Energy Efficiency Policy Workshop on PREE 12: Electrification and Energy Efficiency

APEC Energy Working Group

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Asia-Pacific
Economic Cooperation

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Table of Contents

Workshop Objectives

The 61st Meeting of the APEC Expert Group on Energy Efficiency & Conservation (EGEEC 61) and Associated 7th Energy Efficiency Policy (EEP) Workshop on 16-19 October 2023 was hosted by the Philippines in-person. This meeting brought together APEC member economies and international experts to exchange energy efficiency and conservation policy and actions towards the APEC aspirational target of reducing aggregate energy intensity by 45 percent from 2005 levels by 2035.

Photo: Some of the participants at the 7th Energy Efficiency Policy (EEP) Workshop:

The workshop is a full day event to provide a capacity building opportunity regarding electrification and energy efficiency in designing the effective policies and programs alongside electrification, demand flexibility and energy efficiency. It will include economy's practical trends in energy efficiency, electrification, and best practices to simulate energy efficiency market through presentations and discussions from prominent experts in energy efficiency.

Opening Remarks

To open the APEC Workshop, Mr Munehisa Yamashiro, the Vice President of APERC, delivered opening remarks. Mr Yamashiro first thanked government of the Philippines to host this workshop, and additionally thanked the Global America Business Institute (GABI) for their efforts in preparing this workshop as well as the participants from member economy for traveling overseas to join this international conference. Finally, Mr Yamashiro gave thanks to EGEEC and the APEC Secretariat.

For the first time in four years, the APEC workshop was held in-person, and this year, the focus of the theme is electrification and energy efficiency. The Vice President mentioned that electrification is a basic trend in the current energy transition, therefore, it is important to improve energy efficiency related to electrification not only for decarbonization, but also energy security. Because of this trend, this workshop was organized into two parts. The first part focuses on energy efficiency in the power sector, and the second part will discuss electrification and energy efficiency in energy end use sectors. The hope of this workshop is to allow for the opportunity for APEC members to develop good energy efficiency policies related to electrification.

Afterwards, the moderator of the conference, Ms Florence Lowe-Lee, President and Founder of the Global America Business Institute (GABI) introduced herself, her organization, and expressed her gratitude to the organizers for putting together the program. GABI is a policy focused clean energy organization in Washington with a wide audience of policymakers, industry, academia, and more. She mentioned that energy efficiency is one of the most promising opportunities for meeting climate change goals, and that in the US, approximately 60% of the power is lost from producers to consumers, and up to 30% of the remaining energy is lost from end users using equipment of low efficiency. Focusing on delivering energy efficiency solutions should be the focus of the coming presentations.

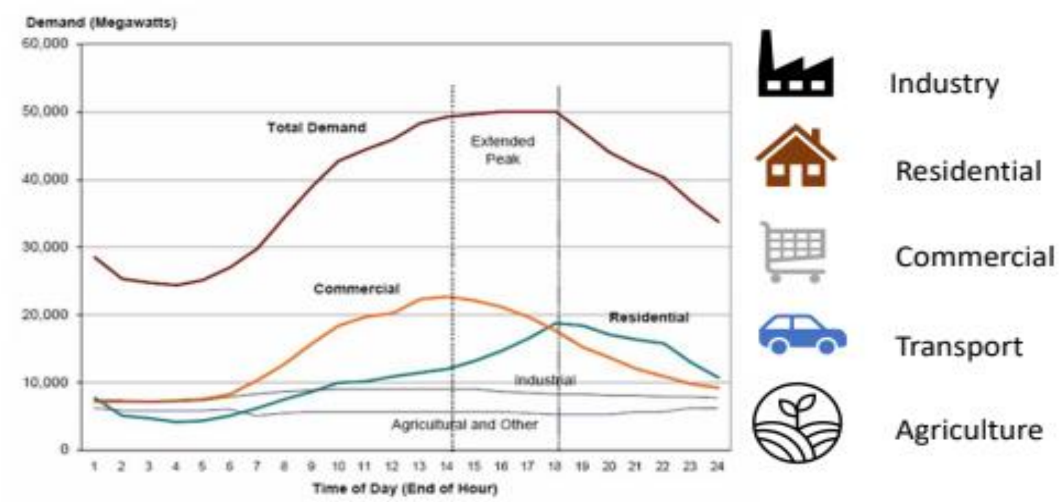
Session 1. Improving Energy Efficiency in the Power Sector

Panel Presentation #1 – Challenges for the power sector to meet growing electricity demand with an increased share of renewable generation

Alexander Izhbuldin, *Senior Researcher, Asia Pacific Energy Research Center (APERC)*

The first presentation was presented by Alexander Ezhbuldin, who is a Senior Researcher at the Asia Pacific Energy Research Center (APERC). His presentation focused on challenges for the power sector to meet growing electricity demand with an increased share of renewable generation. The presenter hopes that this presentation can serve as an overview of what has happened in the power sector in the last two decades with predictions on what will come in the next 2-3 decades.

There are three main parts of the typical power system, which includes the power plant, the transmission line, and the distribution line which connects the power to the consumer. The chart below shows the daily load profile for electricity in a typical power system.



The upper load correlates with total demand, and the various colors refer to different energy demands. The important point is that the building sector demand is the cause for fluctuating demand. There are peak hours in the afternoon and minimum demand during the evening. Electricity cannot be stored at grid scale, so it must be generated at the same time that it is consumed. Thus, the power sector should follow electricity demand with some margin of safety.

There are three main global events that will be mentioned that have affected the global power sector system greatly. The first case is Japan. On 22 March 2022, TEPCO faced a supply and demand crunch. The graph of the Solar PV output during the days of March demonstrated that the high and the low peaks had a difference of up to 12GW. In addition, earthquakes caused shut down of some power plants. With the demand increasing due to cold weather, there was a significant delta in generation capacity and demand. During this time, TEPCO had to utilize all stored pumped hydro resources and requested that citizens reduce their energy demand.

The second case is in the United States. On 6 September 2023, ERCOT declared an Energy Emergency Alert 2. The cooling demand from extreme heat combined with thermal outages and low solar and wind output forced the state's grid operator into emergency operating conditions. The extreme heat conditions led to a peak demand record of 82,705MW, when the 2nd highest demand was recorded at 72,370MW, which is almost 10GW lower. The ERCOT CEO was cited saying that high demand, lower wind generation and the declining solar generation during sunset led to lower operating reserves on the grid and eventually contributed to lower frequency, which precipitated the emergency level 2 declaration.

The third case is in Australia. On 20 September 2023, the National Energy Market in Australia hit 69% renewable generation. Three days after, an article was published on rooftop solar cannibalizing power prices as Australian generators pay to stay online. Wholesale power prices are increasingly turning negative at times of high solar output, and this will make future energy projects much more difficult to pursue due to cost reasons. This cannibalization of solar projects has happened and has been documented around the world, particularly in Spain.

Graphs of electricity generation and installed capacity in the world in 2000-2022 show the trends of how capacity and generation grew over time. In this time, electricity generation almost doubled. Generation from wind and solar increased by 23%. The capacity increase shows an increase of 163%, with wind and solar capacity increasing by 63%. In another chart of world capacity factor by technology, the capacity factor of solar and wind shows that it is much less than other energy technologies. However, it should be noted that only wind and solar gained an increase in capacity factor over time at the cost of all other technologies resulting in a decline in capacity factor as a result of rapid and massive renewable energy deployment. The average capacity factor declined from 56% in 2000 to 40% in 2022, which shows that increased deployment of renewable energy can lead to shortage of generation capacity and balancing power.

The presenter offered some observations both from a technical and market point of view. From a technical point of view, the combination of factors and their overlap over time results in a supply constraint. The need for heating or cooling buildings at times when outside temperatures are significantly different from the average for a given time results in increased demand for electricity. If the time of high demand coincides with weather conditions that limit renewable generation such as cloud cover, sunset time, or low winds, this leads to the need to impose consumption restrictions. From a market point of view, there seems to be a cannibalization effect where the increasing penetration of solar and wind reduces their own unit revenues and the cannibalization effect seems stronger at higher penetration levels. Negative prices reduce attractiveness of new projects and increase overall cost. Reduced capacity factors for conventional generators can cause them to stop operating.

In the APEC Energy Demand and Supply Outlook, there are two referenced scenarios, reference and carbon neutrality, where electricity demand will increase by 46% and 63% respectively. The two main aspects of this to pay attention to are "Transport" and "Buildings". Both sectors will be the main contributors to the increasing electricity consumption, and they are both responsible for fluctuations in demand during the day.

Graphs of electricity generation and GDP growth show that the growth of electricity consumption in advanced and developing economies has been different. Electricity consumption growth in developing economies was comparable to GDP growth, while in advanced economies, GDP grew faster than electricity consumption. GDP assumptions suggest that GDP will continue to grow at a comparable rate through 2050, but electricity consumption is likely to grow faster than GDP even in advanced economies. This may make it more difficult to replace thermal generation with renewable energy sources and meet the growing demand for electricity at the same time. The expansion of electric vehicles fleets will be a significant factor for these predictions.

Panel Presentation #2 – The role of energy efficiency in transition to cleaner energy: a developing economy perspective

Majah-Leah V. Ravago, *Associate Professor, Department of Economics, Ateneo de Manila University Loyola Heights Campus*

The second presenter was Dr. Maja-Leah Ravago, from Ataneo De Manila University, and she was representative of the Philippines on the panel. This presentation was focused on the role of energy efficiency in transition to cleaner energy with a perspective from a developing economy.

Dr. Ravago defines the energy transition, or decarbonization, as a shift from fossil-based fuels, such as oil, natural gas, and coal to renewable energy sources like wind, solar, and biomass. In the energy transition, developed economies typically take leadership positions regarding climate mitigation, while developing economies prioritize increasing living standards.

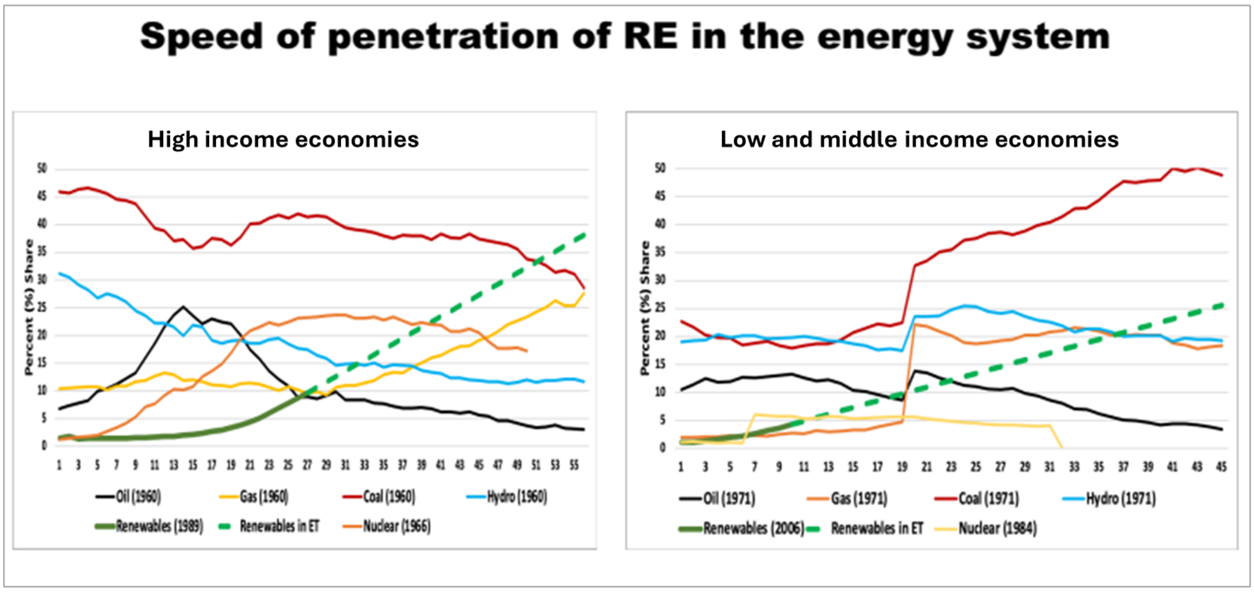
A transition to cleaner energy implies transition to "electricity only" resources. Fossil fuels, when burned releases heat, which can be converted into mechanical energy and further into electricity. However, this comes with the externality of creating emissions through the burning of fossil fuels. "Electricity only" resources such as solar, wind, biomass, tidal and wave power, and hydropower will replace these fossil fuels. Electricity is at the center of this transition, and electricity will become the main format for delivering energy services.

Electrification will change the way we consume electricity. Consumption sectors that will be most transformed will be transport, buildings, commercial, and industrial processes. Transportation is likely to receive the largest electrification shift. Electrification will also change daily consumption patterns by shifting the peak demand. EVs being charged at home may shift the peak demand closer to midnight.

Energy efficiency can play a significant role, and there are many different definitions to energy efficiency such as engineering definitions and UN Sustainable Goals definition. Typically energy efficiency is also referred to as energy intensity. The most common definition is the concept put forward by the UN, where energy efficiency is the amount of energy used per unit of wealth created. However, another way of looking at energy efficiency is the absence of waste.

As the economy becomes more and more electrified and powered by renewables, the system warrants more energy-efficient solutions towards energy transition. Once electrification is underway, its essential to maximize energy efficiency in all sectors where electricity is used. The changing behavior of electricity consumption may require new technologies such as smart meters and energy efficient appliances.

In the energy transition, there are likely to be phased approaches. The first phase is the accelerated deployment of renewable power. The second phase is increasing flexibility by storage and backup solutions, and the third phase is sector coupling. In all stages, studies are further needed to determine the optimal nature of stages and timing.



The speed of penetration of renewables is different in developed versus developing economies. The graphs of developing economies show a lower slope of increasing renewable penetration. In order for developing economies to catch up to developed economies, there needs to be a scaling up of renewables in the energy mix, transforming the power sector infrastructure, and promoting energy efficiency. At the same time, developing economies must meet the increasing energy demand while keeping energy affordable and accessible to the rest of the population.

The case of the energy transition in the Philippines shows the case of developing economies' road to decarbonization. Currently, the Philippines aspires to have 35% of renewable energy in the fuel mix by 2030 and 50% by 2040. As of 2021, there is still a relatively low share of renewables, only making up less than 3% of the mix. In the context of the entire economy, a significant portion of the power generation mix still comprises coal. In Luzon, RE makes up 17% with most of this portion being composed of hydro energy. In Visayas, RE composes 42% of the mix with the majority being geothermal energy. This region does have small amounts of wind and solar. In Mindanao, 31% of the energy mix is RE, with most coming from hydro. Wind and solar are also a very small portion of Mindanao; hydro energy is decreasing in Mindanao, with coal making up the difference.

In the case of the Philippines, RE penetration is quite slow because VREs are cheap. The LCOE in lazard for utility scale solar is about 2.4-9.6 cents/kWh, while retail prices are about 20 cents/kWh. Investors may prefer to wait for subsidies rather than going on their own, but subsidies can potentially limit the pool of investors. For the Philippines to expand RE, there is a need to transform the power sector infrastructure and bottlenecks in transmission need to be addressed. However, new transmission projects still need to pass the cost-benefit test. The Philippines has "priority dispatch" policy for renewables, but the grid is not fully connected. Luzon and Visayas are presently connected with a 230kV high voltage direct current link that allows exchange for up to 440MW.

There is a need to ease regulatory burdens. Permitting and other lags for both generation and transmission need to be addressed. Generation plants need at least 104 permits and take as long as 1.5 years before construction starts. However, in 2018 and 2019 legislation was passed to offer promising ways forward, but implementation and operations needs to be expedited.

Structural changes in the energy sector must be mainstreamed with development. Achieving universal energy access is a fundamental goal. Some Filipinos still have limited access to reliable energy, and affordable energy has eluded the economy for decades. Electricity prices are high by regional standards. The Philippines has a similar electricity price to Singapore despite the large difference in GDP.

Renewable Energy (RE) sources, such as decentralized solar power and microgrids, can play a crucial role in reaching remote and underserved communities. However, there must be a commitment to economic principles of efficient transition to clean energy. The efficient (least social cost) energy transition should take into account the declining costs of wind and solar power and the low costs of managing intermittency. Taxes should reflect the marginal damage costs of pollution, especially from generation with coal. Coal and petroleum excise taxes are part of the 2017 tax reform. Pollution taxes can harmonize the quest for renewability with affordability and other objectives of the EPRIA. The social cost of pollution includes both the domestic cost from carbon emissions and the costs of local pollutants (SO2, nitrous oxides, and particulate matter) that impinge on health.

The per capita consumption of electricity is relatively low in the Philippines compared to its neighbors. This is likely due to inefficient high prices as well as reliability problems, especially for industry and services that either suffer losses or buy their own generator, both slowing the productive investment. Increasing the per capita consumption in developing economies should be a focus of energy transitions.

The Philippines has engaged in a number of energy legislations including electric vehicle mandates and energy management programs to manage the clean energy transition. The Philippines conducted a survey in 2019 and 2022 to investigate what influences people to buy AC, and results showed that showing the energy star rating can increase energy efficient AC deployment by 15%.

Energy efficiency in developing economies should be balanced by low energy consumption. In developed economies, there is a concern about the rebound effect which is increased energy usage because consumer efficiency measures can reduce energy costs. In developing economies, energy efficiency policies are not necessarily aimed at reducing energy consumption. Instead, there is more focus on achieving greater efficiency such as reducing the amount of energy required for one unit of service output. When energy consumption remains constant after applying energy efficiency measures, the energy savings enable consumers to expand energy services, thereby increasing welfare.

Panel Presentation #3 – Energy efficiency technologies for the power sector

Iqlima Fuqoha, *Energy Transition Specialist, Sustainable Energy for All*

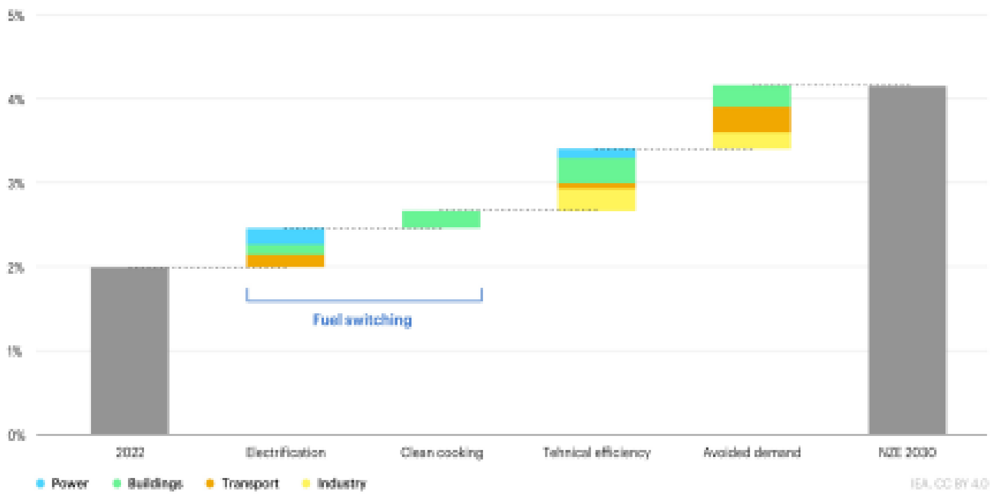
The third presenter on the panel was Iqlima Fuqoha, who introduced herself as an energy transition specialist at Sustainable Energy for All (SEforALL). This presentation was focused on introducing SEforALL as well as discussing the role of energy efficiency in the energy transition. Finally, the speaker introduced the Mission Efficiency concept and partner initiatives.

SEforALL is an organization that is based in US East Coast (DC and NY) as well as Vienna. The organization supports economies to achieve Sustainable Development Goals 7 and 13. SEforALL's energy transition readiness support for developing economies includes three main action categories: economy engagement, net zero emissions pathways for long-term energy planning and policies, and supporting implementation of energy transition. Under economy engagement, activities include global engagement & advocacy, domestic stakeholder dialogues, and just transition engagement. Under net-zero emission pathways for long-term energy planning and policies, activities include modern energy minimum access, demand side management, supply side management, cost abatement and removal of emissions, and macroeconomic cost-benefits. Supporting implementation of energy transition activities include institutional & policy ecosystem support, investment strategy and engagement support, and innovation loop-based implementation framework support.

Energy efficiency is one of the most cost-effective solutions to achieving NZE. Energy efficiency can be done today, and energy efficiency policy and technology solutions are available. Energy efficiency brings social, economic, and health benefits. Energy efficiency is expected to deliver over 40% of the Paris Agreement as predicted by IEA, and energy efficiency investment brings local jobs and local benefits.

Energy efficiency is one of the key levers in reducing energy intensity. Achieving the rate of energy intensity reduction by leveraging fuel switching to electricity, renewables, or modern cooking services; improvements in technical efficiency; and more efficient use of materials and energy including through behavioral change. Improving the rate of energy intensity makes a critical contribution to emission reduction while also bolstering energy affordability and security. Both decarbonizing and implementing energy efficiency measures in the power sector are important to improve the rate of energy intensity.

Average annual rate of total energy intensity reduction by lever



Source: IEA (2023) Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach

Securing electricity supplies becomes more important in the NZE scenario. Reducing inefficiencies in electricity transmission and distribution can significantly lower carbon emissions. In 2021, 1972 billion kWh were lost in transmission, or 7.2% of total generation. These losses compared with electricity generated can be very important in some economies, jeopardizing social and economic development. Potential solutions include upgrading transformers, and power lines, optimizing reactive power profiles, investing in smart grids to manage load peaks, integrating renewables, promoting electric vehicle adoption, and improving overall energy efficiency.

