barriers to investment entry and encourages competition to reallocate resources more efficiently. This movement towards an investor-friendly international economic order has become noticeable in the agenda of international economic negotiation. It has taken on a variety of forms which can be described by the following: deregulation, decontrol, de-monopolization, de-bureaucratization, de-centralization, investment promotion, privatization, and commercialization as well as globalization

D. Economic diversification:

Economic diversification is generally taken as the process in which a growing range of economic output produced. According to Kwanashie (2012 economic diversification is essential in the sustainable management of petroleum resources like natural gas, since it enables a State to develop and utilise industrial activities required for the extraction of non-renewable petroleum resources for other industrial activities as put by (Olav, 2009).

Economic diversification helps to develop associated industries, the transfer of skills and technology to increase knowledge and competence in the natural gas industry, the development of technological excellence in the industry and investment in infrastructure and human capital. This is in line with the submission of Ross (2003) that the best solution to oil dependence is diversification. There is inherent potential of natural gas usage as a national catalyst for achieving economic diversification from crude oil and as a transition fuel from fossil of today to the renewable energy of tomorrow.

3. Research methodology

The methodological frame work involved an extensive literature review on natural gas utilization project and a case study of several existing gas pipe line systems especially the Abuja, Kaduna, Kano (AKK project) gas pipeline which links part of the cluster of pipelines system and serves as one of the drivers of infrastructure for transporting natural gas. Natural gas is a strategic asset and a transition fuel that will bring about sustainable development in Nigeria. The research methodology is also based on deductive logical reasoning combining qualitative and explanatory case studies.

4. Result and discussion

According to Dickson (2010) cheap energy supply is the greatest stimulus for industrialization. Hence investment, diversification, deregulation and creation of regional power supply companies are needed for energy supply bottle neck. In order to diversify its revenue base and reduce the huge wastage of valuable resources and degradation of the environment, as a result of flaring of natural gas Government, NNPC is vigorously pursuing various gas utilisation projects with the joint venture partners. The associated gas that hitherto was being flared is now harnessed to achieve these objectives. A number of gas utilization projects have been completed, commissioned and in operation, while several other are in various stages of execution.

Natural Gas based Projects in Nigeria

Nigerian National Petroleum Corporation (NNPC) and other major Exploration and Production (E & P) operators are currently embarking on several gas utilization projects. The major existing and future projects are:

Escravos- Lagos Pipeline (ELP)

The ELP which was commissioned in 1988, supplies gas to Power Holding Company Nigeria (PHCN) in Egbin Powe plant near Lagos. Spur lines from the ELP supply the West African Portland Cement Company (WAPCO) Plant at Shagamu and Ewekoro , PHCN Delta IV at Ughelli and Warri refinery and petrochemical company (WRPC) at Warri in Delta state

The West African Gas Pipeline (NNPC/SHELL/CHEVRON JV) Project (WAGP)

The West Africa Gas pipeline project was designed to meet the energy needs and other needs of Ghana, Togo and Benin by utilizing Nigeria abundant natural gas reserve. A feasibility report done by PLE of German, has confirmed that the Onshore/offshore, a continuation of ELP from Alagbado to Ghana, is the least cost option for the project. NNPC through it subsidiary NGC, has a participating interest of 25%, with other sponsors being Ghana National Petroleum Corporation, Chevron, shell, Societe Beninnoise du Gas, and Societe Togolaise du gas. The long-term plan is to extend this pipeline to Dakar, Senegal, on order to make Nigerian gas available to the entire subregion. The WAPCo pipeline is seen today by Economists as a catalyst for clean economic growth, a tool for environmental benefit, and a cornerstone for regional integration. WAGP (2005).

Trans-Saharan Pipeline (NNPC/SHELL/CHEVRON JV)

Nigeria underlined its determination to penetrate the European gas market when it signed preliminary agreements with Algeria in October 2001 on a planned Trans-Saharan Pipeline running through the North African country. The project would seek to connect the Nigerian gas field with that of Algeria, to the European market.

Case study of Abuja Kaduna, Kano (AKK) pipeline project and sustainable development in Nigeria

Ajaokuta- Abuja Kaduna pipeline

The project will extend the existing Oben_ Ajaokuta pipeline to supply to Power Holding Company Nigeria (PHCN) at Geregu, Abuja and kaduna, NAFCON 111at Izom in Niger Delta states and various industrial customers in Kaduna. The pipeline will be the backbone of the national grid, linking Kaduna and other Northern cities to the gas fields in the southern part of Nigeria.

Social issues

The pipeline project would create prosperity through massive job opportunities and guarantee peace for the country, it would revamp about 232 industries. The project has been on the drawing for 30 years and the dream was to have gas delivered to Europe across the Trans Sahara route (NNPC news June /July 2021). However, with the Russian-Ukraine war and impending energy crisis, there is the urgent need to fast track this project in order to ameliorate the impending energy crisis in Europe in addition to creating prosperity through massive employment opportunities for Nigerians.