Reducing losses is needed to increase the efficiency of the grid system. Grid losses include technical losses from fixed and variable losses, and non-technical or commercial losses from meter error or theft and illegal connection. There are some proven methods for reducing losses including organizational strategy, technical methods, and data management.

Demand response can enhance grid resilience and reliability. Demand response (DR) refers to specific and immediate actions taken by consumers, facilities, or utilities by shifting or reducing electricity consumption to keep the power grid stable during critical periods. Demand side management (DSM) is a broader and long-term approach that encompasses a range of initiatives and strategies including activities like energy efficiency programs, load management, consumer education, and the adoption of energy-saving technologies. DR application in buildings include shiftable and sheddable loads.

Power system flexibility is the ability of a power system to manage the variability and uncertainty of demand and supply reliably and cost-effectively across all relevant timescales. Demand flexibility is a practice in adjusting load to match the electricity supply. Power flexibility derived from demand response and other sources enables the grid to adapt to sudden changes in demand or supply, ensuring a consistent and reliable electricity supply.

Energy efficiency technology can also provide benefits in a power plant through cogeneration. Efficiency can be increased by 80-90% using cogeneration versus separate power generation. Capital investments range from USD600 to USD720 per kW, and potential savings due to the improved efficiency range from 30%-50%.

Mission Efficiency is a global collective of actions, commitments, and goals on energy efficiency by a coalition of governments, organizations, and initiatives. Energy efficiency represents the largest share of cost-effective actions to achieve the Paris Agreement. Mission Efficiency unites these partners and actions to accelerate the transition towards energy efficient economies worldwide.

Mission Efficiency hopes to drive progress on energy efficiency through three main missions. The first mission is to elevate energy efficiency in personal, organizational, and global agendas. The second mission is to support energy efficiency with strategic and technical assistance by partners for progress in economies on key issues in high impact sectors, across multiple sectors or economy wide. The third mission is to invest in energy efficiency with coordinated and actionable project funding through loans, grants, and incentives for infrastructure and projects by economies, funds and financial institutions.

The outcomes of the Energy Efficiency Financing Charette included the creation of four taskforces to work together in supporting market readiness for energy efficiency investments. These four task forces are energy efficiency narrative task force, widening the net taskforce, solutions selector tool taskforce, and mission efficiency marketplace taskforce.

One of Mission Efficiency's partner initiatives is Grid Efficiency and Resilience (GEAR). GEAR exists to improve electricity grid efficiency and resilience in emerging markets. The mission is to maximize the amount of electricity delivered to households and businesses in emerging markets, thereby accelerating socioeconomic development and reducing GHG emissions. Focus areas include providing policy support to improve the energy efficiency of products, increasing the uptake of energy efficient distribution transformers and interconnection of distributed renewables and the grid, derisk and match energy efficiency projects with appropriate investment and technology, and enhance capacity to improve grid maintenance.
Another partner initiative is Cornerstone of Rural Electrification (CORE). CORE provides technical training and certification on aspects related to increasing safety, efficiency, and reliability of DRE systems.The mission is to enable resilient rural and peri-urban communities by ensuring safety, efficiency, reliability and sustainability become the cornerstone of decentralized electrification.

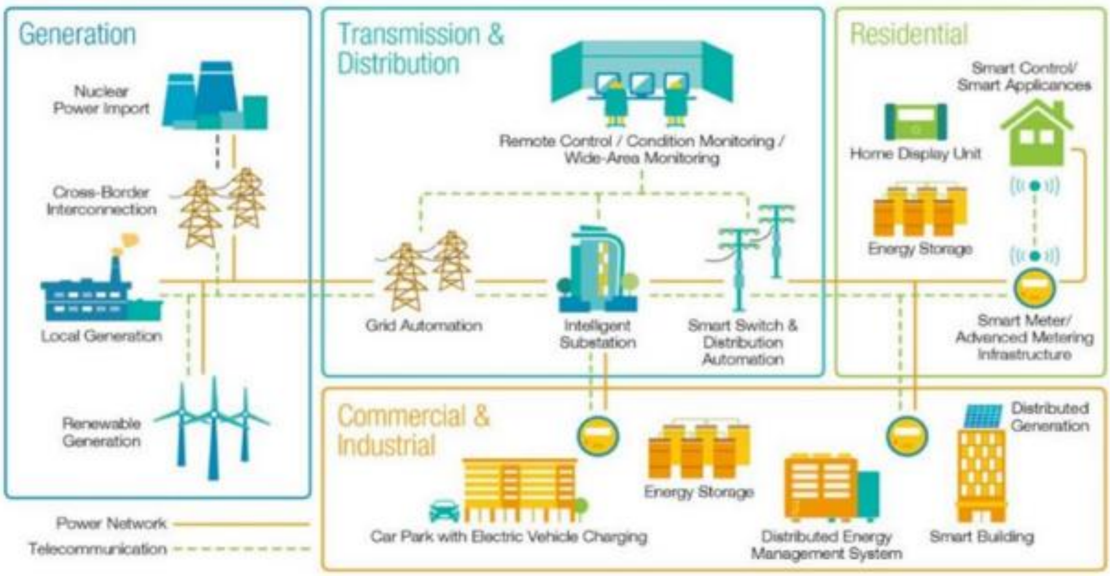
Panel Presentation #4 - Distribution automation of power grids for energy efficiency

Yoon-Hee Ha, *Director of BK 21 Program and Professor, Graduate School of Energy and Environment, Korea University*

The next speaker was Dr. Yoonhee Ha, who is a Professor at Korea University and the Vice President of Energy and Industry Transition Sub-Commission, Presidential commission on Carbon Neutrality and Green Growth. This presentation will be structured into two parts. First the focus will be on improvements in power systems due to digitalization, and then the presentation will transition into Korea's progress and activities in this area.

A smart grid is an advanced electrical grid infrastructure. This technology uses sophisticated information and communication technologies, and it can enable the improvement of reliability, efficiency, and sustainability of electricity production, distribution, and consumption. Smart grids involve integrating digital technology into the existing electrical network to enable real-time monitoring, coordination, and operation of various connected components throughout the power network, from generation to consumption.

The figure below shows a potential distribution of technologies within a smart grid system.



Source: CLP[9], Power Transmission and Distribution in the Smart Grid

There are four key components of the smart grid: power grid, infrastructure, data, and market and institution. The power grid is an advanced IT based power grid equipped with a real-time monitoring system, automated control and management systems, and an integrated control system for renewable energy, among other features. The infrastructure refers to core infrastructure components of the smart grid including advanced metering infrastructure, vehicle to grid technology, energy management systems, and phasor measurement units. Data includes real-time data exchange and analysis among suppliers, consumers, intermediaries, and market operators to enhance energy efficiency. Market and institution refer to real-time pricing and emerging electricity service markets utilize two-way communication and consolidated power data. There are a number of benefits of the smart grid including enhanced energy efficiency, greenhouse gas emissions reduction, operational efficiency for utilities, improved reliability and resilience, integration of DERS, enhanced grid security, and consumer empowerment.

Digitalization can have significant impacts on the electricity sector assets. Data and analytics can allow for predictive maintenance and operational changes that can lead to reduced O&M

costs, improved efficiencies, reduction of unplanned outages, extended lifetime assets, reduced investment needs, reduced fuel consumption and costs, reduced CO2 emissions, improved system stability, and reduced investment needs. These benefits can range from financial benefits for the asset owner, system benefits, consumer benefits, and global environmental benefits.

Potential worldwide cost savings from enhanced digitalization in power plants and electricity networks include lower O&M costs, efficiency cost savings, and lifetime extension savings. Cumulative savings from the widespread use of digital data and analytics in power plants and electricity networks could average around USD80 billion per year.

Studies on the future of potential energy consumption and carbon emission reductions from Smart Grid deployment in 2030 show that there are four main areas that can provide significant reductions. Total reductions can amount to 12% when EVs are included for additional support. In Korea, comprehensive studies have shown that there are significant energy savings through the application of smart grids.

Korea has developed a Smart Grid Roadmap. Korea's smart grid master plans are composed of three phases, where phase 3 begins in 2023-2027. Under the law governing the development and promotion of smart grids, Korea formulates a master plan every five years and has consistently advanced the development of its smart grid infrastructure based on these plans.

Action plan 1 includes empowering small scale demand resources. Achievements include the introduction of the Electricity Brokerage Market, the launch of the National DR Market, pilot time-of-use tariff in Jeju, and strengthened consumer choices in the power market. Limitations exist: various new services have been introduced, but due to insufficient benefits for customers and business, voluntary participation and full-scale proliferation are lacking.

Action plan 2 includes the creation of a smart grid experience zone. Korea has invested USD223 million from 2018-2022 for grid demonstration projects. Smart Grid Infrastructure Deployment has begun with AMI, solar panels, ESS, EV Chargers in Seoul and Gwangju. Through implementation of four programs, a 4.3% reduction compared to previous levels was achieved. However, under the current laws and electricity sales systems, it is difficult to implement various demonstration cases, and there is a lack of consideration for various types of consumers.

Action plan 3 includes enhancing infrastructure and facilities. Achievements include establishing an integrated renewable energy control system, development of xGrid, achieved 157 digital substations of 154kV by 2021, expansion of renewable and ESS with DC power facilities, and demonstrated DC distribution technology. There were challenges in AMI deployment, and installation was limited to 52% of KEPCO customers.

There are grid operation evolutions necessitating smart grid expansion. The first is electrification for carbon neutrality including heating, transportation, and more. Another evolution is the shifting from centralized to decentralized energy systems, which can cause increased grid disruptions. A third evolution is enhancing smart grid roles with distributed energy expansion.

Under the third phase of Korea's smart grid master plan, the goal will be to achieve an 18.6% share of distributed power sources in 2027. Efforts will include developing an intelligent grid system for maximizing energy efficiency, enhancing market and system flexibility for better distributed energy integration, and bolstering the industrial foundation for smart grid activation.

Session 1. Questions and Answers

Q: *Can you please talk a little more about the challenges of meeting growing power demand with increasing renewable energy penetration?*
Alexander Izhbuldin: I would start from the bird eye view level and remember that the chart with generation mix for the US. If you need to provide the same demand for electricity, you can add some technologies and change some technologies. If you are a developing economy with a constantly growing electricity demand, you have less opportunity to make those changes to the electricity mix. It means that in the future, if you expect demand will grow for developed economies, it will be challenging to electrify while meeting energy demand. There are challenges with intermittent and integrating renewables. When you try to displace conventional generation technology with higher capacity factor, for example with solar, if you want to displace 1GW of coal with solar if there is a 20% capacity factor for solar. You will need 3GW of solar to replace 1GW of coal. Coal is also a dispatchable source so you can control the generation level while solar requires battery or energy storage to reach the same capability.

Q: *You talked about the Philippines' case and its energy transition. Can you elaborate more on where the Philippines is in its energy transition and the significance of renewable energy?*
Majah-Leah Ravago: Right now, we are still very low on RE penetration, with most from geothermal or hydro. Solar or wind only takes up ~3%, but we appreciate more penetration. We need to find investments in further solar and wind, and we expect to see more investment. Because of the capacity factor of renewables, we cannot optimize these technologies. Additionally, while the availability of renewable resources is high in one area, the demand might be in another area. Thus, transmission challenges are another issue. In some areas, renewable energy from various sources is competing with each other.

Q: *How realistic are the UN Sustainable Development Goals. You said you are focusing on SDG 7 and 13 which is clean energy and climate action. Can you elaborate on your project especially on the GEAR Project?*
Iqlima Fuqoha: For achieving SDG 7 and 13, we are currently supporting economies mostly in Africa and Asia. We have our capabilities to develop energy outlooks and energy planning and policies to reach net-zero. Indonesia has already set their targets, and we can help set targets. We worked with Ghana and Kenya to set targets, and we are currently working with them to execute these plans. For the GEAR project, it's a partner initiative, so this project is to help economies improve electricity grid efficiency and resiliency. I mentioned we are starting of the first technical assistance with economies in Africa, and we hope to scale it up.

Q: *You talked extensively about Korea's case, but can you discuss more of the challenges of deploying smart grids in Korea?*
Yoon-Hee Ha: There are some serious challenges in the policies and market. The first is a privacy issue, the second is regulation, and the third is electricity market structure. Privacy issue is directly related to smart grid data collection. The smart grid can detect what time I'm taking showers or washing, etc. Privacy can be a showstopper for many other technologies such as drones, so this is a concern for smart grids. Electricity market structure is significant as a challenge, and this is a shared concern between many Asian economies. Price is also not easy, as Korean people are very used to low power prices, so policymakers do not want to increase electricity prices in fear of losing a re-election.

Q: *You mentioned that electricity consumption is closely related to the GDP of economies. Can you discuss the supply and demand side of the advanced economies vs developing economies?*
Alexander Izhbuldin: When developing economies are moving on the pathway from industrial to service base, they will change their consumption. This creates problems when trying to compare efforts. If you are using simple indicators for managing consumption vs GDP, you

can miss important details between advanced and developing economies. If we include the additional indicators into our analysis, it does add complexity, so there is a balance. There should be consideration of further differences.

Q: *What is the relationship between electrification and energy efficiency?*
Majah-Leah Ravago: When we transition to electricity, we need to find more efficient ways to use electricity. Using more energy efficient electric appliances can help with energy demand. The Philippines is also investigating other options such as natural gas, which suggests that reducing energy intensity of electricity can reduce reliance on gas.

Q: *Can you briefly talk about the role of energy efficiency in developing economies' energy transition, particularly in the Philippines?*
Majah-Leah Ravago: We are moving into electrification, but we are still in the early stages. It's difficult to assess the effect right now because we are still early. We are still importing energy, and we do not yet see the results.

Q: *How do you see the forecast growth towards demand response in net zero?*
Iqlima Fuqoha: This is a voluntary action, so there is no obligation. Even if the economy has a regulatory framework, there can be policy incentives or actions. It's important to consider demand response because electrification is growing with EVs being deployed. The growth is driven by so many factors.

Q: *What is the Korean policy on the Smart Grid and end use appliances?*
Yoon-Hee Ha: Smart grid is not a special part of the policy. Smart grid is part of the holistic push for clean energy and energy transition. In Korea, Jeju has a problem of energy curtailment, and they are producing more than they can consume. Transmission lines are difficult to site because of community pushback, so decentralized energy systems emerges as a key issue in Korea. Smart grids can enable DERs and other aspects of the energy system.

Q: *You have a slide that talks about efficiency vs electrification. Can you talk about the difference?*
Alexander Izhbuldin: The focus was on the power sector and the point was that while electrification is happening, efficiency can reduce the challenges for the supply side to add electricity generation sources. Certain limits on supply may be reached that can be overcome by efficiency.

Q: *You have a big target with a master plan. How do you approach the difference of rural vs big cities?*
Yoon-Hee Ha: That target is very ambitious under the current situation, but we have to move forward to reach that target. Our economy has constructed and completed very big power generation, but it could not produce power because it could not be connected to a transmission line. Thus, the Korean government shifted towards smart grids within urban areas.

Q*: In the deployment of Smart Grids, do you have any observations on the differences of integrated grids versus distributed grids? Penetration depends on many factors, and you mentioned the government's role.*
Yoon-Hee Ha: I don't think we have an actual market-based program in this sector. Last year, the RE100 target was introduced with PPAs, and there are indirect and direct PPAs. Most companies use indirect PPAs. KEPCO controls all the PPA markets. If one company wanted to purchase 1% of the electricity, they have to pay an unfavorable electricity price. KEPCO is also a monopolized market, so there are policies to diversify the business. We can say those programs are market based, but that is not entirely true as it is a special treatment or exception from a monopolized market.

Q: *You mentioned the capacity factor. Is that the right indicator of end system efficiency?*
Alexander Izhbuldin: The capacity factor is not the only indicator of the power sector, but I used this for time constraints. Another important indicator is thermal efficiency. In the energy sector, everything is connected, so if your thermal capacity is going down, your efficiency is also going down.

Q: *You are a strong supporter for non-subsidies for the energy transition. The problem is that the subsidies are necessary at certain stages of the energy transition because at the beginning, the cost of clean technology will be higher. The government's role can be to level the playing field. What are your thoughts?*
Majah-Leah Ravago: I am not against subsidy, and the Philippines did have subsidies. The subsidies are replaced by a green energy auction. The Philippines is a developing economy and a lot of investors are foreign investors. Subsidies can affect the feed price and the potential success of future projects as subsidies can cause imbalances in market competition. There are some barriers such as permitting that exist in the Philippines' market that does not exist in other markets, so there are additional considerations and costs to consider.

Q: *The green auctions have driven the price of clean energy low enough to compete against coal. The backbone of the transmission grid is weak in the Philippines. On the other hand, the distribution utility in the Philippines is quite competitive, and Smart Grids can be a potential solution. What do you think of the government's role in this?*
Majah-Leah Ravago: There are many distribution companies, and the problem is that some of the co-ops are intertwined with the local government, so when the administration changes, there is too much of a learning curve. It's still an ongoing concern so I don't have an answer for that.

Session 2. Electrification and Energy Efficiency in Energy Sectors

Panel Presentation #1 - Role of energy efficiency for large-scale electrification in industry
Yukiko Morishita, *General Manager, Washington DC Office, Chubu Electric Power Co.*

The speaker who presented panel presentation 1 in session 2 was Yukiko Morishita from the Washington DC office of Chubu Electric Power Company. This presentation was focused on the role of energy efficiency for large-scale electrification in industry.

Chubu Electric Power Group delivers energy that is indispensable to people's lives and so contributes to the development of society. Chubu was established in 1951, and it is the third largest power supplier in Japan with 10 million customers being served including Toyota Automobiles. Power generation facilities include geothermal power, pump storage, wind, solar, biomass, and nuclear.

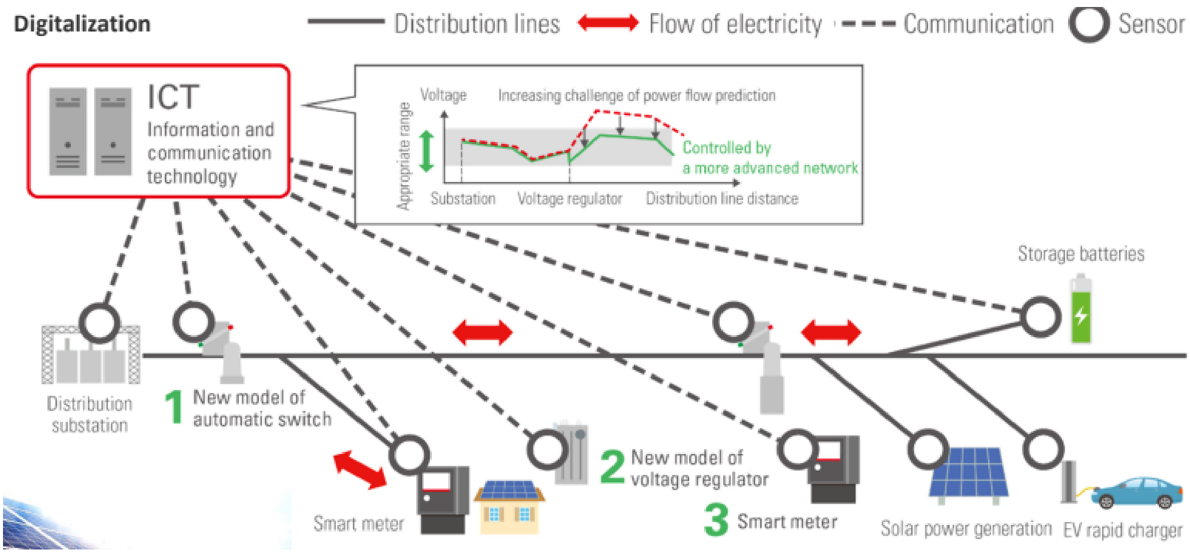
The role of energy efficiency for large-scale electrification in industry is to reduce the carbon intensity. By electrifying industry, Japan can see benefits in terms of self-sufficiency rate, population, and energy efficiency effort. Chubu electric power group has a new management vision where all data is connected to networks and all infrastructures mutually cooperate. Electricity enables optimal control of all things, and it enhances the efficiency of the entire social infrastructure. Chubu Electric Power group hopes to contribute through decarbonization of electric power systems supporting various types of infrastructure and pursuit of value creation by integrating infrastructure and data.

Chubu has a goal of reaching a 50% CO2 emission reduction by 2030, and net-zero CO2 emissions by 2050. Chubu hopes to achieve 100% electrification of company owned and operating vehicles. Chubu hopes to reach net zero through a variety of action plans. One is to achieve higher generation efficiency in LNG-fired power plants, as higher generation efficiency can lead to lower emissions. More efficient electricity production can lead to a reduction of fossil fuel usage. Expectations are growing for the triple combined cycle which combines a gas turbine and a steam turbine with an option of adding a fuel cell. High voltage direct current (HVDC) transmission lines are another important tool.

Chubu transmission lines were constructed in the 1960-70s, and the time has come for equipment renovation. Although power transmission construction in urban areas involves many challenges such as narrow sites and site negotiations with local communities, Chubu is moving forward with a refurbishment project to reconstruct pylons and rewire power lines.

Chubu also sees a stable supply of electricity as a main driver for energy efficiency. As Chubu's supply area is prone to lightning strikes, Chubu has been proactive in advanced lightning countermeasures. The introduction of next-generation equipment enables rapid identification of the distribution line disconnection as well as minimizing the extent and duration of power outages. The next generation power grid plan in Japan focuses on four main pillars: decarbonization, resilience, interregional interconnection, and digitalization.

Transition to the next generation will require digitalization and redistribution of electricity flow. Chubu meticulously controls voltage and power flows based on real-time data and responds to the output fluctuations of renewable energy. Additionally, by monitoring the grid status in greater detail than before, prompt recovery from power outages has become possible.



Chubu is facing a number of challenges moving forward. First, aging facilities need renovation, and new facilities are needed to connect renewable energy. Furthermore, to appropriately handle the increased volume of work as facilities age and require pairs and upgrading, Chubu has worked to standardize the level of construction carried out annually. Chubu is also experiencing a workforce decline, and at the current rate, the number of field workers will decrease in the future. Power transmission work requires unique skills and experiences which are challenging to pass on. Chubu is promoting labor-saving and mechanization of power transmission work.

Chubu is collaborating internationally to develop and demonstrate smart grid projects. In September 2019, Chubu joined the New Clark City Distribution Business with Marubeni, Kansai, and Manila Electric Company. The aim is to learn about the smart grid city infrastructure and integrated energy system which includes EV, battery, and distributed power supply. Chubu is also working with India on local production and local consumption as well as Viet Nam for a renewable energy project.

Panel Presentation #2 - Effective strategies for achieving energy efficiency buildings in existing and new construction: residential and commercial

Vincent Barnes, *Senior Vice President, Policy & Research, Alliance to Save Energy*

The next presentation was presented by Vincent Barnes, Senior Vice President of Policy, Research, and Analysis at the Alliance to Save Energy. This presentation was focused on US efforts to reduce greenhouse gas emissions through energy efficiency measures.

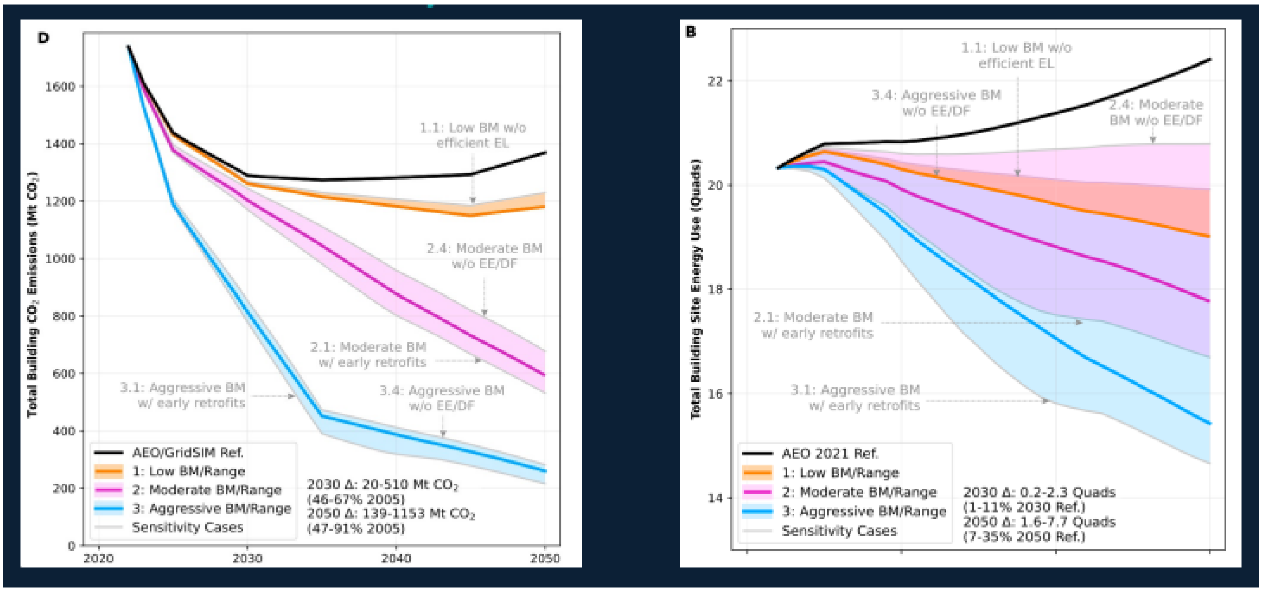
The US has goals to reduce net greenhouse gas emissions (GHGs) by 50-52% from 2005 levels by 2030 and reach 100% carbon free electricity by 2035. Furthermore, the US has hopes to reach net-zero emissions economy wide by 2050. However, some barriers remain.

In order to reach the ambitious climate goals, the US will need unprecedented and accelerated adoption of emissions mitigation solutions across every economic sector. Past US strategies have primarily focused on supply-side solutions for low-carbon energy generation and emission removal technologies. Past US strategies have not focused on demand-side solutions including in buildings.
US building energy consumption is a significant driver of CO2 emissions. In 2022, building consumption accounted for 1.7Gt of CO2, which equated to 35% of the total US CO2 emissions. Buildings equal 74% of electricity sales and 42% of end-use natural gas. On the

demand side, decarbonization improves end use efficiency, flexibly manages building loads and DERs, and improves power grid reliability. Demand side solutions include energy efficiency, demand flexibility, and building electrification. Building energy efficiency is the most extensively studied solution of the three and widely considered a low-cost option to mitigate climate change. Demand flexibility is a complimentary solution that leverages demand-side assets to reduce peak building demand and shift demand to times of high renewable generation, flattening the overall shape of building load on the grid. Building electrification is a key pillar of economy wide decarbonization. The cost and performance of electrification technologies have improved during the same time that ambitious targets for the power sector have been announced.

The US will need to triple its retrofit rate to achieve net-zero targets. According to the IEA, net zero by 2050 hinges on a global push to increase energy efficiency. Building sector solutions are the pathway to economy-wide decarbonization. Research has shown that there are three reference cases that can be seen in the building sector solutions to economy-wide decarbonization: low, moderate, and aggressive cases. The low case is the GridSIM reference case. The moderate case will see grid decarbonization of 80% CO2 reduction from 2005 by 2050. The aggressive case will see 100% CO2 reduction from 2005 by 2035.

There exists the potential for up to 91% reductions in buildings CO2 emissions from 2005 levels by 2050 without corresponding increases in building sector electricity use, given aggressive deployment of demand-side measures and full decarbonization of the electricity supply by 2035. According to the study, demand-side measures in buildings account for up to nearly half of total 2050 CO2 reductions beyond the reference case, with the remainder attributable to decarbonization of the electricity supply. Aggressive deployment of building efficiency and flexibility generates up to USD107 billion in annual power system cost savings by 2050, offsetting more than 1/3 of the incremental cost of full grid decarbonization. Studies also show that total building energy use and total CO2 emissions can be drastically lowered with aggressive deployment of solutions, and aggressive deployment can avoid nearly one-fourth of total energy system CO2 emissions projected for 2050.



If parallel gains in energy efficiency and demand flexibility are not made alongside electrification, building electricity demand will increase significantly placing substantial strain on the electric grid. Electrification occurs gradually, so investments in energy efficiency and demand flexibility should be immediate, and will be needed to substantially contribute emissions reductions. Energy efficiency and demand flexibility will be needed to support increased electrification on the distribution and bulk power systems by mitigating new loads and reducing system peak generation capacity.

Achieving the deepest building CO_2 reductions by mid-century requires deployment of high-performance building technologies and operational approaches at an unprecedented scale and speed. This unprecedented level of change in the building sector will require a rapid and sustained increase in investment alongside policy and regulatory support. Currently, the Inflation Reduction Act and the Infrastructure Investments and Jobs Act serve to support these needs. Further action is needed including additional legislative and regulatory enactments, aggressive building codes and performance standards, supportive electricity rate designs, incentives for early retrofits and continued R&D.

The US has made some immediate actions to support the decarbonization of building technologies including the Greenhouse Gas Reduction Fund from the IRA, FERC Order 2222, and Virtual Power Plants. The Greenhouse Gas Reduction Fund allows for community and rooftop solar, distributed energy generation and storage, net-zero emissions buildings, and zero emissions transportation. The FERC Order 2222 enables DER participation in US electricity markets and includes energy efficiency. Virtual Power Plants are aggregations of DERs that enable power plant-like functions, connected controllability, and reliable and utility grade achievements.

Future actions in the equity space can include inclusion of communities and workers who have been excluded or could be excluded from the energy transition and expansion such as low-income and disadvantaged communities, displaced energy workers, and workforce diversity. Future actions in the policy space can include incentives to accelerate front-of-the-meter demand and flexibility investments, manufacturing incentives to drive R&D and demand flexibility enabled devices, and incentives to accelerate building envelope and other behind the meter investments.

Panel Presentation #3 - Potential for EV's to reduce APEC energy intensity

Finbar Maunsell, *Researcher, Research Department, Asia Pacific Energy Research Centre*

The next speaker in the session was Finbar Maunsell, a researcher at the Asia Pacific Energy Research Center (APERC). The presentation was focused on the topic of the potential of EVs to reduce APEC energy intensity. The first part of this presentation will focus on current projection for the USA in transport model for the 9th edition of the energy outlook and these projections will be used to analyze the effects of EVs on energy intensity. The second part of this presentation will utilize Log Mean Divisia Index (LMDI) method to break down changes in energy use into its different drivers and compare the difference in effects between the Target and Reference scenarios in the outlook. The reference scenario illustrates a pathway where existing policies are retained, and the target scenario illustrates a pathway for each economy towards realizing energy policy targets. APEC has aspirational goals on energy intensity, and currently there is a goal of reducing energy intensity by 45% by 2035 with 2005 as the base year.

In the USA, both the passenger and freight activity are expected to remain the same in both the Target and Reference scenarios. In the current projections for battery electric vehicles and international combustion engine sales and stock shares in the US, the stock share lags the sales share.

The LMDI breaks down changes in energy use into its different drivers. The 2020 energy use is about 20,000PJ, and the passenger and freight km shows that this sector will increase energy use by around 4000PJ. Vehicle type, engine type, and vehicle efficiency all showed decreases in energy use with increases of bus share corresponding to slight energy use decrease, increased stock share of EVs to 10% corresponding with decrease by 1200PJ, and 1% annual improvement of efficiency of all new vehicles corresponding with decrease in energy use by 2203PJ.

When estimated at 2035, the effect of a ~20% stock share of EVs in the target scenario led to a 3623PJ decrease in energy usage compared to the 1200PJ in the reference scenario. Engine type switching in the target scenario would lead to a 6% improvement in USA's energy use and intensity when compared to the projected energy use for the whole economy in the reference scenario 2035. The vehicle efficiency effect is larger in reference because of efficiency improvements in new ICE vehicles having more of an effect because they have a higher sale.

In 2050, the USA can see a ~60% improvement in transport intensity by switching to EVs compared to if no EVs were used at all. For the USA's whole economy, that would lead to a ~26% improvement in energy use and intensity given the projected energy use in the reference scenario in 2050.

According to the target scenario, in 2035, the impact of EVs is relatively low, but by 2050, it becomes 4x larger. This reflects the lag between sales share and stock share. In the reference scenario, the US whole-economy energy intensity is projected to be 2.08PJ per billion 2018 USD PPP in 2035 compared to 3.57 in 2005, which is a 42% drop.

Improving ICE engine efficiency can be one alternative. For the sake of finding the highest possible improvement, gradual achievement of several factors should be considered through 2050 including weight reduction, engine efficiency, eco driving systems, and hybrid systems. An increase in vehicle efficiency by a factor of 1.4 compared to 1.2 has led the vehicle efficiency factor in the reference scenario to grow from -2203 PJ to -3383PJ through 2035 and can grow to -8110PJ by 2050. In summary, the impact of switching to the more efficient IV is better for energy intensity than slowly switching out current ICEs for marginally more efficient ICEs. However, areas like heavy freight, where focus on ICEs (including hybridization), may benefit intensity more than EV, because the switch to alternative engine types is expected to be slower due to battery cost or hydrogen for fuel cell vehicles.

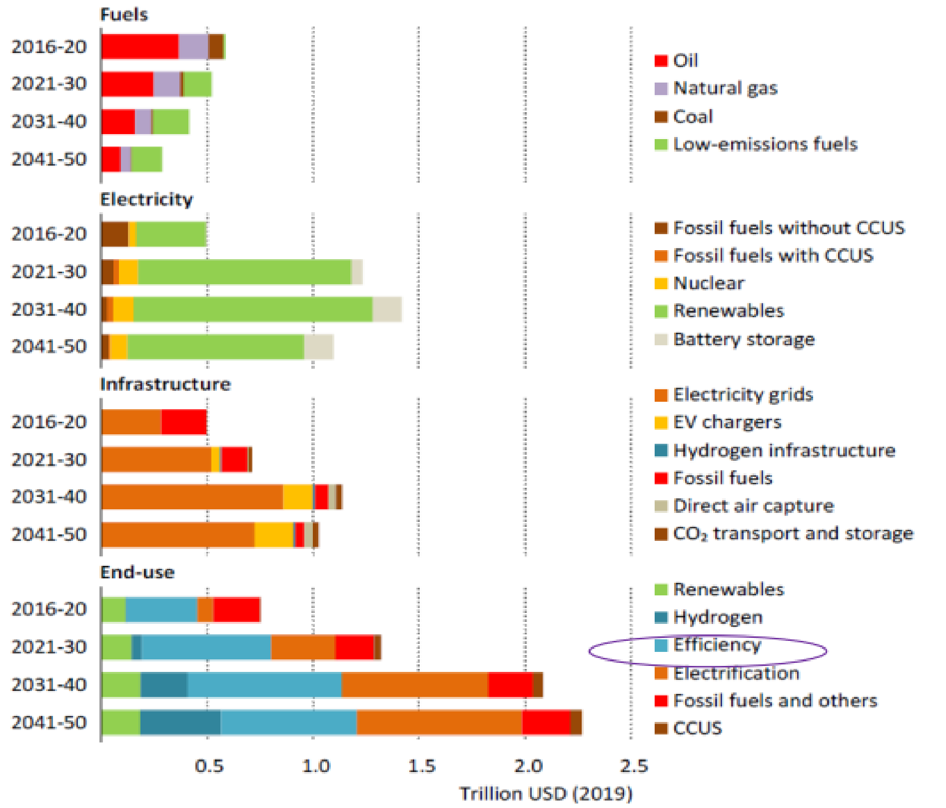
Panel Presentation #4 - Setting energy efficiency programs for local communities under the electrification trend

Younsung Kim, *Associate Chair, Professor of Public Policy and Management, Department of Environmental Science and Policy, George Mason University*

The next and final speaker in the 2nd session was Dr. Yongsuk Kim, from George Mason University. This presentation was focused on setting energy efficiency programs for local communities under the electrification trend.

In the IEA's pathway to Net Zero, there are a number of key milestones to reach net zero by 2050 with a number of efforts spanning sectors such as buildings, transport, industry, electricity and heat, and more. Furthermore, the global average annual energy investment needs by sector and technology vary in the NZE. However, in the end using technologies, efficiency comprises a significant portion of the investment needs.

Figure 4.2 ▷ Global average annual energy investment needs by sector and technology in the NZE



Source: IEA (2021)

Policy pushes are critical for 2050 NZE scenarios as all the technologies needed to achieve the necessary deep cuts in global emissions by 2030 already exist, and policies have been proven to drive deployment of these technologies.

ACEEE has projected the US electricity generation through 2050, and the prediction includes significant contributions from natural gas and solar with support from wind, nuclear, and coal. Furthermore, the projections of CO2 emissions reductions per sector show that energy efficiency is one of the most significant reduction strategies through 2050.

The current Biden-Harris administration in the US prioritizes climate change efforts greatly. This administration admits that there is no greater challenge than climate change and is utilizing domestic and global climate threats to revitalize the US energy and manufacturing sectors, create millions of high-quality, good paying jobs, and addresses historic environmental injustices and inequalities. This administration is aiming to reach a 100% clean energy economy and net-zero emissions by 2050.

The US Department of Energy created a new office called the DOE Office of State Community Energy Programs (SCEP). This new office was created to implement nearly USD16 billion in programs from the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) as well as annual appropriations. SCEP works to accelerate high-impact, self-sustaining clean energy projects that improve people's lives, aid state and local governments, tribes, community-based organizations and others in deployment, and center the needs of low-income households and Disadvantaged Communities.

There are a number of projects coming out of the SCEP office such as USD250 million for energy efficiency revolving loan funds, USD50 million for energy efficiency for non-profits, USD550 million for energy efficiency and conservation block grants program, USD500 million for energy efficiency and renewable energy in public schools, and more. The DOE has also launched a USD27 million grant program to support local, state, and tribal government-led partnership efforts. The program will advance clean energy program innovation and ensure benefits flow to disadvantaged communities. The Local Energy Action Program (LEAP) is another program from DOE that focuses on partnering with low income, energy burdened communities. USD18 million in funding is provided for technical assistance to 24 competitively selected communities to develop clean-energy-related economic development pathways.

The Energy Efficiency & Conservation Block Grant Competitive Program supports state, local, and tribal governments to reduce fossil fuel emissions and total energy use while improving energy efficiency in transportation, buildings, and other sectors. The goal is to prioritize disadvantaged communities and prioritize applicants in states and territories with less than 2 million people. The US EPA support for local communities focuses on technical assistance and resources for local governments seeking to promote energy efficiency in their communities.

New South Wales, Australia has developed an energy efficiency action plan that includes a number of aspects. The Energy Efficient Communities Program 2020 is focused on community energy efficiency and solar grants. This program will provide community groups with grants up to USD12,500 for energy efficient equipment, energy generation and storage systems, and energy audits. The aim is to improve energy efficient practices and increase the uptake of energy efficient technologies.

The Victoria Business Recovery Energy Efficiency Fund is a USD31 million business recovery efficiency fund that provides grant funding to businesses for energy efficient capital works and energy demand management technologies. This program has 108 energy management projects. Furthermore, Australia's National Construction Code (NCC) changed the minimum energy rating of new homes from 6 to 7 stars.

Barriers to further energy efficiency deployment remain. Lack of institutional capacity and financial constraints in developing economies can prove to be barriers to widespread deployment of energy efficient technologies. Equity concerns should be prioritized with low-income residents being eligible for rebates with energy efficient homes. Furthermore, expanding and strengthening voluntary EE policy measures will be important as federal governments play a role in effectiveness.

Session 2. Questions & Answers

Q: *You talked about the criteria for the selected communities. What are the other criteria to receive funds?*
Younsung Kim: The DOE has different priorities for the different programs but the core initiatives are the same in how they hope to achieve energy efficiency. Partnerships are also encouraged with private sector and local banks.

Q: *As part of Biden's goal of having 50% of new vehicles sales be electric by 2030, the BIL and IRA were passed. What are some of the hurdles and challenges in achieving these objectives?*
Finbar Maunsell: The US requires more of a driving range for EVs than China, which results in bigger batteries in EVs. Additionally, the US is looking to ban imports of EVs from China, which may or may not even work. The US EV sales may fall behind if this doesn't work. Furthermore, China has a monopoly on critical minerals.

Q: *What are your next steps with the research you've conducted?*
Vincent Barnes: We are really trying to push the concept of energy efficiency first before doing supply side solutions. This is because if you lower demand, you can redefine capacity. We are looking to pose the question of the role of energy efficiency in climate policy, and we will look this data and convert it into policy discussions on Capitol Hill.

Q: *Your study proposed a significant level of investment. How can we accelerate retrofits to accomplish this?*
Vincent Barnes: We can make investments to bring down demand instead of making significant investments in transmission and distribution infrastructure. We think the private sector should be involved to facilitate the cost.

Q: *Can you describe how energy efficiency fits into Chubu's next generation power grid plan?*
Yukiko Morishita: The most important thing for power companies is to provide customers with safe, reliable, and affordable energy. The electricity price in Japan is the most expensive in the world, and it is double the price of US electricity. Energy efficiency can increase the supply of energy available without adding any new infrastructure or stations.

Q: *You've been with Chubu for many years, so you have an understanding of the company as well as the changes over time. In your opinion, what kind of leadership role is needed in order to maintain advanced energy workforces?*
Yukiko Morishita: The energy sector is very male dominated, and only 10% is female. We are hoping to find more ways to increase this percentage. The younger generation does not like the older generation's management style, so there should be some diversification of leadership. I try to be more adaptable, open minded, and fair.
Vincent: Early exposure to the workforce can be very significant in bringing minority population groups to the energy industry.

Q: *Have you looked at other industries to look at their leadership styles?*
Yukiko Morishita: I am part of a women's networking group in other industries, and I would like to export this kind of idea to Japan.

Q: *How do other economies differ in their intensity improvement from EVs?*
Finbar Maunsell: China has a strong EV market, but if you look at economies like Japan, there are significant opportunities to electrify as they have small vehicles with low driving ranges.

Q: *The Biden Harris administration has the SCEP program. Is there enough budget for this?*
Younsung Kim: If we see the whole picture of the funding from the IIJA and IRA, combined together, there is significant funding available. However, the amount of funding made available for energy efficiency and community funding are very small compared to the trillions of dollars being appropriated to other energy sources. This is not in line with the ratio of the amount of savings that can come from energy efficiency. Energy efficiency is the low hanging fruit, and we feel that we can make significant progress with more funding.

Q: *You mentioned something about new construction will only use hydrogen power in 2035. Can you meet this target in Japan?*
Yukiko Morishita: That is for a different company than Chubu. Further technological advance will be needed to support this suggested hydrogen infrastructure.

Q: *Japan is not producing hydrogen in-house but only for import?*
Yukiko Morishita: Yes. Currently, we are seeing imports as easier than exports.

Q*: In 2050, you suggested that 50% will still be fossil fuels. How does this relate to the NZE target?*
Younsung Kim: That slide shows electricity generation forecast for 2050. 10% of the mix will be coal. This means that most of the mix will still be reliant on fossil fuels. When the US sets the goals, they can also have an offset system with carbon capture and storage. Energy efficiency can compensate from emissions from fossil fuel.

Q: *You mentioned that Chubu is promoting labor saving and mechanization. What is your opinion on the displaced workers?*
Yukiko Morishita: We are looking to digitalize, and it is a challenge but we are thinking about it.