Economic issues

The AKK project would also lead to the development of three Independent Power plant s (IPP) in Abuja, Kaduna and Kano adding that the IPP would boost electricity supply and promote growth of small and medium scale enterprise in Nigeria. The project would also boost the agricultural, industrial, manufacturing and Power sector for the overall growth of the Nigerian economy.

Environmental issues.

The AKK gas pipeline project would also reduce Nigeria carbon foot in line with global quest to arrest global warming and climate change in addition to other on-going gas utilisation program in Niger Delta region of the country.

According to Bello and Dauda (2022): The Nigeria Gas Master Plan (NGMP) was developed in 2008 given that the country intends to be a key player in the international gas business as well as to lay a solid framework for gas infrastructure development within the domestic market. The AKK gas project would serve as gas supply link to other African countries and Europe upon completion.

The gas master plan key objective

- Maximizing the multiplier effect of gas in domestic economy
- Optimizing Nigeria and competitiveness in high value export markets
- Assure the long energy (gas) security to Nigeria

Expansion of domestic gas distribution network (NNPC/SHELL/CHEVRON JV)/

Several distribution schemes are planned to help promote Nigerian consumption of natural gas. The proposed $745-million Ajaokuta-Abuja-Kaduna pipeline will deliver gas to central and northern Nigeria, while the proposed $552-million, Aba-Enugu-Gboko pipeline will deliver natural gas to portions of eastern Nigeria.

Synergy for promoting natural gas utilization in Nigeria

A strategic partnership between the investors and other stakes holders on the user of natural gas is critical to the optimum utilization of natural gas in Nigeria. (Humphrey and Adewale, 2016). The formation of such strategic alliance will not only provide a common focal point but will also provide economies of scale for the development the natural gas market.

The Nigerian National Petroleum Company Ltd has commenced discussion with the United States Finance Corporation and Exim Bank to seek funding for its multi-billion-dollar gas projects. Also, NNPC and Economic community of West African States (ECOWA Commission reaffirmed their commitment on the project to provide natural gas to the West-African countries through the Morocco and subsequently Europe.

5. Conclusion

The factor influencing the utilization of natural gas are adequate infrastructure, diversification, deregulation, collaboration and funding. The study highlighted the strategies needed for optimization of natural gas in Nigeria. Based on the analysis, the overall findings and conclusions are that the available infrastructure are inadequate. Globalization and liberalized market are the major issues in the present-day world economy. These are the factors that determine the extent of national economies. It is therefore essential that the natural gas companies in Nigeria, Investors and Government key into competitiveness and cluster-based systems in order to enhance their performance. This will hence promote natural gas development in Nigeria rapidly and enlarge the marketing of natural gas products beyond the Nigeria shores. The policies makers in Nigeria should not only promote and implement policies on competitiveness and cluster-based systems; the operators and investors in natural gas should imbibe same. But, these shall be impossible without adequate infrastructures, collaboration, liberalization and economic diversification.

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Quantifying the (In)Convenience of Electric Vehicle Charging

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Introduction

A perceived barrier to widespread adoption of electric vehicles[1] (EVs) is the presumed inconvenience of charging them for personal transportation. Infrastructure for refueling internal combustion engine vehicles (ICEVs) is nearly ubiquitous, highly visible, and relatively easy and fast to use. On the other hand, even though progress towards expanding a diverse and accessible public charging network continues, EV charging stations are currently less available and accessible, not as publicly visible, and "refuel" vehicles at slower rates. We contend that charging infrastructure planning/operation that considers the consumer-centric concept of convenience will improve the acceptability of electrified transportation and ultimately sustain its economic viability.

At present, evidence suggests that publicly available charging infrastructure remains insufficient for many potential EV owners to achieve convenience parity relative to their ICEV experience. This situation hinders consideration of EV purchases for those who contemplate long-distance driving in their transportation mix. Further, the lack of multi-unit dwelling charging infrastructure constrains EV purchase for those other than single-family households. Similar situations apply to individuals living in rural or mountainous areas, and to those who do not work or have no access to workplace charging. In each of these cases, 100% electrification of personal vehicle fleets will be difficult to achieve if vehicle charging and operation are inconvenient.

With passage of the Infrastructure Investment and Jobs Act (IIJA) in November, 2021, the US will attempt to address charging inequity by investing approximately $5B over five years in a national EV charging network. Ultimately the near- and medium-term viability of EV ownership will depend on how these funds are deployed. Thus, it is critical to develop evaluation criteria and methods which go beyond geographic distribution and focus on the convenience and value of the driver-infrastructure interaction.

Defining Charging Convenience

We define convenience here as the absence of waste (time, money) experienced while operating a vehicle. Using this definition, we assert there are both well-documented inconveniences and conveniences associated with EV operation relative to ICEVs. Considering these together promotes a deeper understanding of how to approach charging infrastructure planning, and how best to communicate EV operation.