Q: *Energy efficiency is the low hanging fruit, but I'm wondering about the grants initiated by the US government. Will it be enough to cover the communities? Will this be for residential communities only?*
Younsung Kim: I see some changes with the grants because it involves partnerships and knowledge building. This is more about creating the ecosystem, and the plan is to scale up.

Q: *You said you are happy to see capital investments into energy efficiency? How can we make this happen in the building sector?*
Vincent Barnes: I agree that it's not enough but there are other tools that can be used to help support the transition into energy efficiency. There are rebate programs in the DOE as well based on income. The way we read the IIJA and IRA is that these are the start of discussions, not the end. Utility partnership with a commercial entity is another option. We can also expand demand response participation.

Q*: For EVs, one important thing is charging structure. Who is better to build the infrastructure?*
Finbar Maunsell: Generally, we are looking at one charger for 10 EVs, and we feel that upgrading networks are going to be the big challenge. To me, the best builder for the infrastructure will depend on the government and how they incentivize and create the policies.
Florence: Biden's proposal for IRA does include subsidies for the infrastructure for EV charging stations. Hopefully this will be a significant tool to push us towards EV deployment.

Q: *You have mentioned the efficiency for ICE. For freight, there is research to suggest that hydrogen fuel cells will be more efficient than EVs for long distance freight. What are your thoughts?*
Finbar Maunsell: I think there is a chance both can work because we are seeing battery costs come down. Hydrogen is also likely to be very expensive in the future. Rail is another

alternative, and China is moving their freight to rail. In my modeling, I do a 50/50 sales share by 2050 but it will depend on the cost of hydrogen.

Moderator Wrap Up and Closing Remarks

Ms Florence Lowe-Lee, President of the Global America Business Institute (GABI) and Moderator of the workshop, concluded the panel by first thanking the participants for their participation and passion for climate change efforts. She mentioned that there are increasingly significant weather events across the globe that can be attributed to climate change. Ms Lowe-Lee then also proceeded to give thanks to the panelists and speakers for their international attendance and presentation preparation. Additionally, Ms Lowe-Lee also thanked the organizers and the APEC Secretariat for their support in hosting the program. She then gave the floor to Mr Kim for final remarks.

Mr Kim concluded Session 2 and thanked the speakers and participants for their presentations and discussion. Mr Kim also thanked Ms Florence Lowe-Lee for moderating the session. Mr Kim then played a final remarks video by Mr Li Meng.

Mr Li Meng greeted the participants and speakers and thanked everyone for a successful conference and congratulated everyone as well. Climate change is a global concern, and energy efficiency is well accepted as a critical solution. It can simultaneously make energy supplies more secure, more affordable, and more sustainable. Furthermore, there are an increased number of end users of energy that are receiving electrification. Within this context, Mr Li Meng mentioned his excitement that insights were shared under the topics of energy efficiency in power sectors and energy efficiency and electrification in energy sectors, and these are all necessary for developing a robust energy policy. Additionally, Mr Li Meng mentioned that he noted many participants are from stakeholder economies and the speakers are senior experts in their areas, so the participation from all was a crucial success to the region's energy concerns.

Workshop Conclusions

The energy efficiency workshop was part of the APEC peer review on energy efficiency projects, and the overall objective of the Energy Efficiency Policy Workshop is to promote "high-performance" energy efficiency policy measures in the APEC member economies by sharing information and experiences. This one-day in-person workshop was designed to provide capacity building opportunities as well as to introduce new approaches of examples for energy efficiency.

Part 1 - Improving Energy Efficiency in the Power Sector

- Global events from 2000-2022 demonstrate that climate events are not only increasing the demand for energy in certain localized areas, but these climate events are also reducing the amount of available renewable energy generation potential. Furthermore, as the penetration of renewables in an energy mix increases, the prices for energy fall, resulting in a "cannibalization" effect that will slow down grid-scale projects because the energy prices fell too low.
- The clean energy transition will be significantly more challenging towards developing economies than developed economies, as the existing electricity infrastructure and pricing in some areas like the Philippines are already presenting significant challenges to meet current demand. Energy efficiency technologies are instrumental to developing economies so that the electricity demand profile can be managed while additional transmission and generation capabilities are being added to the grid. The low cost of renewable energy generation technologies can also provide added capacity at a very cost-effective rate, and the combination of renewable energy penetration alongside

energy efficiency deployment can support developing economies' clean energy transition.

- Energy efficiency practices are aimed at reducing energy intensity, and there are a few methods including reducing the energy loss (technical and non-technical losses), lowering demand through demand-side management, and deploying energy efficiency technology in power plants through cogeneration or combined heat and power systems. Mission Efficiency is a globally focused organization that is designed to help economies around the world meet their net zero needs through these energy efficiency practices.
- Korea is investing in smart grid technologies to drive energy efficiency. This digitalization of power grids and systems worldwide is estimated to be able to average USD80 billion per year. Korea is currently in the 3rd of 3 phases in their Smart Grid Master Plan. There are several action plans remaining including empowering small-scale demand resources, creation of a smart grid experience zone, and enhancing infrastructure and facilities.

Part 2 – Electrification and energy efficiency in energy sectors

- Chubu Electric Power Company is looking to address the role of energy efficiency for large-scale electrification in industry as it can have strong benefits in self-sufficiency rate, population, and the energy efficiency effort. To decarbonize industry, energy efficiency technologies can be deployed to reduce the emissions generated from the same amount of energy usage. Additionally, Chubu Electric Power Company is also investing in a next-generation electricity distribution network that will allow for the flow of electricity in both directions. Challenges remain, but efforts have been made to address these challenges.
- For the US to reach net-zero by 2050, an unprecedented and accelerated adoption of emissions mitigations solutions across every economic sector. Previous US strategies have focused on the supply side, but it is now becoming apparent that demand-side management will be key to achieving net zero goals. The main pillars of the demand side management in the US include building energy efficiency, demand flexibility, and building electrification.
- The utilization of EVs could potentially dramatically reduce the energy intensity of an energy system. APEC's goal on energy intensity is to reduce energy intensity by 45% by 2035. Data collected from EV stock shares and energy intensity show that there is a strong correlation between the two variables, as an increase of EV stock shares is correlated to a decrease in energy intensity. This suggests that switching ICEs to efficient EVs will result in a larger decrease of energy intensity than switching ICEs to marginally more efficient ICEs.
- Energy efficiency has been identified as a key pathway for reducing emissions. Currently, the technology required to reach net-zero exists, and policies can be instrumental in allowing these technologies to reach their potential of delivering a net-zero future. US policies have committed significant funds towards community energy programs along with the Energy Futures Grants, which is a USD27 million grant program to ensure that adequate support for the clean energy transition goes towards disadvantaged communities.

Agenda

"Electrification and Energy Efficiency"	
APEC Expert Group on Energy Efficiency and Conservation (EGEE&C) 61st Meeting	**Location: Legaspi 1, Makati Diamond Residences, the Philippines Date: October 16, 2023 Time: 09:30 – 12:00 and 14:00 – 16:30 (The Philippines time – GMT+8)**
09:00 to 09:30	**Registration**

Part 1 - Improving Energy Efficiency in the Power Sector (09:30 – 12:00)	
09:30 to 09:35	**Opening Remarks by *Mr. Munehisa Yamashiro*, APERC Vice President**
09:35 to 09:40	**Introduction to the agenda of Part 1 by Moderator** ***Moderator: Ms. Florence Lowe-Lee***
09:40 to 11:00	1. **Challenges for the power sector to meet growing electricity demand with an increasing share of renewable generation** *Mr. Alexander Izhbuldin* Senior Researcher, Research Department Asia Pacific Energy Research Centre 2. **The Role of energy efficiency in transition to cleaner energy: A developing economy perspective** *Dr. Majah-Leah V. Ravago* Associate Professor, Department of Economics Ateneo de Manila University Loyola Heights Campus 3. **Energy efficiency technologies for power sector** *Ms. Iqlima Fuqoha* Energy Transition Specialist Sustainable Energy for All 4. **Distribution automation of power grids for energy efficiency** *Dr. Yoon-Hee Ha* Director of BK 21 Program and Professor Graduate School of Energy and Environment Korea University
11:00 to 11:40	**Moderated discussion among the four presenters**
11:40 to 11:55	**Q&A from participants**

11:55 to 12:00	**Summary by Moderator**

Part 2 – Electrification and energy efficiency in energy sectors (14:00 – 16:30)

14:00 to 14:05	**Introduction to the agenda of Part 2 by Moderator** ***Moderator: Ms. Florence Lowe-Lee***
14:05 to 15: 25	**5. Role of energy efficiency for large-scale electrification in industry** *Ms. Yukiko Morishita* General Manager, Washington DC Office Chubu Electric Power Co. **6. Effective strategies for achieving energy efficiency buildings in existing and new construction: residential and commercial** *Mr. Vincent Barnes* Senior Vice President, Policy & Research Alliance to Save Energy **7. Potential for EV's to reduce APEC energy intensity** *Mr. Finbar Maunsell* Researcher, Research Department Asia Pacific Energy Research Centre **8. Setting energy efficiency programs for local communities under the electrification trend** *Dr. Younsung Kim* Associate Chair, Professor of Public Policy and Management Department of Environmental Science and Policy George Mason University
15:25 to 16:05	**Moderated discussion among the four presenters**
16:05 to 16:20	**Q&A from participants**
16:20 to 16:25	**Summary by Moderator**
16:25 to 16:30	**Closing Remarks by *Mr. Liu Meng*, EGEEC Chair**
16:30	**Group photo**

Speaker Bios

Opening / Closing Remarks

Opening remarks

Mr. Munehisa Yamashiro is Vice President, Asia Pacific Energy Research Centre (APERC). Mr. Yamashiro joined APERC in 2018. Previously, he had worked for Japan's Ministry of Economy, Trade and Industry for 32 years. When he was in charge of international energy issues in mid-1990s, he was involved with establishment of APERC. He holds a Bachelor of Engineering from the University of Tokyo and a Master of Arts in International Relations from Yale University.

Closing remarks

Dr. LIU Meng is the Chair of the APEC Expert Group on Energy Efficiency and Conservation (EGEEC). Dr. Liu received his Ph.D degree in Engineering Thermophysics from Graduate School of Chinese Academy of Sciences. He then joined the Branch of Resources and Environment, China National Institute of Standardization (CNIS) in 2008. His main research interests focus on energy standardization and energy conservation policy. He is actively involved in the international activities on energy efficiency and conservation since 2011. He plays important roles in the International Organization for Standardization (ISO) for energy efficiency and solar energy standardization.

Moderator / Speaker

Moderator

Ms. Florence Lowe-Lee is Founder and President of the Global America Business Institute (GABI) in Washington, DC. Since its founding, one of the primary organizational missions has been to act as a forum and platform for discussion on policy-relevant energy and technology issues, with a focus on technologies that facilitate an environmentally sustainable and low-carbon energy future. GABI approaches energy from various viewpoints — economics, security of supply, diversity, safety, technological development and geopolitics. GABI regularly organizes seminars and workshops, and the primary audience has been the policy community in Washington, DC, which includes think tanks, NGOs, U.S. government agencies, congressional offices, embassies, academics, industries, etc.

Previously, Ms. Lowe-Lee served as Treasurer, Director of Finance and Publications at the Korea Economic Institute of America (KEIA) in Washington, DC where she focused on issues impacting Korea's macroeconomic development as well as security concern on Korean peninsula. She worked as Director of Operations at the Massachusetts Senate Ways and Means Committee and served as an advisor to the Massachusetts Office of Trade and

Investment. Earlier, she was a research assistant at the Neuroanatomy and Neuroendocrinology laboratory at Rockefeller University in New York City.

Ms. Lowe-Lee received a BA in Neuroscience from Mount Holyoke College and an MA in Industrial/Organizational Psychology from Columbia University. She is also an Adjunct professor at School of Global Entrepreneurship and ICT at the Handong Global University as well as distinguished Professor of Global Cooperation at the Busan University of Foreign Studies in Korea.

The Philippines Speaker

Majah-Leah V. Ravago is an economist and academic looking for policy solutions to real-world problems and challenges, especially in the energy sector. She advises the government, particularly the National Economic and Development Authority, the Department of Energy, and the members of Ph Congress. She is also a policy and research consultant for the World Bank Manila, Asian Development Bank (ADB), ADB Institute, and USAID Ph. She is an Associate Professor at the Department of Economics, Ateneo de Manila University. She is also a Research Fellow at the Research Institute for Environmental Economics and Management (RIEEM) at Waseda University in Japan. She was a U.S.-Philippines Alliance Research Fellow at East-West Center (EWC) in Washington, DC. She was the Program Director of the 2014–2018 USAID grant project – the Energy Policy and Development Program (EPDP).

She served as the President of the Philippine Economic Society in 2018. She received the One UP Faculty Grant Award in Economics for Outstanding Research and Public Service in UP Diliman (2016-2018) as an Assistant Professor at UP. The National Academy of Science and Technology (NAST) awarded her the Outstanding Young Scientist in Economics in 2016.

She earned her BS in Business Economics and MA in Economics from the University of the Philippines. She obtained her PhD in Economics from the University of Hawaii in 2012 under the
East-West Center Graduate Degree Fellowship Program.

Indonesia Speaker

Iqlima Fuqoha is an Energy Transition Specialist at Sustainable Energy for All (SEforALL), mainly working on energy modelling and providing policy analysis of the energy transition plans. With a focus on emerging economies, SEforALL is currently working with the Government to build the energy transition and investment plans (ETIP). The ETIP aims to help the economy frame an energy transition agenda that will attract investment to achieve net zero while also ensuring a just transition that fully supports the socio-economic growth trajectory. Ms. Fugoha has prior professional experience in the development sector across Indonesia and Southeast Asia. She was involved in the energy modelling and writing of the 6th ASEAN Energy Outlook published in 2020. She specializes in energy statistics, energy policy, and sustainable energy technologies.

She earned her BEng in Chemical Engineering from the University of Indonesia and MSc in Project Management for Energy and Environmental Engineering from École des Mines de Nantes, France.

Korean Speakers

Yoonhee Ha is a professor at the Graduate School of Energy and Environment (Green School) and Director of the BK21 Education Research Center for Sustainable Energy Resource Technology-Policy-Data, Korea University. She is vice chairperson of the energy and industry transition Sub-commission of the Presidential Commission on Carbon Neutrality and Green Growth. She is also the organizing chair of the IEEN* since 2020, whose membership includes public officials, academics, and company executives in the energy and climate change sectors from developing economies. She specializes in public finance and sustainable development. Her research interests include energy governance, energy justice, sustainable energy policy, developing economy's renewable energy market development, and government budgeting & dynamics of R&D policy. She received her Ph.D. in energy and environmental policy from the University of Delaware.

** IEEN has organized annual forums on solar, wind, ESS, smart energy systems, electric vehicle charging infrastructure, hydrogen, and bilateral partnerships for greenhouse gas reduction and publishes reports analyzing relevant developing economy markets.*

Younsung Kim is Professor and Associate Department Chair in the Department of Environmental Science and Policy at George Mason University. Her research lies in collaborative governance and self-regulatory policy tools designed to address today's complex environmental and sustainability challenges. Focusing on the private sector's role in environmental governance, she has investigated such topics as whether Environmental Management Systems (EMSs) are effective, why some companies are more receptive to regulatory environmental policy, and which type of firms would be most likely to form cross-sector partnerships for sustainability solutions. Her recent research interests cover sustainable packages and waste management and recycling policy.

In 2016, her co-authored research article "Business as a Collaborative Partner: Understanding Firms' Sociopolitical Support for Policy Formation" received the Best Article Award from the Public and Nonprofit Management Division of the Academy of Management.

Prior to her career in academia, Dr. Kim worked for the Ministry of Environment in Korea as Deputy Director of the Public Information Office and served on the World Bank's Carbon Finance Assist Team. Recently, she served as an external reviewer of the US Environment Protection Agency's Pathfinder Innovation Projects. She holds PhD from George Mason University, Environmental Science and Public Policy program.

Japanese Speaker

Yukiko Morishita is General Manager of Chubu Electric Power Co., Inc in the Washington, DC office. Since joining Chubu Electric in 2001 as Assistant Manager in the public relations department, Ms. Morishita has held various positions responsible for risk control procedures related to the handling of typhoons and facility troubles to managing a large construction project of the transmission cable in Shizuoka. As a General Manager of the General Affairs Group, Networking Planning Office, she was responsible for setting up the personnel management system and structure for a new electricity transmission and distribution ("T&D") subsidiary which was scheduled to be established in April 2020 to comply with the Japanese regulatory change.

During 20+ years at Chubu, Ms. Morishita was instrumental in implementing special training programs to recognize and promote female employees, especially in managerial positions. Her effort made significant changes to the company's internal policy to better support female employees. She received BA in economics from Shizuoka University in Japan. She is a member of Women Committee of Energy and Environment (WCEE) and is an alumna of the International Visitor Leadership Program (IVLP)of the US Department of State in 2015.

U.S. Speaker

Vincent Barnes is Senior Vice President (SVP) of Policy and Research at the Alliance to Save Energy. As SVP, he is the organization's primary policy lead, responsible for working with the President, Board of Directors and staff to ensure that the Alliance to Save Energy is the leading voice on energy efficiency policy in Washington, D.C. As a respected government affairs professional with over 20 years of policy and executive leadership experience, Mr. Barnes has an extensive track record engaging members of Congress, participating in regulatory rulemaking, legislative development, and stakeholder engagement. His leadership record also includes developing and executing policy campaigns and building consensus through multiple stakeholder and organization interests.

Prior to joining the Alliance to Save Energy, Mr. Barnes served as Senior Advisor with Gray Global Advisors, where he developed and executed policy objectives for the investor-owned utility, natural gas, and nuclear energy industries, and helped lead the firm's energy and power, telecommunications, financial services, and healthcare portfolios. He is also former Legislative Counsel to Congressman Bobby Rush, Chairman of the House Committee on Energy and Commerce, Subcommittee on Energy. He also served as Senior Federal Legislative Counsel with the American Bankers Association. Mr. Barnes holds a BA in English from Brigham Young University and received his JD from the University of Utah S.J. Quinney College of Law.

APERC Speakers

Alexander Izhbuldin is a Senior Visiting Researcher at APERC since October 2020. His main responsibilities include the development of the Power Sector model for all APEC member economies as part of APERC's flagship project, the APEC Energy Demand and Supply Outlook. Before joining APERC, he worked at the Melentiev Energy Systems Institute, Siberian Branch of the Russian Academy of Sciences, Irkutsk, Russia, one of the leading academic institutes in Russia that researches energy sector development. While working at the institute, he participated in various research projects focused on problems of energy sector development in the regions of Eastern Siberia and the Far East, including a detailed study of the state and problems of energy development in the Eastern Arctic. Among the research projects were the development of regional energy development programs, and energy supply schemes for industrial consumers. He also participated in joint research on energy cooperation with research organizations in China; Japan; Korea, and Mongolia. Mr. Izhbuldin holds a Master's in management from Baikal State University, Irkutsk, Russia.

Finbar Maunsell is a Researcher, Asia Pacific Energy Research Centre (APERC) Tokyo, Japan. He previously worked at New Zealand's Ministry of Business, focusing on energy statistics. Now based in Tokyo, he's diving deep into transport energy modeling for the 21 APEC economies. While his Python-based model is still a work in progress, Finn aims for it to eventually contribute to policy discussions and strategic planning.

Speaker Presentation Materials

Challenges for the power sector to meet growing electricity demand with an increasing share of renewable generation

Alexander Izhbuldin, Asia Pacific Energy Research Centre (APERC), Senior Researcher

Energy Efficiency Policy (EEP) Workshop
Manila, the Philippines, 16 October 2023

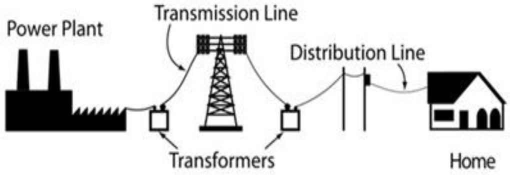
Outline

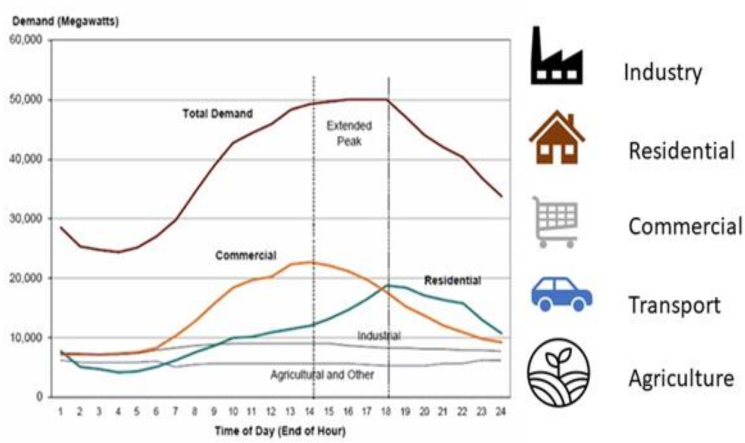
- Notable recent events in the power sector of Japan, USA, and Australia
- Electricity generation, installed capacity, and capacity factors in the world in 2000-2022
- Electrification: challenges for the power sector
- Conclusions

2

Typical Power System

- Electricity is generated at the same time as it is consumed.
- Generation should follow demand and provide peak load with a certain reserve margin level.





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Notable recent events and what has happened to the electricity generation in the world between 2000 and 2022

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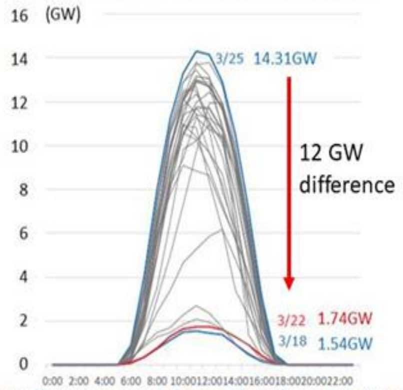
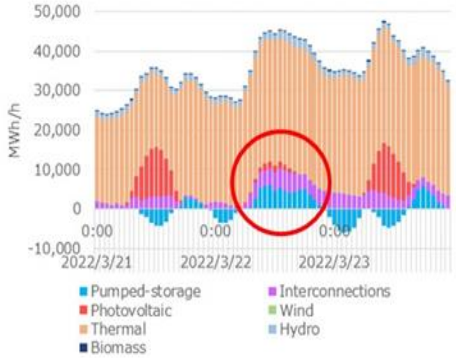
Japan: Supply demand crunch in TEPCO area in March 2022

- Some power plants were shut down due to the earthquake that occurred several days ago,
- Demand increased due to the cold weather, and the output of solar power plants declined due to cloudy weather
- In recent years, the supply-demand crunch has frequently occurred due to a lack of generation capacity and balancing power.

Solar PV output for everyday of March



Supply-demand balance around March 22 in TEPCO area



APERC https://www.tepco.co.jp/forecast/html/area_data_j.html
https://www.meti.go.jp/shingikai/enecho/denryoku_gas/denryoku_gas/pdf/047_03_04.pdf

5

United States: ERCOT declared an EEA2 on September 6, 2023

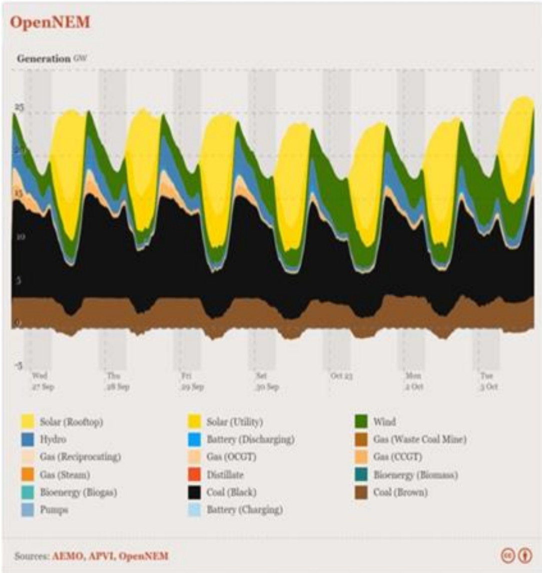
- The Texas grid narrowly avoided blackouts on September 6 evening as cooling demand from extreme heat combined with thermal outages and low solar and wind output to force the state's grid operator into emergency operating conditions.
- The ERCOT declared an Energy Emergency Alert 2 around 7:30 p.m. local time, allowing it to bring all available generation online, utilize reserve power, and call on demand response.
- The extreme heat led to a new ERCOT September peak demand record of 82,705 MW. Last September, the highest demand recorded was 72,370 MW, according to the grid operator.
- ERCOT CEO also said: "High demand, lower wind generation, and the declining solar generation during sunset led to lower operating reserves on the grid and eventually contributed to lower frequency, which precipitated the emergency level 2 declaration.

ERCOT: The Electric Reliability Council of Texas
APERC https://www.utilitydive.com/news/ercot-declares-emergency-conditions-extreme-heat-texas-blackouts/692963/

6

Australia: The NEM hit 69% renewables on September 20, 2023

- The NEM in Australia hit 69% renewables on September 20, 2023
- On September 23 article "Rooftop solar 'cannibalising' power prices as Australian generators pay to stay online" were published
- Wholesale power prices are increasingly turning negative at times of high solar output
- Observers say rooftop solar is "cannibalizing" electricity prices and hitting large-scale solar hard
- There are calls for storage and greater daytime demand to help soak up solar production



NEM: National Electricity Market. National Electricity Market
The National Electricity Market (NEM) is comprised of five physically connected regions on the east coast of Australia

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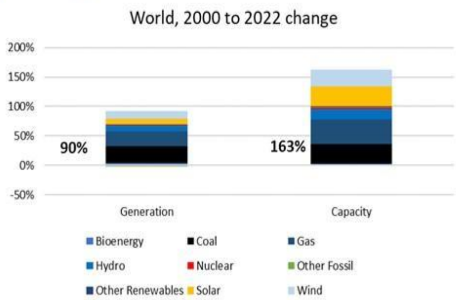
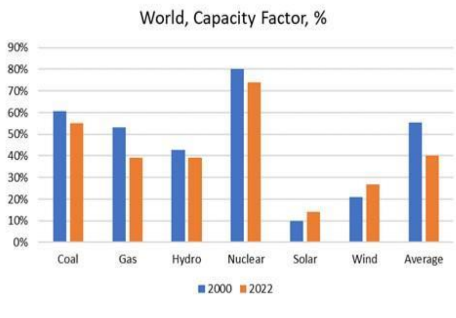
https://www.abc.net.au/news/2023-09-23/rooftop-solar-cannibalising-australian-power-market/102889710
https://opennem.org.au/energy/nem/?range=3d&interval=30m

7

Electricity generation and installed capacity in the world in 2000-2022

- Electricity generation almost doubled
- Generation from wind and solar increased by 23%
- Wind and solar generation capacity increased by 63%
- The capacity factor of solar and wind has increased slightly over time
- Average capacity factor declined from 56% in 2000 to 40% in 2022 due to lower capacity factor of wind and solar generation and reduced capacity factors of conventional generation technologies
- Potentially, this could lead to a shortage of generating capacity and balancing power





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Some observations

- **Technical point of view**
- The combination of factors and their overlap over time results in a supply constraint.
- The need for heating or cooling buildings at times when outside temperatures are significantly different from the average for a given time results in increased demand for electricity.
- If the time of high demand coincides with weather conditions that limit renewable generation (cloud cover, sunset time, low winds), this leads to the need to impose consumption restrictions
- **Market point of view**
- "Cannibalization" effect: Increasing penetration of solar and wind reduces their own unit revenues, The cannibalization effect is stronger at high penetration levels
- Negative prices reduce the attractiveness of new projects and increase overall cost
- Reduced capacity factors for conventional generators can cause them to stop operating

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9

Electrification: challenges for the power sector

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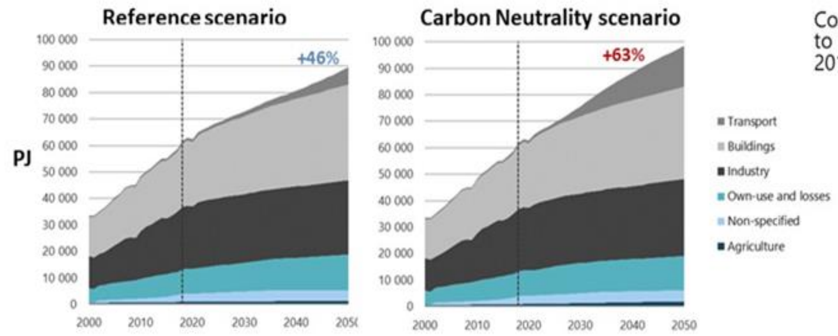
Electricity consumption by sector projection in APEC (8th Edition)



Contribution of the end-use subsectors to electricity consumption growth from 2018 to 2050:

Reference scenario:
- Transport 20%
- Buildings 44%
- Industry 16%

Carbon Neutrality scenario:
- Transport 39%
- Buildings 30%
- Industry 15%

- Buildings and the transportation sector will account for a major share of electricity consumption growth.
- Both of these sectors are responsible for fluctuations in demand during the day.

APEC Energy Demand and Supply Outlook 8th Edition
https://aperc.or.jp/reports/outlook.php

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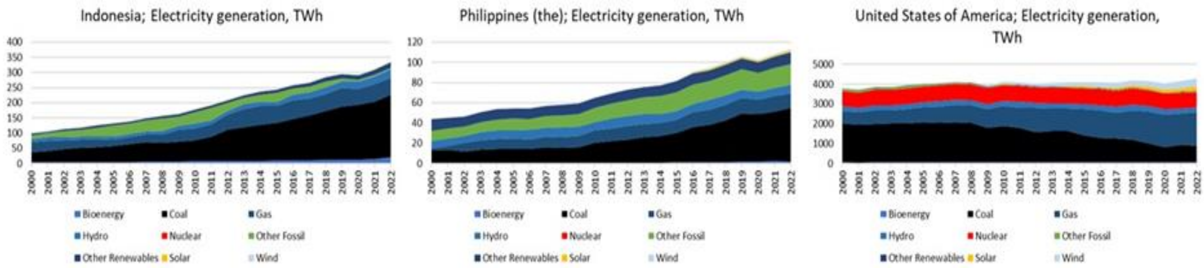
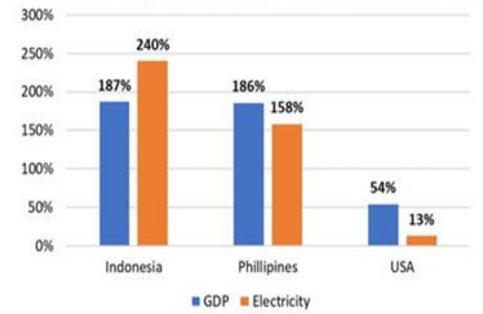
11

Economy cases: electricity generation vs GDP



GDP vs electricity consumption % change in 2000-2022



- The growth of electricity consumption in advanced and developing economies has been different: rapid in developing and modest in advanced economies.
- Electricity consumption growth in developing economies was comparable to GDP growth.
- In advanced economies GDP grew faster than electricity consumption

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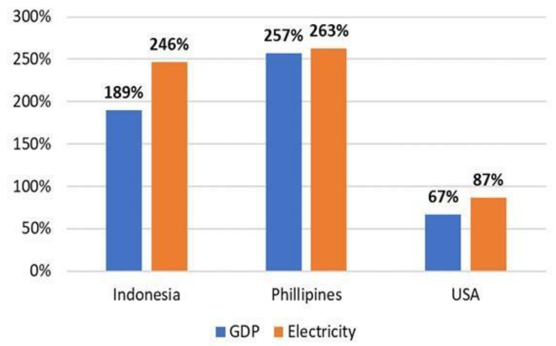
12

Economy cases: GDP vs electricity consumption change in 2022-2050



- Our GDP assumptions suggest that it will continue to grow at a comparable rate through 2050.
- But electricity consumption due to electrification is expected to grow much faster.
- Electricity consumption is likely to grow faster than GDP, even in advanced economies.
- This may make it more difficult to replace thermal generation with renewable energy sources and meet the growing demand for electricity at the same time.

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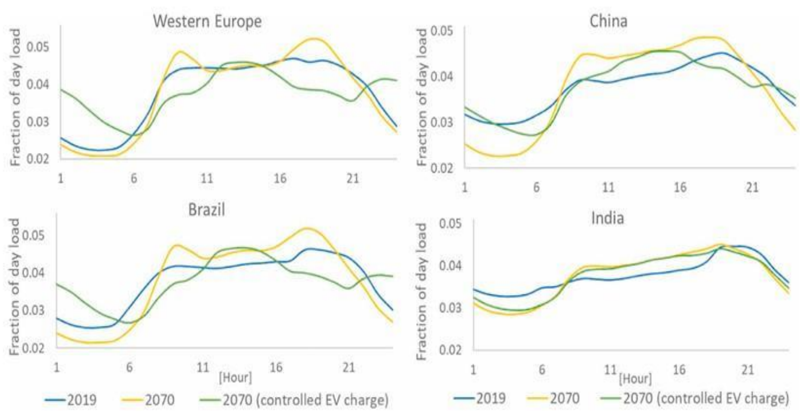
13

How to meet growing electricity demand?

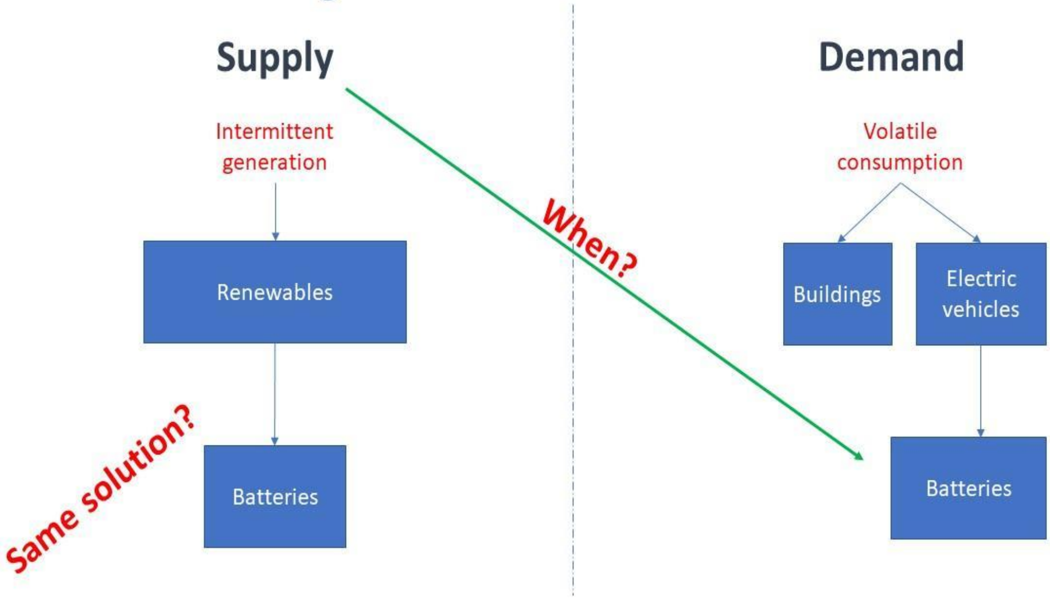


- <u>Efficiency vs Electrification</u>
  despite energy efficiency improvements, electrification is likely to increase electricity consumption
- <u>Electricity consumption is expected to increase in **Buildings** and **Transport**</u>
  How will the increase in consumption be distributed in the daily load?
  Do we need to change consumer behaviour?

APERC Future global electricity demand load curves https://doi.org/10.1016/j.energy.2022.124741

14

Batteries challenge



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Conclusions

- In general, unusual weather events lead to increased demand for electricity (higher than average).
- If the same weather circumstances cause a reduction in renewable generation, a supply constraint or even an emergency situation may occur in power systems with a high share of renewables.
- Power systems with a high share of renewables should be able to overcome such critical events without loss of stability and significant power supply limitations.
- The "Cannibalization" effect may slow down the implementation of new, especially grid-scale projects.
- Electricity demand is expected to grow despite energy savings and energy efficiency improvements.
- A key challenge is how to meet the increasing day-changing demand that will come from buildings and the transportation sector, with a growing share of intermittent generation from renewables.

APERC 16

Asia-Pacific Economic Cooperation

Energy Efficiency Policy (EEP) Workshop

The Role of Energy Efficiency in Transition to Cleaner Energy: A Developing Economy Perspective

Majah-Leah V. Ravago, PhD

16 October 2023, Monday, 9:30 am - 4:30pm
Makati Diamond Residences, Makati City

Energy Transition

Energy transition or decarbonization - shift from fossil-based fuels, such as oil, natural gas, and coal to renewable energy sources like wind, solar, and biomass.

- **Developed Economies**
  - **Take leadership positions regarding climate mitigation.**
- **Developing Economies**
  - **Prioritize increasing living standards.**

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Transition to cleaner energy implies transition to “electricity only” resources.

- Fossil fuels, when burned releases heat, which can be converted into mechanical energy and further into electricity.

Externalities:

- Burning creates emissions (including waste from inefficient conversion processes).

- Also creates noise

→

“Electricity only” resources

- Solar, wind, and biomass

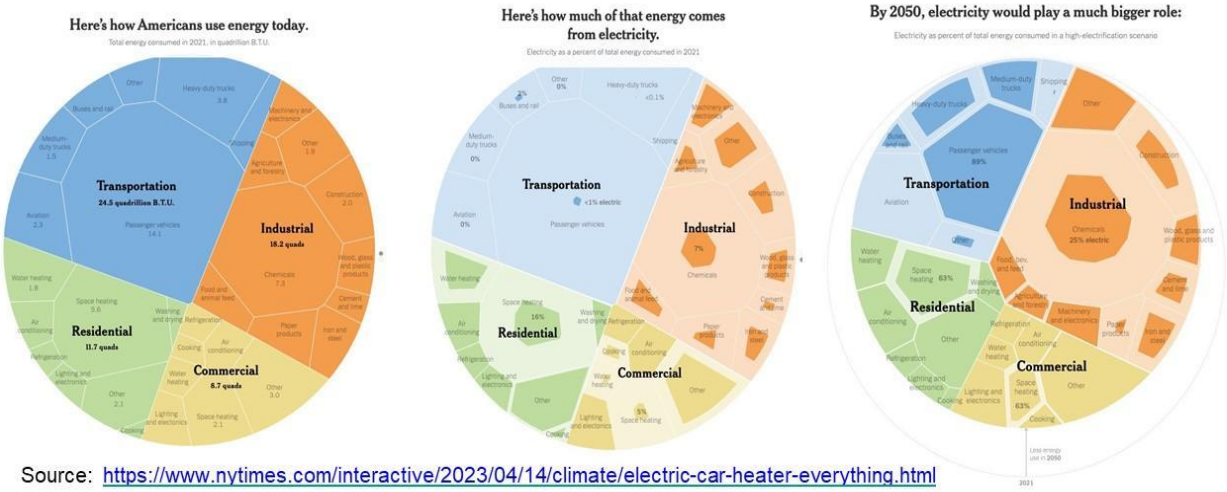
- Emerging resources: tidal and wave power

- Traditional resources: hydropower

- Electricity is at the center of this transition.
- Electricity will become the main format for delivering energy services.

Electrification will change the way we consume electricity....

Transform consumption sectors: transport, buildings, commercial and industrial processes

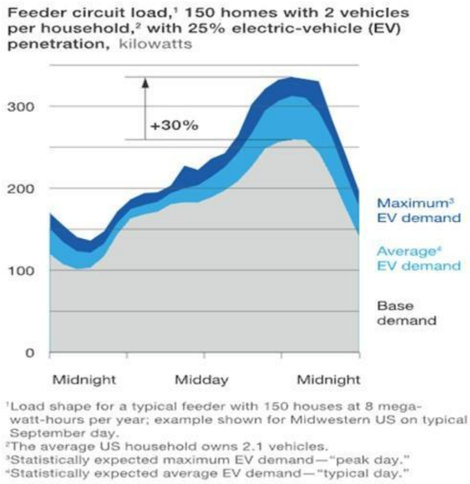


Source: https://www.nytimes.com/interactive/2023/04/14/climate/electric-car-heater-everything.html

Electrification will change daily consumption patterns

When local electric-vehicle penetration hits 25 percent, peak circuit loads can grow 30 percent.

Peak consumption shift to midnight when EVs are being charged at home.



Source: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-potential-impact-of-electric-vehicles-on-global-energy-systems

This is where energy efficiency comes in....

What is energy efficiency?

- Engineering applications: based on the first-law of thermodynamics and is a measurement of the heat content of inputs and outputs.
- Economic efficiency indicators which measure both input and output in monetary terms.

  $\frac{\text{Energy consumed}}{\text{Energy service}}$

  - <=>?@A B=C>=DBCA = Energy inputs / Useful !"#$"#%
  - <=>?@A >GGBHB>=HA = &%'(") !"#$"#% / +,'-./ 0,$"#%

- UN Sustainable Development Goal 7: "energy efficiency is most commonly measured in terms of "energy intensity" or the amount of energy used per unit of wealth created.
  - <=>?@A B=C>=DBCA = primary energy supply / annual GDP created

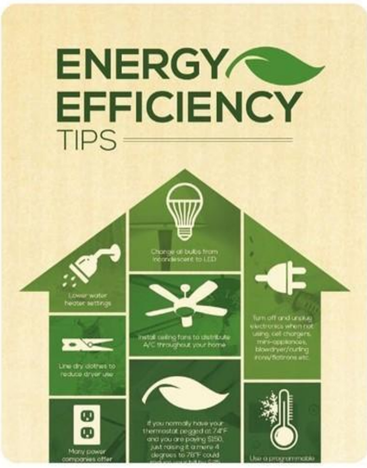
Role of energy efficiency in the transition

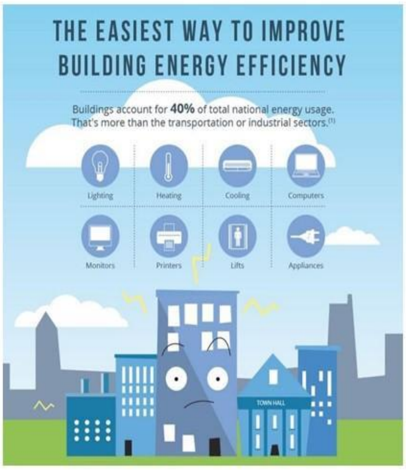
As the economy becomes more and more electrified and p by renewables, the system warrants more energy-efficient solutions towards energy transition.

- ❖ Once electrification is underway, it's essential to maximize energy efficiency in all sectors where electricity is used.