As defined, inconvenience is minimized when EV owners charge their vehicles while parked at locations having high driver utility, like home or work (Figure 1). Time-to-charge (dwell time) is generally not an issue because owners typically recharge their batteries overnight or leave them plugged in when not being driven. In this sense, EV owners have an advantage since ICEV owners cannot refuel at home/work and must make dedicated trips or detours for fueling. Still, as suggested above, there are situations in which charging at home/work is not possible, leading to reliance on publicly available charging locations in the same way that ICEV owners rely on publicly available refueling locations. Further, at-home charging, itself, can be inconvenient because, without access to a fast-charging unit, dwell time can be lengthy depending on the battery's current charge state. In some cases, the time required to charge an EV will be longer than the time the vehicle is parked. Hence, slower charging and shorter dwell times may constrain on-demand, full-range EV operation, forcing owners to pursue more inconvenient public charging alternatives.

Generally speaking, public charging convenience reflects the geographical availability/accessibility of a charging station and the time required to fully recharge the vehicle's battery. This has to do with charging sta-

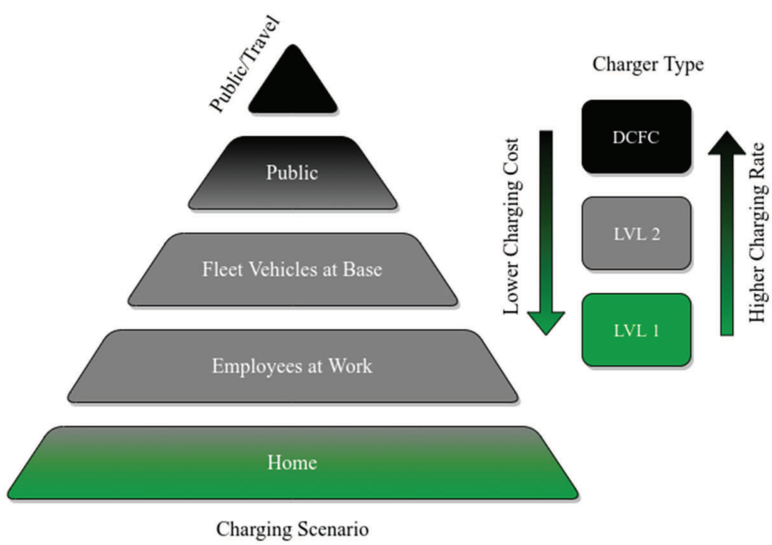

Figure 1. Charging activity pyramid. Modified composite of original graphic by T. Bohn, Argonne National Laboratory.

tion density in the vehicle owner's accommodation region, the time/route necessary to travel to the nearest available charging location, and any time delay experienced when arriving at the charging location. Charging density can mean the existence of multiple charging ports at a specific location or the number of charging locations with at least one charging port in a particular geographic area. The owner's accommodation region is the typical space within which s/he travels during a week to shop, conduct personal business, etc. Individual itineraries within a given region will vary greatly, and different individuals will experience differing levels of convenience even in similar situations.

Dwell time is important when evaluating recharging convenience at public stations, and it depends on a number of technical factors, including charging port type, age and state of the vehicle's battery, and ambient temperature. For example, public stations equipped with direct current fast-charging (DCFC, or Level 3) ports provide faster charging than Level 2, but there are even different levels of DCFC chargers. Though the situation continues to improve, EV owners are not likely to be able to charge their vehicles today at any publicly-available station in the same time that it would take them to refuel a comparable ICEV at a gasoline/diesel pump (roughly 10 minutes, depending on tank size, pump speed, and amount of fuel remaining in-tank upon arrival).

As noted, an additional aspect of public charging convenience is the potential delay that can be experienced upon arriving at a charging location. Although improving, today EV owners do not typically have equivalent access to the same number of charging ports at a specific location as the number of pumps that IECV owners would encounter upon arriving to refuel at a gasoline station. While it is true that ICEV drivers do often have to wait in line, the time delay is typically short, as is the typical time to complete a transaction once refueling begins, resulting in fairly continuous flow of ICEVs in and out of a station. By comparison, EV owners may have to wait longer in line upon arrival because there are insufficient ports to serve demand and/or the charging time is longer, leading to a more constrained flow of vehicles in/out of the charging location. Further, the smaller number of charging ports at a specific site than a comparable number of fueling pumps at a gasoline station may increase the potential for EV owners to experience a charging port malfunction or lack of vehicle-to-port interoperability, resulting in a further time delay at that site or in transit to a different site. Due to the greater density of gasoline stations and the larger number of fueling pumps per station, an ICEV owner would likely experience a lesser degree of inconvenience than an EV owner in either situation.

A further question is whether cost is part of public charging convenience. At first blush, the temptation might be to consider cost differently. However, in the same sense that ICEV owners may choose to drive further to obtain cheaper fuel or opt for higher-priced fuel at a closer location when time or fuel level is critical, EV owners may choose to drive to charging locations where the cost-to-charge is less expensive. Unfortunately, charging stations do not typically post the price of electricity in the same way that gasoline stations post the daily fuel price. Additionally, many EV owners do not have a full appreciation of the actual cost-to-charge, nor can they easily translate between the cost of gasoline/diesel and electricity because of complexities in pricing structures. For example, some stations impose plug-in fees or other costs in addition to the actual electricity price to help defray infrastructure expense, whereas at others the cost-to-charge may be entirely free, or it may be hidden in the overall price paid.

Because the perception of convenience can be confounded by many interacting factors, perhaps a more direct way to consider convenience (noted above) is to explicitly view it as the lack/absence of inconvenience. For example, an EV owner is inconvenienced when required to deviate from a planned itinerary to charge the vehicle's battery, and such events become more inconvenient the longer the charging event. However, if the EV owner is only required to charge at locations where s/he would be present anyway, such as at home, work, or certain other "long dwell" destination types/events (shopping malls, movie theaters, etc.), then the owner would conceivably experience little or no time-based inconvenience. An EV owner can even be inconvenienced by at-home charging if dwell time limits that individual's ability to maintain a planned schedule, take advantage of unscheduled opportunities, or react to emergencies or other unplanned requirements (e.g., drive to an urgent care center). On whole, such inconvenience would typically be less than if home charging was not available at all. Further, individuals with high mileage commutes might invest in higher-rate charging at home or be incentivized to seek publicly available fast-charging; but this, too, could be considered an inconvenience from a cost perspective.

Community Charging Versus Corridor Charging

The type of charging discussed above is sometimes called community charging (local "gas station style"), as distinguished from corridor charging2 associated with individuals or families traveling longer distances away from their homes/workplaces (e.g., cross-country vacations). Many aspects of community charging convenience already identified apply equally to corridor charging but become somewhat more critical. Accessibility to charging stations is particularly route-sensitive for corridor travel. Whereas charging stations are regularly available along interstate and other major highways in populous regions (e.g., travel plazas), that is not necessarily true everywhere. Further, access may be restricted to drivers who belong to a specific charging network. For example, Tesla owners have access to a proprietary charging network in the US, but, currently, no one else can charge at these stations. Density of charging stations at a particular location is also an issue. Some restaurants and hotels provide fee-based charging stations for overnight guests, but most do not; and, if multiple EV owners happen to frequent the same establishment, there would likely not be enough to go around. Further, depending on the destination and route, drivers traveling cross-country may find themselves in mid-route or at end locations with no charging access at all, or they may experience malfunctioning equipment, thereby requiring emergency charging services. Despite these concerns, as EV ownership becomes more prolific, corridor charging will also become more accessible and convenient, certainly along major highways and thoroughfares.

Quantifying Charging Inconvenience

Because these same considerations help define the convenience of refueling ICEVs and EVs, it is instructive to consider the differential convenience associated with owning the two different vehicle types. Making the assumption that the convenience of refueling an ICEV forms the baseline understanding of transportation effort in the minds of most consumers,[3] the difference can be stated in terms of the inconvenience level experienced by EV owners relative to what they might otherwise encounter with an ICEV. The end goal is to establish a single metric with which to directly compare the in(convenience) of owning any type of vehicle as objectively as possible under a variety of operating scenarios.

Prior Work

The question of EV charging in(convenience) and its influences has not been widely studied. Using a Household Activity Pattern Problem model to estimate equivalent cost of delay for households pursuing theoretical itineraries, Kang & Recker[4] conclude that EV drivers who can charge at home on Level 2 chargers experience low levels of inconvenience in monetary terms. Tamor & Milačić[5] and Tamor et al.[6] define inconvenience in terms of the number of days per year that an EV has insufficient range to complete its itinerary. Using real itineraries and assuming at-home charging only, they conclude that EVs with a 120-mile range would be acceptable as one-to-one replacements for 90% of US vehicles and 60 miles would be sufficient for 90% of US households to own at least one EV. Roughly 65% of Americans live in owner-occupied detached dwellings[7] leaving 35% for whom nightly charging at home must be accommodated with non-dedicated charger/parking combinations. Dixon et al.[8] attempt to understand EV inconvenience for those with limited charging options by considering it both in terms of infeasible itineraries and delays to itineraries. Data were obtained from the UK National Travel Survey which collected week-long travel itineraries from almost 40,000 households. Assigning charges to type of destination (e.g., food shopping, entertainment), and assigning charging events via a scheduling heuristic, they found that around 95% of those who charge at home can achieve convenience parity with low-end EVs, but that the percentage is much lower for those who cannot. There are a number of limitations to the Dixon et al. approach, including several assumptions that may not be totally supportable; but the main one is the absence of a single metric of inconvenience. Zhou et al.[9] consider inconvenience in the interacting contexts of cost avoidance and time sensitivity as drivers attempt to accommodate an optimum schedule; and Greene et al.[10] discuss the value that public charging infrastructure imputes to EV owners by increasing their mobility and access, partially offsetting a perceived cost penalty attributable to vehicle range and dwell time.