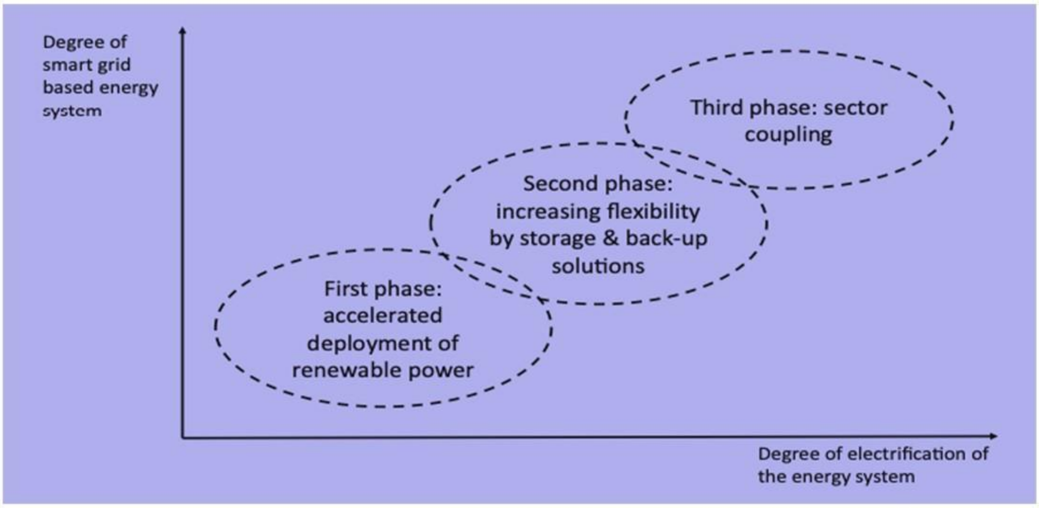
Electrification and energy efficiency measures

– Changing behavior
  - Revving charging up at times of excess solar and wind generation
  - Smart meters
  - Energy efficient appliances and technologies





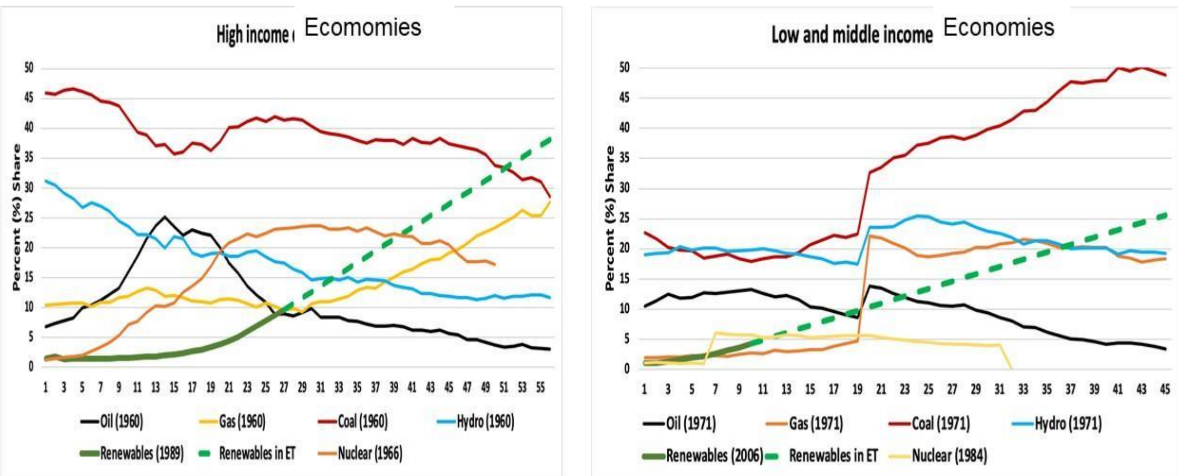
Stylized stages of electrification-based transition



Source: Aalto, Koj0, & Mori 2021. "Toward a roadmap for electrification."

Need to study the optimal nature of stages and timing.

Speed of penetration of RE in the energy system



Source of Basic Data: World Development Indicators, World Bank

Energy transition in developing economies...

Requires…

A. Scaling-up renewables in the energy mix
B. Transforming the power sector infrastructure (most importantly transmission)
C. Promoting energy efficiency

At the same time

Improve well-being

- Meet the increasing demand
- Keep energy affordable
- Provide access to the rest of the population

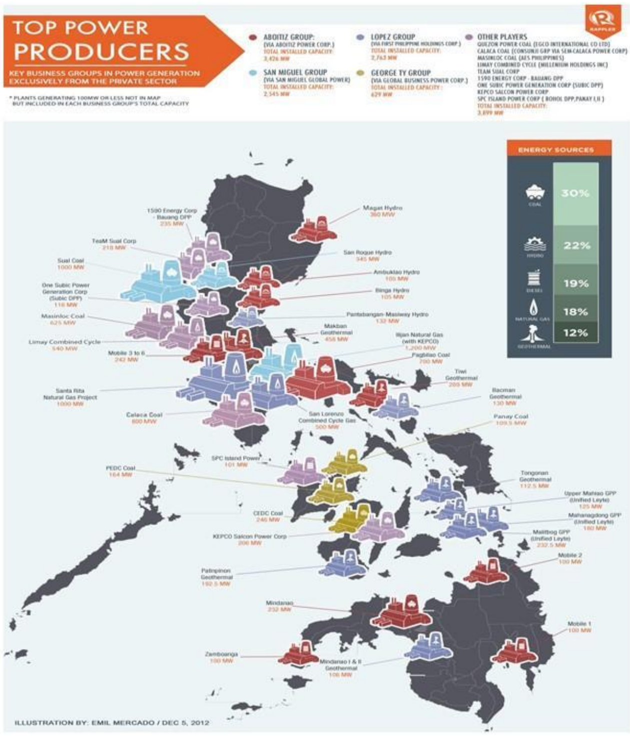
Mandates and subsidies tend to decrease efficiency.
Efficiency means facilitating renewable adoption when it is (socially) cheaper.

Energy transition and efficiency in developing economies present unique challenges and opportunities.

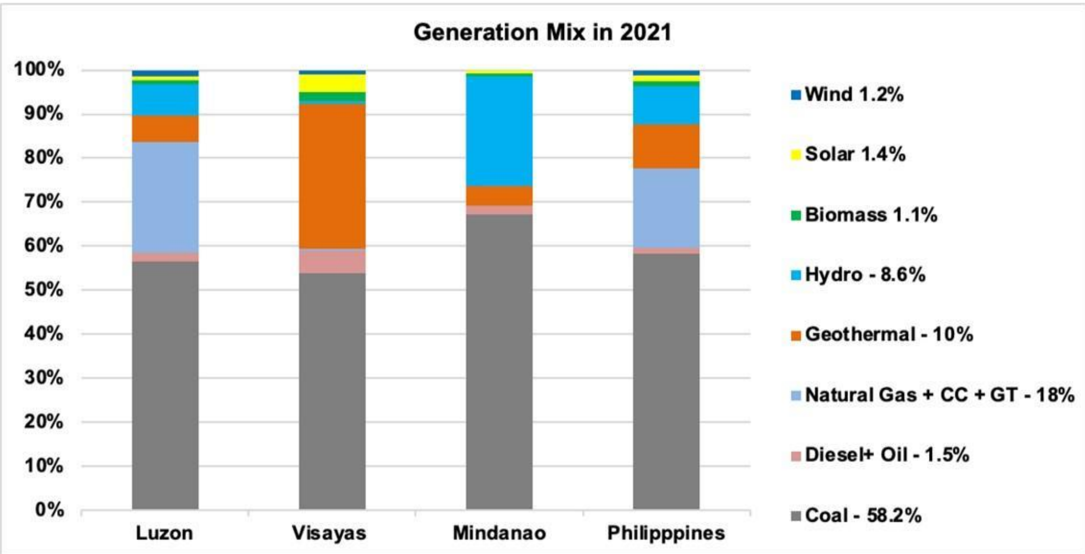
The Philippine case

A. Scaling up renewables in the mix

The Philippines aspire to have 35 percent of RE in the fuel mix by 2030 and 50 percent by 2040.



Small share of RE in generation capacity: 22.4%



Source of basic data: DOE Power Statistics

TOTAL	106,618,069	In MWh

14

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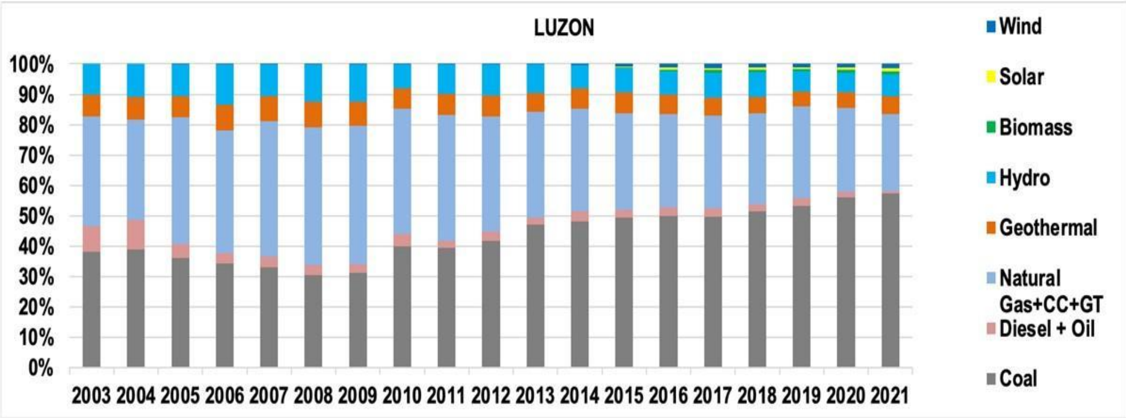
17% RE in Luzon generation mix in 2021

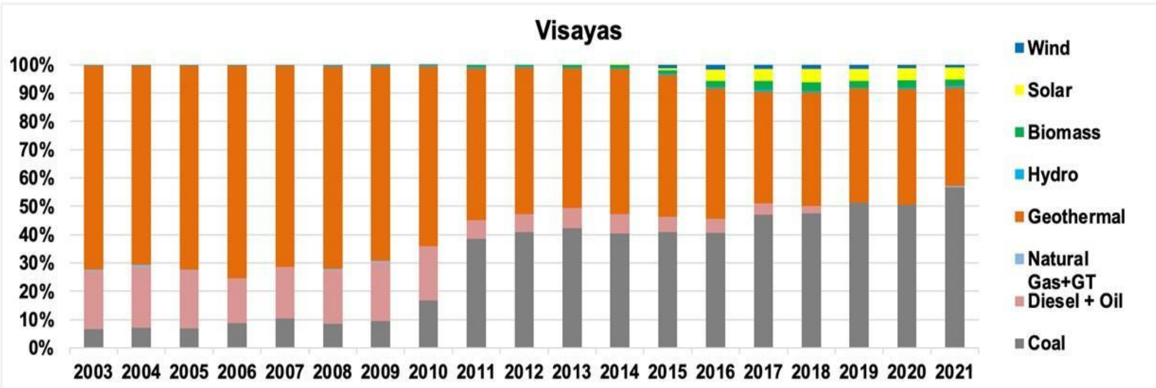


Total Grid Generation in '000 MWh

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
37,535	39,854	40,627	41,241	43,620	44,200	44,975	50,265	50,017	52,312	54,820	56,766	60,113	66,498	68,512	72,728	76,177	72,419	75,243

Source of basic data: DOE Power Statistics

42% RE in Visayas generation mix in 2021

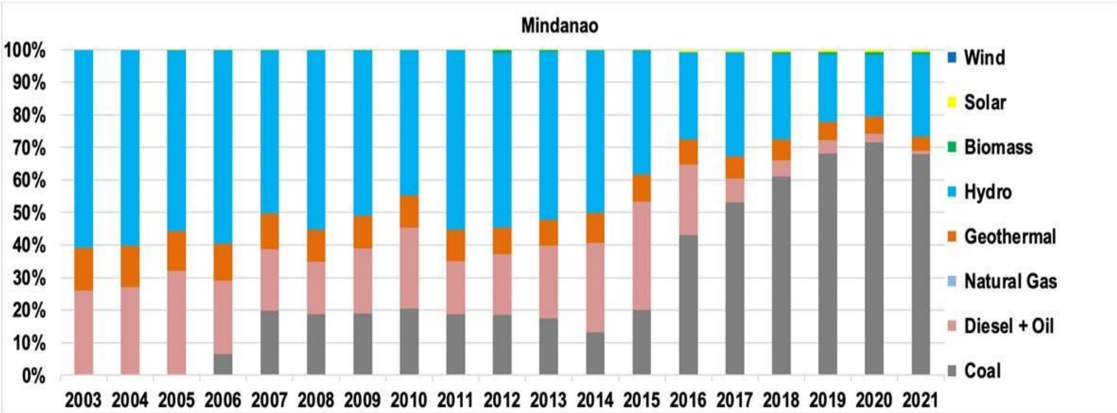


Total Grid Generation in '000 MWh

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
8,842	9,016	8,698	8,129	8,102	8,650	8,724	9,075	10,456	11,483	11,100	11,014	12,170	12,955	14,054	14,266	16,060	15,485	16,268

Source of basic data: DOE Power Statistics

31% RE in Mindanao generation mix in 2021



Total Grid Generation in '000 MWh

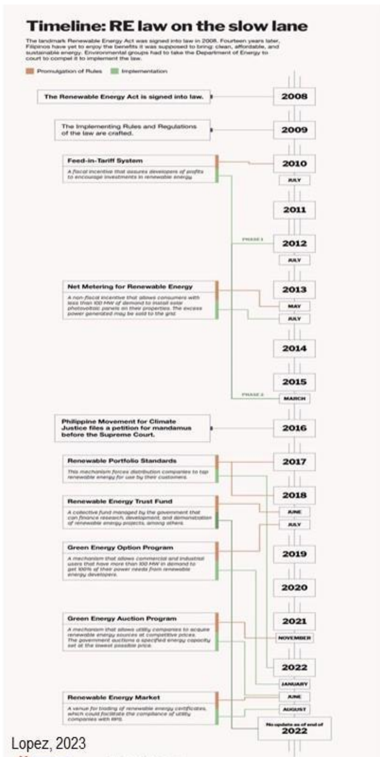
2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
6,564	7,087	7,243	7,414	7,890	7,972	8,235	8,403	8,703	9,127	9,347	9,481	10,130	11,345	11,804	12,770	13,805	13,852	14,604

Source of basic data: DOE Power Statistics

Why the slow penetration of RE?

- **VREs are cheap.**
  - **LCOE in lazard for utility scale solar is about 2.4 – 9.6 cents/kWh, while retail prices in the Philippines are around 20 cents/kWh.**
  - **So why is investment so low?**

Do investors prefer to wait for subsidies rather than go on their own?
Subsidies can potentially limit the pool of investors.



Lopez, 2023

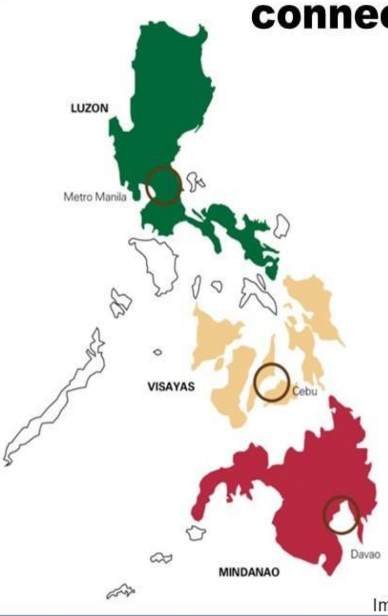
How does The Philippines expand RE?

- **Need to transform the power sector infrastructure.**
- **Need to address bottlenecks in transmission ...**

New transmission projects still need to pass benefit-cost test.

19 ATENEO DE MANILA UNIVERSITY PHILIPPINES

"Priority dispatch" policy but the grid is not fully connected.



Luzon and Visayas are presently connected with a 230 kV High Voltage Direct Current link that allows exchange of power for up to 440 MW.

Image from Thomas Ackermann

20 ATENEO DE MANILA UNIVERSITY PHILIPPINES

Need to ease regulatory burdens

- Permitting and other lags for both generation and transmission
  - Generation plants need at least 104 permits and take as long as 1.5 years before the construction starts.
  - Ease of Doing Business (2018) and the Energy Virtual One-stop Shop (2019) are promising ways forward, but implementation and operationalization needs to be expedited.
  - Right-of-way problems in building transmission.

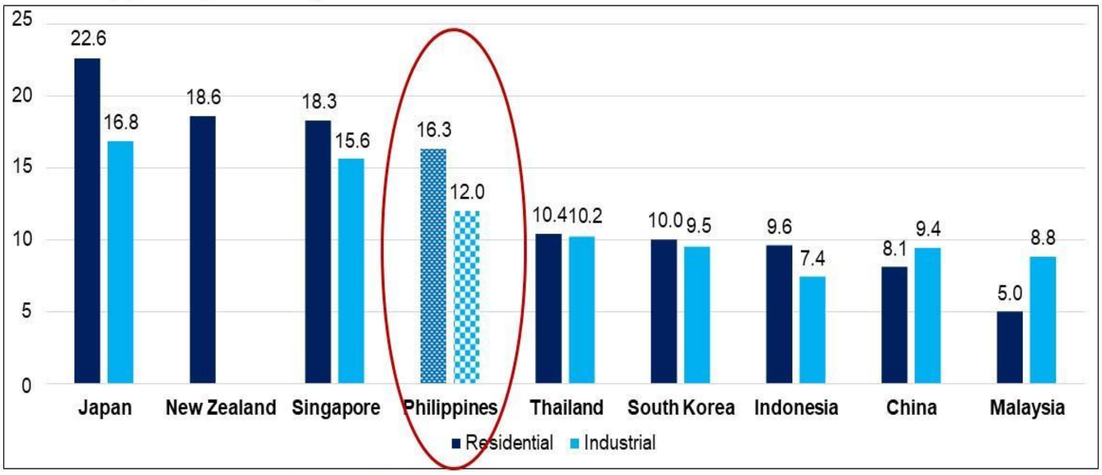
21 ATENEO DE MANILA UNIVERSITY PHILIPPINES

Structural changes in the energy sector must be mainstreamed with development.

- Achieving universal energy access is a fundamental goal.
- Some Filipinos still have limited access to reliable energy.
- Affordable energy has eluded the country for decades.

22 ATENEO DE MANILA UNIVERSITY PHILIPPINES

Electricity prices in the Philippines are high by regional standards.



Source of primary data: Global Petrol Prices. https://www.globalpetrolprices.com.

Development Agenda

AMBISYON NATIN 2040

No. 1 in the 8-Point Socioeconomic Agenda of the current administration 👉

1. Protect purchasing power of families

Ensure food security	Reduce transport and logistics cost	Reduce energy cost to families

Can transitioning to RE help in making electricity accessible and affordable?

- RE sources, such as decentralized solar power and microgrids, can play a crucial role in reaching remote and underserved communities.

Efficient Pricing: Economic Principles of efficient transition to clean energy

- The efficient (least social-cost) energy transition should take into account the declining costs of wind and solar power and the low costs of managing intermittency (Heal 2017).
- Taxes should reflect the marginal damage costs of pollution, especially from generation with coal.
  - Coal and petroleum excise taxes are part of the 2017 tax reform.
  - Pollution taxes can harmonize the quest for renewability with affordability and other objectives of EPIRA.

The social cost of pollution includes both the domestic cost from carbon emissions and the costs of local pollutants (SO_2, nitrous oxides, and particulate matter) that impinge on health.

The Philippines per capita consumption is low relative to its neighbors.

	Per capita electricity generation (kWh/cap), 2022[a]	Net installed electricity capacity (GW), 2020[c]	Population (million), 2022[d]	Per capita GDP (constant 2015 US$), 2022[d]
The Philippines	975.61	26.3	116	3,527.98
Indonesia	2,662.31	53.0	276	4,073.61
Thailand	1,210.67	49.6	72	6,278.17
Malaysia	5,318.78	33.4	34	11,371.97
Singapore	9,168.82	11.5	6	67,359.79
China	6,199.04	2,201.7	1,412	11,560.33
Japan	7,799.17	269.6	125	36,032.39
Korea	11,705.12	128.8	52	33,644.65
New Zealand	8,504.83	9.5	5	42,271.71

Sources: [a] Our World in Data. https://ourworldindata.org.
[c] United Nations Data. http://data.un.org. UN Statistics Division. https://unstats.un.org.
[d] World Development Indicators. https://data.worldbank.org

This is likely due to:
- Inefficient high prices.
- Reliability problems, especially for industry and services that either suffer losses or buy their own generator, both retarding productive investment.

27 ATENEO DE MANILA UNIVERSITY PHILIPPINES

Road to electrification...

S. No. 1382
H. No. 10213

Republic of the Philippines
Congress of the Philippines
Metro Manila

Eighteenth Congress

Third Regular Session

Begun and held in Metro Manila, on Monday, the twenty-sixth day of July, two thousand twenty-one.

[REPUBLIC ACT NO. 11697]

AN ACT PROVIDING FOR THE DEVELOPMENT OF THE ELECTRIC VEHICLE INDUSTRY

Passed into law on April 15, 2022.

ELECTRIC VEHICLE INDUSTRY DEVELOPMENT ACT (EVIDA)

Comprehensive Roadmap for the Electric Vehicle Industry (CREVI)

CREVI is the national development plan for the EV industry with an annual work plan to accelerate the development, commercialization, and utilization of EVs in the Philippines. CREVI has the following components:

- Electric Vehicles and
- EV Charging Stations
- Manufacturing
- Research and Development
- Human Resource Development

SALIENT FEATURES OF EVIDA - IRR

- Electric Vehicle and EV Charging Station
- Electricity for EV Charging Station
- EV Charging Station Provider
- Mandatory EV Share in Corporate and Government Fleets
- Dedicated Parking Slots for Evs
- Fiscal and Non-Fiscal Incentives
- Prohibited Acts, Fines, and Penalties

28 ATENEO DE MANILA UNIVERSITY PHILIPPINES

Promote energy efficiency

S. No. 1531
H. No. 8629

Republic of the Philippines
Congress of the Philippines
Metro Manila

Seventeenth Congress

Third Regular Session

Begun and held in Metro Manila, on Monday, the twenty-third day of July, two thousand eighteen.