A Proposed Charging Inconvenience Metric

We seek to understand the technical combinations of vehicle and infrastructure characteristics that allow EVs to attain convenience parity with ICEVs apart from behavioral considerations. The objective is to develop a generally applicable method for predicting EV inconvenience which can be compared vehicle-to-vehicle and location-to-location.

Hence, a flexible metric of inconvenience is needed that can be evaluated for any vehicle. To operationalize this approach, it is necessary to shift from the notions of vehicle refueling and charging to the more comprehensive idea of vehicle "energizing." This redefinition allows for direct comparison of EVs and ICEVs traveling on the same itineraries/routes and, thus, the direct comparison of inconvenience between the two, regardless of trip length, dwell time, and location type.

In order to quantitatively evaluate inconvenience, a universal method for calculating energizing inconvenience is needed. As suggested above, inconvenience is essentially a function of time spent out-of-itinerary and money spent on energy. Because the relative importance of time and money is subjective and individualized, we propose to use the parsimonious expression in [1]:

$$S_{IC} = \beta_T T + \beta_C C, \qquad [1]$$

where is an inconvenience score, is a time multiplier, is a cost multiplier, and and are the time (minutes) added to the itinerary due to an energizing event and the actual energizing cost (dollars), respectively. Using direct comparisons can be made between vehicles with any sort of powertrain. A direct comparison in terms of S_{IC} should be made between best case scenarios for the vehicles involved in order to negate the effects of individual operator behavior. An estimate of globally optimal energizing behavior can then be generated using dynamic programming.

The optimization problem relies on the availability of known or simulated itineraries that identify the starting time (UTC code), ending time and location of each trip, total trip time and distance, and type of energizing location (home, work, or other). Using this formulation, the energizing event itself can be the primary trip purpose, or it can be embedded in sustained travel that continues after energizing is complete. Optimization also relies on technical parameters associated with specific vehicle models (standardized through simulation) to account for onboard energy storage capacity, average speed, and energy consumption under various driving conditions (city, highway, mixed). Relative to EVs, other important inputs include the likelihood of available charging ports at beginning and ending locations, port type (Level 2, DCFC), charging rapidity, and battery state-of-charge (SOC); and for IECVS, typical or average fueling time. Rabinowitz et al. provide additional details.[11]

Our approach has the following benefits: (1) it is location agnostic, (2) it leads to a single inconvenience score which does not depend on the vehicle powertrain type, and (3) by taking itinerary specifics into account, the generated results provide greater insight into EV charging inconvenience than simple geographical analysis.

Conclusion

Achieving convenience parity through public policy is difficult because there are multiple paths to consider, and the most efficient use of public funds must be ascertained. Our ultimate objective is to determine whether convenience parity can be achieved for those without access to chargers at home and whether such individuals are best served by public/destination chargers and DCFC stations. While more work is needed, results to date based on proprietary data indicate that: (1) from a time-only inconvenience perspective, parity can only realistically be achieved with home charging; and (2), in the absence of home charging, other parameters such as destination charging likelihood and in-route charging rapidity become important.

We note here the absence of publicly available data of sufficient quality and quantity on which to truly test our hypotheses, and conjecture that simulated or augmented data could be used to expand our research and knowledge. In addition, approaches other than dynamic programing, such as neural networks, could be used to develop alternative approaches for evaluating EV (in)convenience.

Footnotes

[1] Battery electric vehicles; plug-in hybrid electric vehicles.

[2] Sometimes referred to as destination charging; we make the distinction because a destination can be a convenience store a block away rather than a location several hours away.

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Freeze the Market Prices: Two National Energy Companies Alleviates World Inflation Impact on Taiwan

BY HUEI-CHU LIAO

Abstract

Beginning with the implementation of freezing the market price by two national energy companies, which did calm down Taiwan's economy, and reviewing some windfall tax literature, the author suggests that current energy liberalization systems should reconsider some mechanisms, such as freezing the market price to cope with sudden great impacts.

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Two National Energy Companies in Taiwan Freeze the market price

Compared with many people suffering with the high inflation rate due to the Russia-Ukraine war all over the world, people living in Taiwan experience a lower inflation rate since two national energy companies absorb most of the rising energy costs. Figure 1 shows the weekly unleaded gasoline price in Taiwan from Oct. 31, 2021 to Oct. 2, 2022. Obviously, this price trend is much flatter than many countries in the same period such as the price trend in USA shown in Figure 2. In order to stabilize the market price, the state-owned oil refiner, CPC Corporation, Taiwan (CPC) froze the gasoline price in some of the worst periods. Since Taiwan imports almost 100% crude oil from other countries, CPC must pay a higher crude oil international market price. In the worst period, CPC needs to absorbs cost up to NT$6 per liter (around 0.76 US dollar per gallon) to flatten the gasoline price. It is said that in the worst scenario case, CPC may lose up to NT$180 billion in 2022.

Another state-owned company (Taiwan Power Company, Taipower) also calms down the energy price by freezing electricity prices for its customers. Although the Taiwan government has implemented power market liberalization for more than 20 years, it has only liberalized the power generation sector in the past two decades, the wholesale market is liberalized only for the green power market recently. Taipower still controls the whole power market by integrating the power generation, transmission, distribution and sale markets. Except for very small shares of green power, all power users must buy power from Taipower. The total power sold by Taipower accounts for more than 99% of the power sales market in 2021. With this market domination, Taipower can easily compensate the electricity prices for all consumers by freezing the electricity price. However, the electricity price of large power users in the industrial and services sectors rise up to 15%, while in the residential sector up to 9% to cover a small share of the rising cost. Since natural gas and coal prices increase much more than crude oil prices in the world market, Taipower faces a more severe situation than CPC. Finally, The Ministry of Economic Affairs in Taiwan reached a preliminary consensus to give NT$150 billion (around 50 billion US dollar) to Taipower in the general budget of 2023.

Windfall Tax on Oil and Gas Companies

Windfall tax on oil and gas companies is a hot issue after the Russia-Ukraine war. Although many households and firms are suffering from the high energy cost, some giant oil and gas companies are earning huge profits. IMF (2022) pointed out that the return of equity (percent) of some companies in 2022 are even up to 55% (Enquire), 45% (Conoco) and 44% (Saudi Aramco). In order to rebalance the economy, many

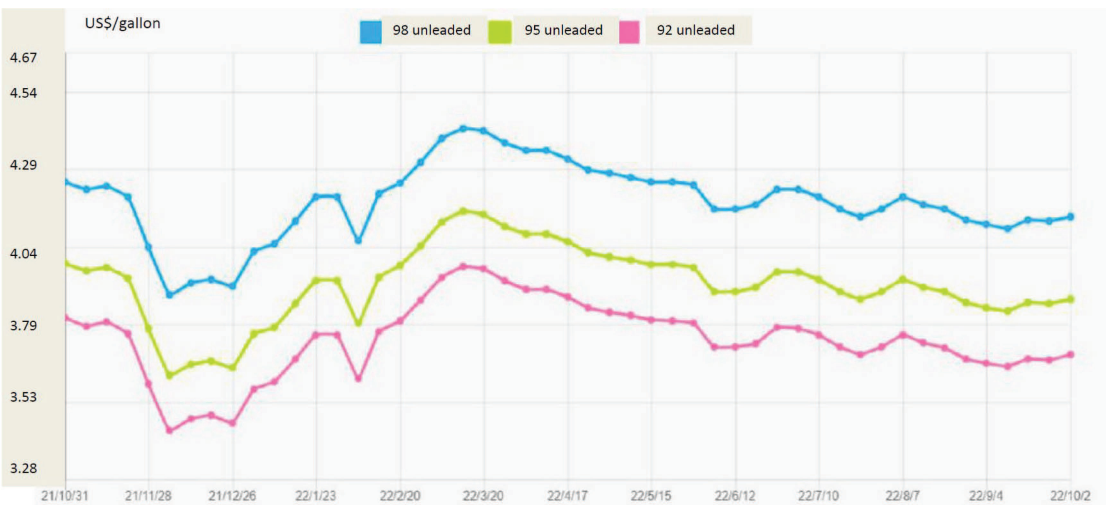

Figure 1: Weekly Unleaded Gasoline Price in Taiwan (Oct. 31, 2021 to Oct. 2, 2022)

Data Sources: https://www2.moeaboe.gov.tw/oil102/oil2017/A03/A0302/sys28.asp

Note: The author redraws the figure by changing the unit from NT$/liter to US$/gallon assuming the exchange rate is 1US dollar equals to NT$30 dollar.