[REPUBLIC ACT NO. 11285]

AN ACT INSTITUTIONALIZING ENERGY EFFICIENCY AND CONSERVATION, ENHANCING THE EFFICIENT USE OF ENERGY, AND GRANTING INCENTIVES TO ENERGY EFFICIENCY AND CONSERVATION PROJECTS

Approved and signed by President Rodrigo Roa Duterte on 12 April 2019 and effective on 22 May 2019.

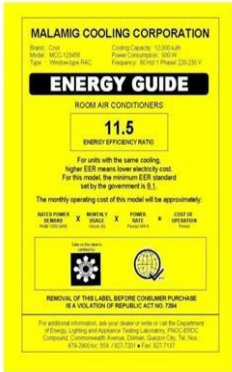
Philippines' efforts towards energy efficiency

Source: DOE Philippines

Are eco-labels effective?

- We conducted the face-to-face survey in 2019 and 2022 to investigate what influence people to buy AC (price, additional function, energy efficiency, manufacturer)
- People tend to choose AC …
  - with smart function helping people use AC more efficiently
  - manufactured by Philippine manufacturers
  - with higher(est) energy efficiency
- Energy efficient AC could be chosen by 15 percentage points more if Energy Star Rating is shown compared to EER

VS



Nakai, M., **M. V. Ravago**, Y. Miyaoka, K. Saito, T. Arimura. 2023. "Consumers' Preferences for Energy-Efficient Air Conditioners in a Developing Country: A Discrete Choice Experiment Using Eco Labels," *Energy Efficiency,* 16(14) https://doi.org/10.1007/s12053-023-10095-8

Balancing low energy consumption in developing economies with energy efficiency

Developed economy's concern: Rebound effect (increased energy usage because consumer efficiency measures reduce energy costs).

- Developing economies: energy efficiency policies are not necessarily aimed at reducing energy consumption.
  – More on achieving greater efficiency, i.e., at reducing the amount of energy required for one unit of service output.

When energy consumption remains constant after applying energy efficiency measures, the energy savings enable consumers to expand energy services, thereby increasing welfare.

Concluding Remarks

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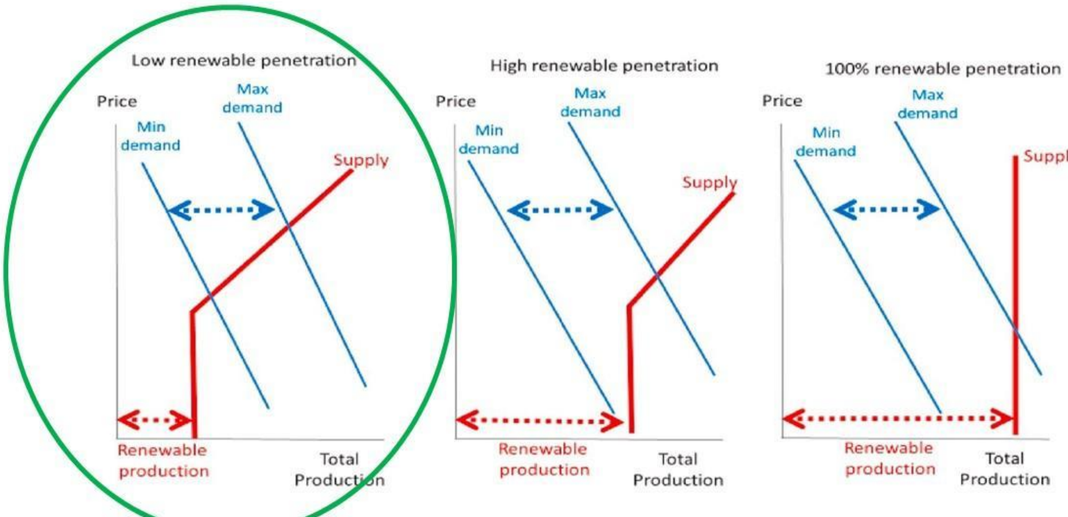
Transition is not abrupt... it is a dynamic process



Stages in the Energy Transition

Source: Blazques, Fuentes, Manzano 2020

As the economy aspire to transition to cleaner energy and becomes electrified, energy efficiency becomes increasingly important.

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The Philippines is in a good position to implement reforms necessary for energy transition....

- **Moratorium on new coal power plants.**
- **Liberalization of the RE sector; relaxation of the 60-40 rule (local content)**

SENATE
S.B. No. 157
RECEIVED BY:

Introduced by Senator WIN GATCHALIAN

AN ACT PROVIDING FOR A NATIONAL ENERGY POLICY AND FRAMEWORK FOR A CLEAN AND JUST ENERGY TRANSITION IN THE COUNTRY, AND APPROPRIATING FUNDS THEREFOR

https://legacy.senate.gov.ph/lisdata/3786534306!.pdf

DoE, ERC seek enhanced powers in EPIRA amendments

BusinessWorld

May 23, 2023 | 8:44 pm

https://www.bworldonline.com/economy/2023/05/23/524581/doe-erc-seek-enhanced-powers-in-epira-amendments/

GMA NEWS ONLINE
YOUR NEWS AUTHORITY

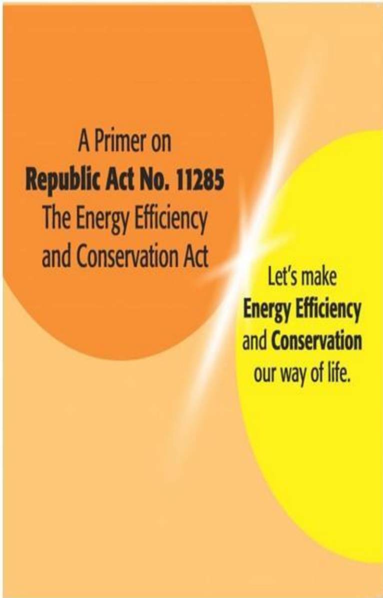
NEWS

DOE urges Congress to review NGCP franchise amid energy transmission problems

By LLANESCA T. PANTI, GMA Integrated News
Published May 16, 2023 3:14pm

https://www.gmanetwork.com/news/topstories/nation/870193/doe-urges-congress-to-review-ngcp-franchise-amid-energy-transmission-problems/story/

The challenge is to translate these intentions to actual reforms to realize AMBISYON2040.

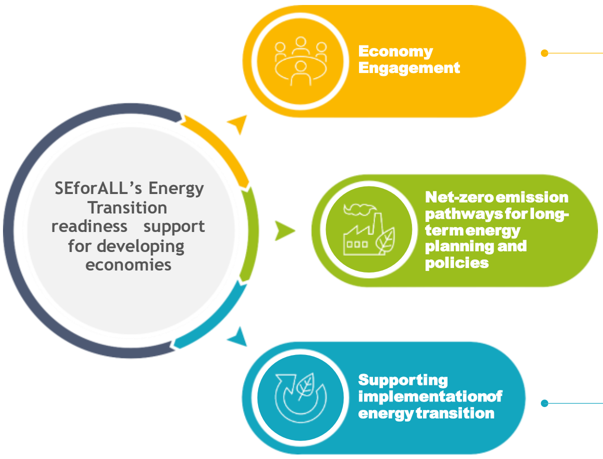


Agenda

1. **Sustainable Energy for All**
2. The Role of Energy Efficiency in the Energy Transition
3. Mission Efficiency and Partner Initiatives

2

SEforALL supports economies to achieve SDG7 and SDG13 goals



- Global engagement & advocacy
- Domestic stakeholder dialogues
- Just transition engagement

- Modern Energy Minimum access
- Demand side – energy efficiency, storage, demand response and cleaner fuel switching
- Supply side – Grid RE, DRE, and sector coupling
- Cost of abatement and removal of emissions
- Macroeconomic cost-benefits

- Institutional & policy ecosystem
- Investment strategy and engagement
- Innovation loop-based implementation framework

3

Agenda

1. Sustainable Energy for All
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3. Mission Efficiency and Partner Initiatives

4

#1 Energy efficiency is one of the cost-effective solutions to achieve the NZE

Energy efficiency can be done today

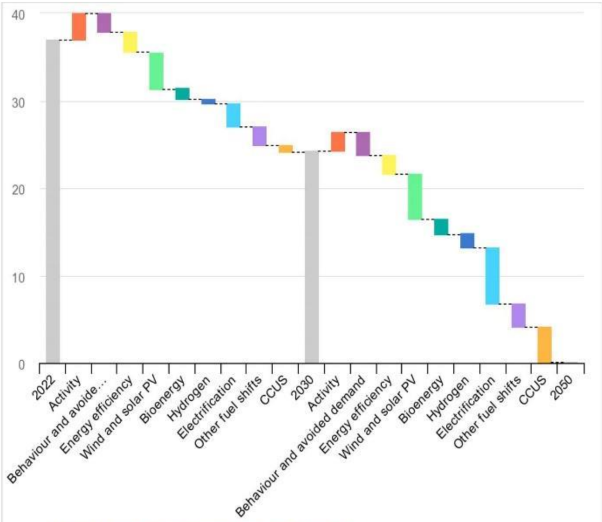
Energy efficiency policy and technology solutions are available

Energy efficiency brings social, economic, and health benefits

- Energy efficiency to deliver over 40% of the Paris Agreement (IEA)
- Energy efficiency investment brings local jobs and local benefits

Emissions reduction potential by mitigation measure, 2020-50

(in Gt CO2)

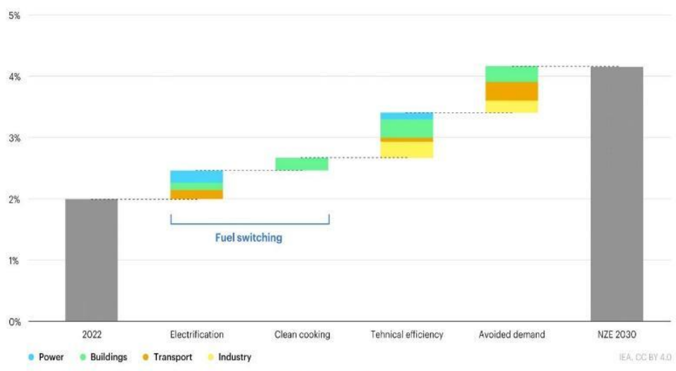


Source: IEA (2023) Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach

5

#2 Energy efficiency is one of the key levers in reducing energy intensity

Average annual rate of total energy intensity reduction by lever



Source: IEA (2023) Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach

- Achieving the rate of energy intensity reduction by leveraging:
  - **Fuel switching** to electricity, renewables, or modern cooking services
  - Improvement in **technical efficiency**
  - The more **efficient use of materials and energy** including through behavioral change
- Improving the rate of energy intensity makes a critical contribution to emission reduction while also bolstering energy affordability and security
- Both decarbonizing and implementing energy efficiency measures in the power sector are important to improve the rate of energy intensity

6

#3 Securing electricity supplies becomes more important in the NZE scenario

- Reducing inefficiencies in electricity transmission and distribution can significantly lower carbon emissions
- In 2021, 1 972 billion kWh were lost in transmission, or 7.2% of total generation. These losses compared with electricity generated can be very important in some countries, jeopardizing social and economic development.
- Potential solutions:
  - upgrading transformers, and power lines,
  - optimizing reactive power profiles,
  - investing in smart grids to manage load peaks,
  - integrating renewables,
  - promote electric vehicle adoption,
  - improve overall energy efficiency

% Transmission & Distribution losses of APEC Members in 2021

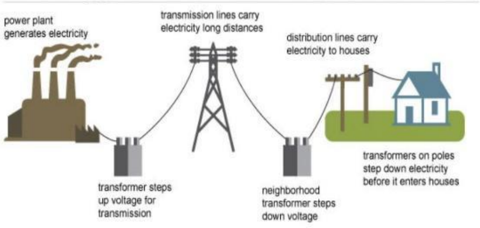
Australia	3.8	Papua New Guinea	6.1
Brunei Darussalam	9.4	Peru	11.0
Canada	5.3	the Philippines	9.0
Chile	3.9	Russia	8.6
China	4.0	Singapore	1.1
Hong Kong, China	4.2	Korea	3.3
Indonesia	8.5	Chinese Taipei	3.1
Japan	4.4	Thailand	6.9
Malaysia	7.6	The U.S.	5.4
Mexico	11.4	Viet Nam	6.7
New Zealand	6.7	APEC Average	6.2

Transmission and distribution losses compared to net electricity generated (in billion kWh)
Source: EIA (latest statistics in 2021)

7

Reducing losses is needed to increase the efficiency of the grid system

Electricity generation, transmission, and distribution



Source: adapted from EIA

Grid losses

- Technical losses: Fixed losses; Variable losses
- Non-technical or commercial losses: Meter error; Theft and illegal connection, …

Proven methods for reducing losses (Schneider Electric, 2020)

1. Organizational strategy
   - Feeder and transformer loading
   - Balancing load between phases
   - Fault and maintenance management
   - Demand response management, …
2. Technical: efficient components or solutions
   - Efficient transformers
   - Network automation
   - Harmonic filters
   - Reactive power compensation, …
3. Data management
   - Monitoring (SCADA)
   - Smart metering, …

8

Demand response enhance grid resilience and reliability

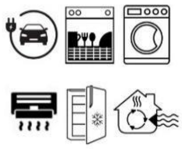
Demand response vs Demand-side management

- **Demand response (DR): specific and immediate actions** taken by consumers, facilities, or utilities by shifting or reducing electricity consumption to keep the power grid stable (supply-demand balance) during critical periods
- **Demand-side management (DSM):** a **broader and long-term approach** that encompasses a range of initiatives and strategies including activities like energy efficiency programs, load management, consumer education, and the adoption of energy-saving technologies

DR application in buildings

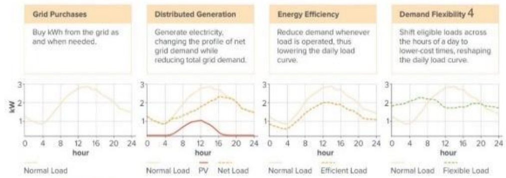
Shiftable loads

Sheddable loads



What is the role of DR in power flexibility?

"Power system flexibility is the ability of a power system to reliably and cost-effectively manage the variability and uncertainty of demand and supply across all relevant timescales."



Source: RMI (2015)

- Demand flexibility is a practice in adjusting load (or energy usage) to match (be reduced, increased, or shifted) the electricity supply.
- Power flexibility, derived from demand response and other sources e.g., energy storage, enables the grid to adapt to sudden changes in demand or supply, ensuring a consistent and reliable electricity supply.

9

EE Technology in Power Plant: Cogeneration or Combined Heat and Power (CHP)

Cogeneration vs Separate Power Generation

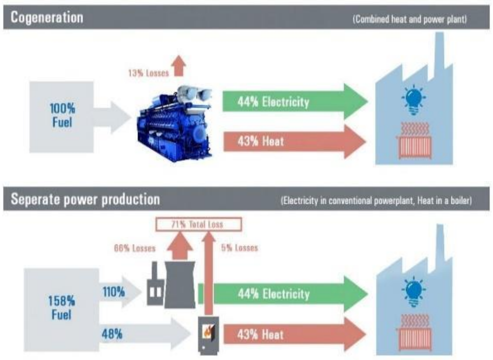


Illustration source

Key parameters of each cogeneration system

Cogeneration system	Heat-to-power ratio (kWth / kWe)	Power output (as % of fuel input)	Overall efficiency (%)
Back-pressure steam turbine	4.0 – 14.3	14 – 28	84 – 92
Extraction-condensing steam turbine	2.0 – 10.0	22 – 40	60 – 80
Gas turbine	1.3 – 2.0	24 – 35	70 – 85
Combined cycle	1.0 – 1.7	34 – 40	69 – 83
Reciprocating engine	1.1 – 2.5	33 – 53	75 – 85

Source: Bureau of Energy Efficiency, Govt of India

Capital **investment** ranges from $600 to $720 per kW

Potential **savings** due to the improved efficiency range from 30% to 50%

10

Agenda

1. Sustainable Energy for All
2. The Role of Energy Efficiency in the Energy Transition
3. **Mission Efficiency and Partner Initiatives**

11

Mission Efficiency is a global collective of actions, commitments and goals on energy efficiency by a coalition of governments, organizations and initiatives. Energy efficiency represents the largest share of cost-effective actions to achieve the Paris Agreement.

Mission Efficiency unites these partners and actions to accelerate the transition towards energy efficient economies worldwide.

Learn more at missionefficiency.org

Mission Efficiency

Photo: Energy efficiency financing charette hosted at the UNEP Copenhagen Climate Centre, June 2022

12

Mission Efficiency

Elevate. Support. Invest.

Seeking to drive progress on energy efficiency:

- **Elevate energy efficiency** in personal, organizational and global agendas - a clear narrative, convening partners, matching solution offers and advocating for energy efficiency.
- **Support energy efficiency** with strategic and technical assistance by partners for progress in economies on key issues in high impact sectors, across multiple sectors or economy wide.
- **Invest in energy efficiency** with coordinated and actionable project funding through loans, grants and incentives for infrastructure and projects by economies, funds and financial institutions.

www.MissionEfficiency.org

13

An Energy Efficiency Ecosystem.

non-exhaustive list of ecosystem partners

Energy Efficiency Market Readiness

The outcomes of the Energy Efficiency Financing Charette included the creation of four taskforces to work together in supporting market readiness for energy efficiency investment:

Energy Efficiency Narrative Taskforce

To reframe key messages for a range of audiences on the benefits, experiences and feelings received from energy efficiency.

Widening the Net Taskforce

Identification of key partners and socializing energy efficiency investment with economy/city governments, solution providers and capital markets.

Solutions Selector Tool Taskforce

Building on years of success with the EBRD Green Technology Selector and Carbon Trust's work, this taskforce will work to further expand the tool for use across more economies and to capture all bankable energy efficiency solutions (technologies, services) and the policies that enable energy efficiency investment.

Mission Efficiency Marketplace Taskforce

Supporting market readiness for energy efficiency investment, including through a facility to de-risk energy efficiency finance, through project origination and matchmaking and through collective support from partner initiatives to enable integrated investments and reduce risk, cost and time for financial institutions and investors.

15

SUSTAINABLE ENERGY FOR ALL

Mission Efficiency

Partner Initiatives

Grid Efficiency and Resilience (GEAR) 1 2

GEAR

ABOUT GEAR

GEAR exists to improve electricity grid efficiency and resilience in emerging markets.

Mission: Maximise the amount of electricity delivered to households and businesses in emerging markets, thereby accelerating socioeconomic development and reducing GHG emissions.

Focus areas:

1. Provide policy support to improve the energy efficiency of products.
2. Increase the uptake of energy efficient distribution transformers and interconnection of distributed renewables and the grid.
3. Derisk and match energy efficiency projects with appropriate investment and technology.
4. Enhance capacity to improve grid maintenance.

GEAR

www.gear-initiative.org

Managed by

Alliance for Rural Electrification — *Shining a Light for Progress*

Founding partners

iea · Sustainable Energy for All · UNIDO · International Copper Association · Carbon Trust · U4E

17

Grid Efficiency and Resilience (GEAR) 1 2

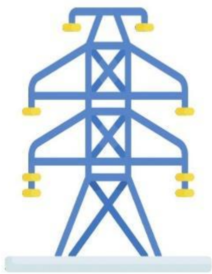
GEAR KEY ACTIVITIES

1 Support utilities in **identifying energy efficiency projects,** including the phase-out of inefficient equipment.

2 **Perform grid assessments, analysis and evaluations** for utilities and governments from developing countries to help develop energy efficiency projects.

3 **De-risk and match** identified energy efficiency **projects with appropriate finance and state-of-the-art technologies.**

4 Provide **capacity building** to utilities and other key stakeholders **to improve grid maintenance.**



LEARN MORE

www.gear-initiative.org

18

Cornerstone of Rural Electrification (CORE) 1 2

About: CORE provides **technical training and certification** on aspects related to increasing **safety, efficiency and reliability** of DRE systems.

Mission: CORE enables resilient rural and peri-urban communities by ensuring **safety, efficiency, reliability** and **sustainability** become the cornerstone of decentralized electrification.

Vision: As the world moves towards universal access by 2030, CORE supports and improves the livelihood of rural communities by ensuring all decentralized electrification projects meet the **highest standards of sustainability.**

www.core-initiative.org

19

Cornerstone of Rural Electrification (CORE) 1 2

OUR IMPACT

1,521 practitioners trained
in Africa, Asia & Latin America between 2021 and 2023

84 trainers trained
in Lesotho, Nigeria, Rwanda, Uganda and Thailand between 2021 and 2023

15 trainings
between 2021 and 2023

12 economies covered so far
including Chad, Ethiopia, Nigeria, Kenya, Lesotho, Malawi, the Philippines, Rwanda, Thailand, Uganda and Zambia

LEARN MORE

www.core-initiative.org

20

Global Energy Efficiency Accelerator Platform

- The Global Energy Efficiency Accelerator Platform was launched by SEforALL in 2014.
- Accelerators have focused on six key energy efficiency sectors.
- One platform defining common elements to support progress (e.g., governance, performance metrics, reporting, commitment management, policies, resources, tools, public and private financial support).