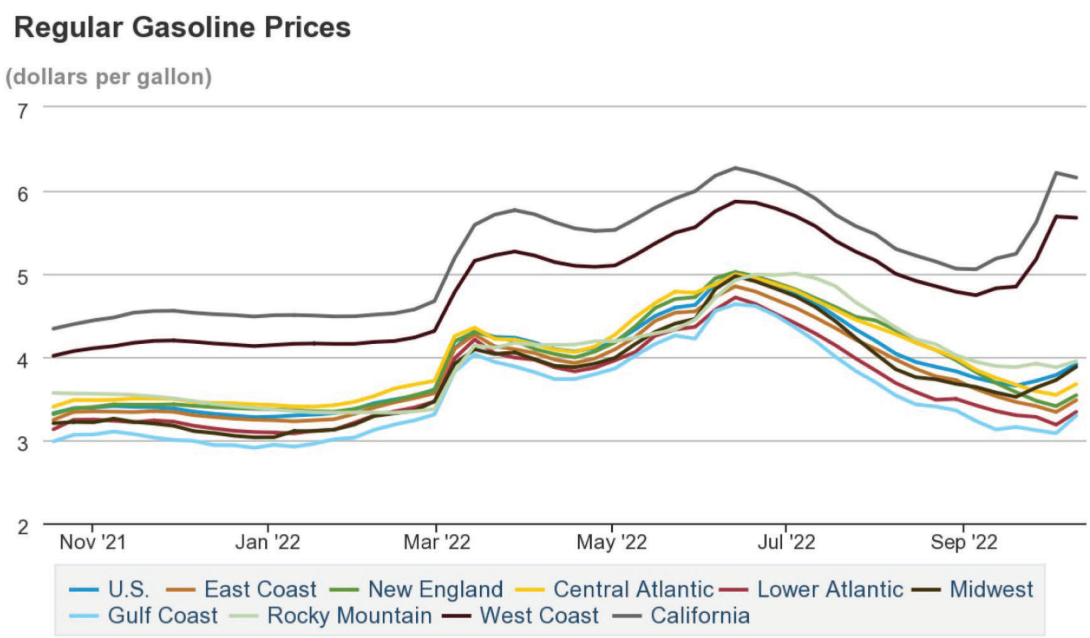

Figure 2: Regular Gasoline Price in USA

Data Sources: https://www.eia.gov/petroleum/gasdiesel/

countries implement a temporary windfall tax, which ranges from 25% (i.e. UK) to 90% (i.e. Greece). The Governments hope to collect more tax from high profit companies and then redistribute to vulnerable energy users. Since the windfall tax may incur some negative side effects, the European Commission has issued guidance for helping better design of temporary windfall profits tax. IMF (2022) also addressed several recommended guidelines such as a permanent tax from fossil fuel extraction, reducing investor risk, switching to renewable energy, and the clear measure of excess profit for implementing the windfall tax.

Freezing the Market Price May Be Another Good Option

The levy of windfall tax aims to alleviate the rising energy cost pressure for the public. However, a poorly-designed tax may discourage energy investment and bring more harm to the public. Rather than focusing on the windfall tax, this author suggests that freezing the market price may be another good option. From the implement cost view, the levy of windfall tax costs more, while, from the experience in Taiwan, freezing the market price has the lowest administration costs, less uncertainty (e.g. freezing price as price up to a certain level), can be implemented quickly, is more flexible (e.g. freezing the price for the poor household) and definitely a temporary policy. If all the government, energy investors, and the public have consensus for helping vulnerable energy users in the worst crisis period, then we just freeze the market price in the worst period. Once the crisis has passed, the economy system just goes back to the normal track, the government will have sufficient money to pay back compensating firms' loss due to the freezing policy.

Since the climate change issue is getting worse, and the world financial market is becoming more volatile, the scenarios of market failure resulting from sudden and great impacts should come out more frequently. The liberalization market system would be more difficult to operate. Freezing the market price temporary may be a good option to handle the unexpected giant shocks.

Reference

EIA, 2022, Gasoline and Diesel Fuel Update, October 11, 2022

Formosa News, https://english.ftvnews.com.tw/news/2022727W03EA,2022

IMF,2022, Taxing Windfall Profits in the Energy Sector, IMF Notes, August 30, 2022.

Calendar

08-09 November 2022, Reuters Events: Floating Wind USA 2022 at Hotel Kabuki, 1625 Post Street, San Francisco, California, 94115, United States. Contact: Email: diana.dropol@thomsonreuters.com URL: https://go.evvnt.com/1193631-0?pid=204

09-10 November 2022, Reuters Events: Energy Transition North America 2022 at TBC, Houston, TX, United States. Contact: Email: owen.rolt@thomsonreuters.com URL: https://go.evvnt.com/1093186-0?pid=204

15-17 November 2022, SPE Annual Caspian Technical Conference | 15-17 November 2022, Nur-Sultan, Kazakhstan at TBC, Nur-Sultan, Kazakhstan. Contact: Email: kdunn@spe.org URL: https://go.evvnt.com/1181983-0?pid=204

15-16 November 2022, Reuters Events: Energy Transition Europe 2022 at Leonardo Royal at Tower Bridge, 45 Prescot St, London, England, E1 8GP, United Kingdom. Contact: Email: luke.brett2@thomsonreuters.com URL: http://go.evvnt.com/1239858-0?pid=204

21-23 November 2022, Electric Vehicles & the Grid (Live Online Course) at Singapore. Contact: Phone: +65 6325 0210, Email: emilia@infocusevent.com URL: https://www.infocusinternational.com/ev

21-22 November 2022, Future of Utilities Summit 2022 | 21-22 November | Business Design Centre, London at Business Design Centre, 52 Upper St, London, N1 0QH, United Kingdom. Contact: Email: sfox@marketforcelive.com URL: http://go.evvnt.com/1238097-0?pid=204

28-29 November 2022, Utility Scale Solar And Wind Europe 2022 at Hilton Munich Park, 7 Am Tucherpark, München, Bayern, 80538, Germany. Contact: Email: Leonel.Lamreis@thomsonreuters.com URL: https://go.evvnt.com/1267666-0?pid=204

28-30 November 2022, Argus Clean Ammonia Europe Conference, Hamburg, Germany And Online Access at Hotel Atlantic Hamburg, Autograph Collection, 72-79 An der Alster, Hamburg, 20099, Germany. Contact: Email: teri.arri@argusmedia.com URL: https://go.evvnt.com/1285877-0?pid=204

28-29 November 2022, World Energy Capital Assembly 2022 at TBC, London, England, United Kingdom. Contact: Email: matt.maginnis@energycouncil.com URL: http://go.evvnt.com/1272087-0?pid=204

November 30 - December 01 2022, Reuters Events: Energy Transition Asia Pacific 2022 at Virtual Event, Singapore. Contact: Email: katie.silver@thomsonreuters.com URL: https://go.evvnt.com/1263934-0?pid=204

05-06 December 2022, Energy from Waste Conference 2022 at Copthorne Tara Hotel London Kensington, Scarsdale Pl, London, England, W8 5SY, United Kingdom. Contact: Phone: +44 (0) 20 7827 6164, Email: olefter@smi-online.co.uk URL: http://go.evvnt.com/1207657-0?pid=204

12-15 December 2022, Energy Storage (Live Online Course) at Singapore. Contact: Phone: +65 6325 0210, Email: emilia@infocusevent.com URL: https://www.infocusinternational.com/energystorage-online

17-20 January 2023, Carbon Capture, Utilisation and Storage (CCUS) - Live Online Course at Singapore. Contact: Phone: +65 6325 0210, Email: emilia@infocusevent.com URL: https://www.infocusinternational.com/ccus

05-08 February 2023, 44th IAEE International Conference: Energy Market Transformation in a Globalized World at Riyadh, Saudi Arabia. Contact: Email: moneefma@gmail.com URL: www.iaee.org

07-09 March 2023, SPE / IADC International Drilling Conference & Exhibition | 7-9 March 2023, Stavanger Forum, Norway at Stavanger Forum, 13 Gunnar Warebergs gate, Stavanger, Rogaland, 4021, Norway. Contact: Email: kdunn@spe.org URL: https://go.evvnt.com/1180445-0?pid=204

15-16 March 2023, Energy From Waste 2023 at The Gloucester Hotel, 4-18 Harrington Gardens, London, England, SW7 4LH, United Kingdom. Contact: Email: karen.duncan@markallengroup.com URL: https://go.evvnt.com/1222000-2?pid=204

02-02 July 2023, XI INTERNATIONAL ACADEMIC SYMPOSIUM: Green investments for the energy transition at Barcelona. Contact: Email: ieb.simposium@ub.edu URL: https://ieb.ub.edu/ca/event/xi-international-academic-symposium-green-investments-for-the-energy-transition/

23-26 June 2024, 45th IAEE International Conference, Overcoming the Energy Challenge at Izmir, Turkey. Contact: Phone: 216-464-5365, Email: iaee@iaee.org URL: www.iaee.org

International Association for
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IAEE/Affiliate Master Calendar of Events

(Note: IAEE Cornerstone Conferences are in boxes)

Date	Event and Event Title	Location	Supporting Organizations(s)	Contact
2022				
October 24-26	39th USAEE/IAEE North American Conference *Theme TBD*	Houston, Texas	USAEE/IAEE	Doug Conrad usaee@usaee.org
November 20–22	8th Latin American Energy Economics Conference	Bogota, Colombia.	ALADEE	Gerardo Rabinovich grenerg@gmail.com
2023				
February 4-9	44th IAEE International Conference *Pathways to a Clean, Stable and Sustainable Energy Future.*	Riyadh, Saudi Arabia	SAEE/IAEE	Majid Al-Moneef moneefma@gmail.com
July 17-20	18th IAEE European Conference *The Global Energy Transition: Toward Decarbonization*	Milan, Italy	AIEE/IAEE	G. Battista Zorzoli https://www.aiee.it/
October 22-25	40th USAEE/IAEE North American Conference *Theme TBD*	Chicago, Illinois	USAEE/IAEE	Doug Conrad usaee@usaee.org
2024				
June 23-26	45th IAEE International Conference *Overcoming the Energy Challenge*	Istanbul, Turkey	TRAEE/IAEE	Gurkan Kumbaroglu http://www.traee.org/
2025				
June 22-26	46th IAEE International Conference *Title TBA*	Paris, France	FAEE/IAEE	Christophe Bonnery https://www.faee.fr
2026				
May-June	47th IAEE International Conference *Forces of Change in Energy: Evolution, Disruption or Stability*	New Orleans	USAEE	Peter Balash www.usaee.org
Sept 6-9	19th IAEE European Conference *Energy Security, Sustainability and Affordability: Does Regulation or Liberalization Pave the Way?*	Munich, Germany	GEE	Aaron Praktiknjo apraktiknjo@eonerc.rwth-aachen.de
2027				
August 15-18	48th IAEE International Conference *Reshaping Energy for the Future*	Hong Kong	City Univ. of HK	Lin Zhang l.zhang@cityu.edu.hk
2028				
March 14-18	49th IAEE International Conference *Energy Security and the Energy Transition*	Abu Dhabi	UAEE	Steve Griffiths steven.griffiths@ku.ac.ae

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