1 2

Appliances and Equipment and Lighting Accelerator

Building Efficiency Accelerator

District Energy in Cities Initiative

Global Fuel Economy Initiative

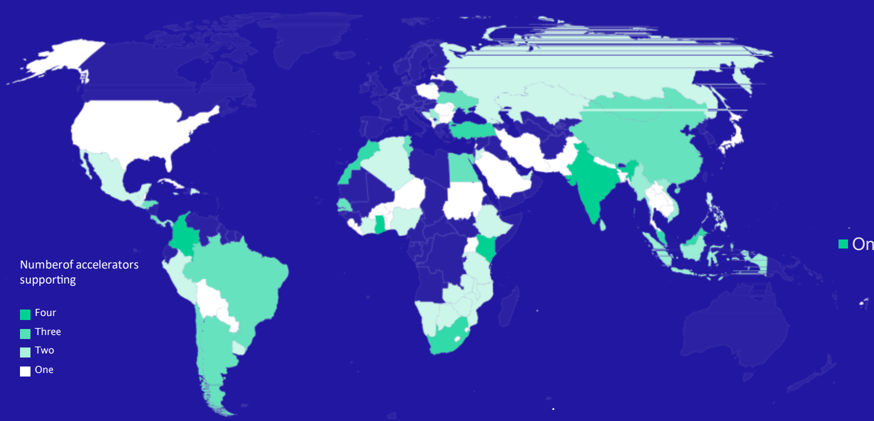
Industrial Energy Accelerator

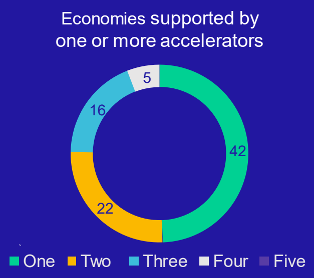
21

1 2

Mission Efficiency builds on the **Global Energy Efficiency Accelerator Platform**, which together:

- ✔ Has supported 85 economies to deliver energy efficiency progress
- ✔ Mobilized almost $180Min efficiency investment by 2020





$176.9M

investment mobilized

22


SUSTAINABLE
ENERGY
FOR ALL
THANK YOU !
www.seforall.org

Distribution Automation of Power Grids
for Energy Efficiency

Dr. Yoonhee Ha

- Professor at Korea University
- Vice President, Energy and Industry Transition Sub-Commission, Presidential Commission on Carbon Neutrality and Green Growth

Part I:

Digitalization-Driven Power System Efficiency

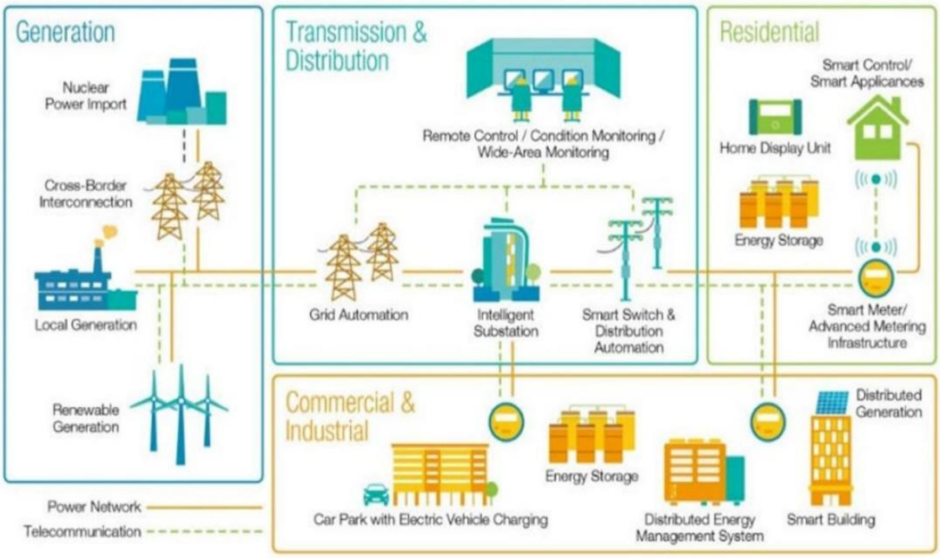
Part 1

Smart Grid

- ✓ An advanced electrical grid infrastructure
- ✓ Uses sophisticated information and communication technologies
- ✓ Improves the reliability, efficiency, and sustainability of electricity production, distribution, and consumption
- ✓ Involves integrating digital technology into the existing electrical network to enable real-time monitoring, coordination, and operation of various connected components throughout the power network, from generation to consumption

Part 1

SELECT SMART GRID TECHNOLOGIES ACROSS THE POWER SYSTEM



Source: CLP[9], Power Transmission and Distribution in the Smart Grid

Part 1

Key Components of Smart Grid

Power Grid

An advanced IT-based power grid equipped with a real-time monitoring system, automated control and management systems, and an integrated control system for renewable energy, among other features

Infrastructure

Core infrastructure components of the smart grid, including Advanced Metering Infrastructure (AMI), Vehicle-to-Grid (V2G) technology, Energy Management Systems (EMS), and Phasor Measurement Units (PMU)

Data

Real-time data exchange and analysis among suppliers, consumers, intermediaries, and market operators to enhance energy efficiency

Market and Institution

Real-time pricing and emerging electricity service markets utilize two-way communication and consolidated power data

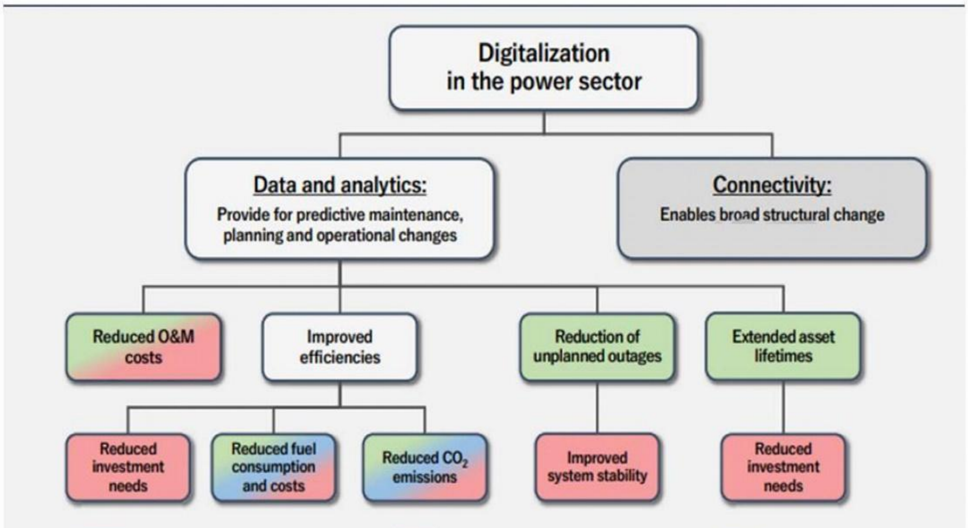
Part 1

Benefits of Smart Grid

- Enhanced Energy Efficiency
- Greenhouse Gas Emissions Reduction
- Operational Efficiency for Utilities
- Improved Reliability and Resilience
- Integration of DERS (Renewable Energy Sources)
- Enhanced Grid Security
- Consumer Empowerment

Part 1

Impact of Digitalization on Electricity Sector Assets

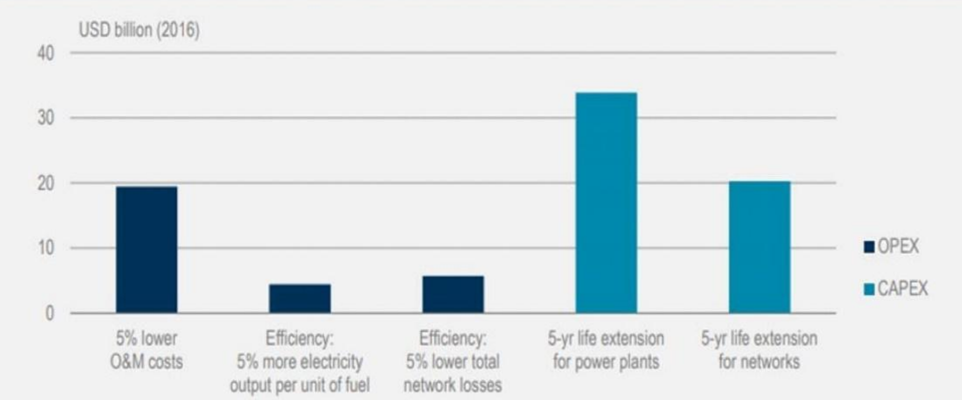


Notes: green: financial benefits for asset owner; red: system benefits, consumer benefits; blue: global environmental benefits; CO_2 = carbon dioxide.

Source: US Department of Energy. (January 2022). 2020 Smart Grid System Report. United States Department of Energy, Washington, DC 20585

Part 1

Potential Worldwide Cost Savings from Enhanced Digitalization in Power Plants and Electricity Networks (2016-40)



Key message: Cumulative savings from the widespread use of digital data and analytics in power plants and electricity networks could average around USD 80 billion per year.

Notes: Assumes the enhanced global deployment of existing digital technologies to all power plants and network infrastructure; CAPEX = capital expenditure; OPEX = operational expenditure; yr = year.

Source: IEA (2017), *Digitalization and Energy*, IEA, Paris https://www.iea.org/reports/digitalisation-and-energy, License: CC BY 4.0

Part 1 The U.S. Potential Energy Consumption and Carbon Emissions Reductions from Smart Grid Deployment in 2030 (1)

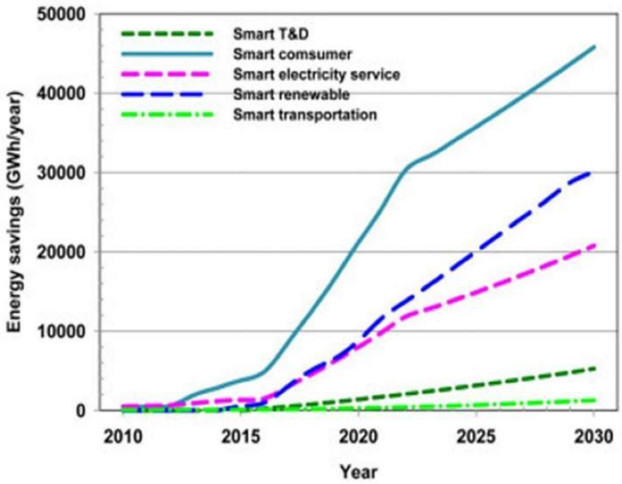
	Reduced Energy Consumption (2030)					Electric Sector Annual Reductions (2030)			
				Baseline Electricity Consumption		Energy		Carbon Emissions	
Direct Reduction Mechanism	Est. %	Low %	High %	End-Use Sector(s)	(10^9 kWh/year)	% of United States	(10^9 kWh/ year)	% of United States	(MMT/ yearr)
A. Conservation Effect of Consumer Information and Feedback Systems	6	1	10	Residential	1722	3	155	3	92
	6	1	10	Small/Medium Commercial Buildings	854				
C. Enabling Mass Deployment of Diagnostics in Residential and Small/Medium Commercial Buildings	15	10	20	Residential (Heat Pump & Air Conditioner)	331	3	152	3	90
	20	10	30	Small/Medium Commercial Buildings (HVAC + Lighting)	510				
D. Measurement and Verification for Efficiency Programs: *Marginal Efficiency Measures Enabled by Acurate M&V*	7	5	20	Residential (Heat Pump & Air Conditioner)	331	1	59	1	35
	7	5	20	Small/Medium Commercial Buildings (HVAC + Lighting)	510		155		
E. Shifting Load to More Efficient Generation	0.04	0.02	0.06	Total Electric Supply	4968	0.04	2	0.03	1

Source: Pratt, R. G., Balducci, P. J., Gerkensmeyer, C., Katipamula, S., Kintner-Meyer, M. C., Sanquist, T. F., ... & Secrest, T. J. (2010). *The smart grid: An estimation of the energy and CO_2 benefits* (No. PNNL-19112 Rev 1). Pacific Northwest National Lab.(PNNL), Richland, WA (United States).

Part 1 The U.S. Potential Energy Consumption and Carbon Emissions Reductions from Smart Grid Deployment in 2030 (2)

	Reduced Energy Consumption (2030)					Electric Sector Annual Reductions (2030)			
				Baseline Electricity Consumption		Energy		Carbon Emissions	
Direct Reduction Mechanism	Est. %	Low %	High %	End-Use Sector(s)	(10^9 kWh/year)	% of United States	(10^9 kWh/ year)	% of United States	(MMT/ yearr)
F. Support Additional Electric Vehicles (EVs) / Plug-In Hybrid Electric Vehicles (PHEVs)	3	2	5	Electricity Equivalent of Light Vehicle Transportation (cars, vans, SUVs, light trucks)	5135	3	139	3	82
G. Conservation Voltage Reduction and Advanced Voltage Control	2	1	4	Total Electric Supply	4968	2	99	2	59
H. Support Penetration of Solar Generation: *Reduced Energy for Regulation (25% RPS)*	Note: Estimates for extra regulation required by solar generation are not available, but may be similar to that for wind. Therefore the savings for meeting a 20% RPS, all or in part with solar, are already included in the estimates for wind generation (Mechanism I)								
I. Support Penetration of Wind Generation: *Reduced Energy for Regulation (25% RPS)*	20	10	30	Fuel Savings for 0.1% Additional Regulation Requirement	5	0.02	1	0.02	1
Total, Direct Reductions									
without additional EVs/PHEVs						**9**	**931**	**9**	**277**
including support for additional EVs/PHEVs						**12**	**1070**	**12**	**359**

Source: Pratt, R. G., Balducci, P. J., Gerkensmeyer, C., Katipamula, S., Kintner-Meyer, M. C., Sanquist, T. F., ... & Secrest, T. J. (2010). *The smart grid: An estimation of the energy and CO_2 benefits* (No. PNNL-19112 Rev 1). Pacific Northwest National Lab.(PNNL), Richland, WA (United States).



Source: Soo-Hwan Park.Sang-Jun Han.Jung-Ho Wee (2017). Analysis of Energy Savings and CO_2 Emission Reductions via Application of Smart Grid System. *Journal of Korean Society of Environmental Engineering*, Vol. 39(6), pp. 356~370.

Part II:

Korea's Roadmap

Achievements & Limitations:
Smart Grid Deployment Policies in Korea

Korea's Smart Grid Master Plans

- **1st Phase**: 2012-2016
- **2nd Phase**: 2018-2022
- **3rd Phase**: 2023-2027

Under the law governing the development and promotion of smart grids, Korea formulates a master plan every five years and has consistently advanced the development of its smart grid infrastructure based on these plans.

Action Plan 1: Empowering Small-Scale Demand Resources

Achievements

- Introduction of the Electricity Brokerage Market
- Launch of the National DR (Demand Response) Market
- Pilot Time-of-Use Tariff in Jeju
- Strengthened consumer choices in the power market

Limitations

- Various new services have been introduced, but due to insufficient benefits for customers and businesses, voluntary participation and full-scale proliferation are lacking.

Action Plan 2: Creation of a Smart Grid Experience Zone

Achievements

- **Grid Demonstration Project**: A total investment of USD 223 million from 2018 to 2022
- **Smart Grid Infrastructure Deployment**: AMI, solar panels, ESS, EV chargers
  - Seoul(3,000 households), Gwangju(8,000 households)
- **Through Implementation of 4 programs**, achieved 4.3% reduction compared to previous levels
  - Customer-Participatory Green Tariff, Renewable Energy Sharing Community, Mobile Energy Share Car, Virtual Power Plant Electricity Trading

Limitations

- Under the current laws and electricity sales systems, it is difficult to implement various demonstration cases, and there is a lack of consideration for various types of consumers.

Action Plan 3: Enhancing Infrastructure & Facilities

Achievements

- Establishing an Integrated Renewable Energy Control System
- Development of xGrid: Integrated Smart Grid Platform
- Achieved 157 digital substations of 154 kV by 2021
- Expansion of renewable and ESS with DC power facilities
- Demonstrated DC distribution technology

Limitations

- Challenges in AMI Deployment:
  - Installation limited to 52% of KEPCO customers
  - Lack of consumer participation incentives
  - Global semiconductor shortage

Part 2

Grid Operation Evolutions Necessitating Smart Grid Expansion

Electrification for Carbon Neutrality: Heating, Transportation & More

- Electricity Demand is forecasted to be 2.3x the current level by 2050.
- The swift energy transition is vital for stability, but increasing challenges in enhancing infrastructure, such as new power plant construction and Transmission network expansion.

Shifting from Centralized to Distributed Energy Systems

- Increased grid disruptions, such as curtailment as distributed energy expands

Enhancing Smart Grid Roles with Distributed Energy Expansion

- Utilizing real-time bidirectional communication, the smart grid optimizes supply and demand through demand management, mitigating instability from volatility and related challenges
- Anticipating rapid growth in the new industry market linked to innovative energy demand management, integrating high-efficiency, low-consumption ICT technology
- Global Market Forecast for Digital Demand Efficiency: From 71 trillion won in 2020 to 174 trillion won in 2027 (IEA, 2021)

Part 2

Goal and Tactics: Korea's Third Phase of the Smart Grid Master Plan

Goal	Achieving an 18.6% share of distributed power sources in 2027
Directions	➢ Intelligent grid system for maximizing energy efficiency ➢ Enhancing market and system flexibility for better distributed energy integration ➢ Bolstering the industrial foundation for smart grid activation

Part 2

Goal and Tactics: Korea's Third Phase of the Smart Grid Master Plan

Tactic	Details
Tactic 1. Establishing a smart power consumption framework	• Expanding the demand resource market • Constructing a smart power metering system • Broadening seasonal & time-of-use tariffs
Tactic 2. Continuously expanding distributed energy supply	• Securing resources for a flexible power supply • Introducing integrated power plants • Developing core technologies for distributed energy
Tactic 3. Enhancing power system operations	• Leveraging ICT for a smarter power grid • Developing regional power management systems • Setting up distributed energy operations
Tactic 4. Expanding regional smart grid	• Establishing Distribution Network Management • Promoting Microgrid Implementation • Promoting Growth of Energy Prosumers
Tactic 5. Boosting smart grid industry competitiveness	• Establishing Power Data Utilization Systems • Activating Smart Grid Standards & Certifications • Laying the Foundation for Smart Grid Industry Activation

Thank you.

Asia-Pacific Economic Cooperation

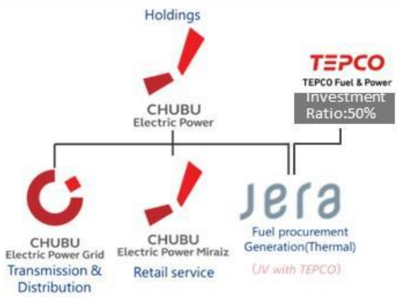
Role of energy efficiency for large-scale electrification in industry

October 16, 2023
Makati City, Metro Manila, The Philippines

Yukiko Morishita
Washington DC Office, Chubu Electric Power Company

Who We Are

CHUBU Electric Power



Corporate Philosophy

Chubu Electric Power Group delivers the energy that is indispensable to people's lives and so contributes to the development of society.

By the Numbers

30+ billion dollar※
2022 Operating revenues
※2022 exchange rate average

4.3 minutes
2021 Annual average of failure/outage time per household

117.8 billion kWh
2021 Electric energy sold

13,995 persons (as of March 31 2022)
Number of Employees (Consolidated 28,365 persons)

Power generation facilities (Chubu Electric Power) — As of March 31, 2022

Renewable energy	General hydroelectric power	Approx. 2,150 MW
	Pumped storage power	Approx. 3,320 MW
	Wind power	Approx. 20 MW
	Solar power	Approx. 20 MW
	Biomass	Approx. 50 MW
	Nuclear	3,617 MW

Power transmission/distribution facilities (Chubu Electric Power Grid) — As of March 31, 2022

Transmission line length	11,983 km
Number of supporting structures (iron tower, etc.)	34,936 units
Number of substations	1,005 locations
Distribution line length	135,702 km
Number of supporting structures (utility poles, etc.)	2,859,565 units
Communication lines	52,128 km

CHUBU Electric Power

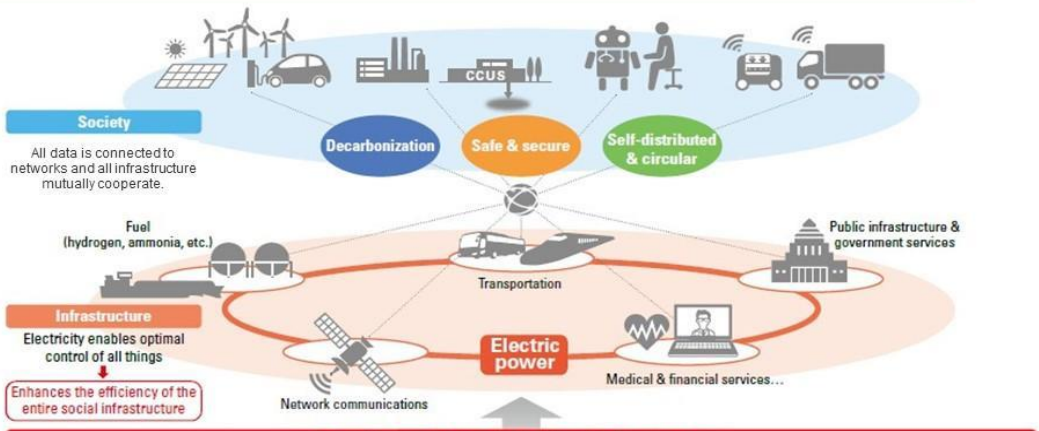
Role of energy efficiency for large-scale electrification in industry

- Self sufficiency rate
- Population
- Energy efficiency effort

Optimizing Downsizing Being Efficient

CHUBU Electric Power

Chubu Electric Power Group Management Vision 2.0



Contributions by the Chubu Electric Power Group

- Decarbonization of electric power systems supporting various types of infrastructure, Sophistication of electric power grid
- Pursuit of value creation by integrating each infrastructure or infrastructures and data

Coexistence with residents of the local communities

Working to achieve technological innovation and cost reductions in response to a rise in costs resulting from transformation of society and also delivering new value-added services

Contributing to a Carbon-Free Society

CHUBU Electric Power

2030

We will reduce CO2 emissions from electricity sold to customers by

50% or more

compered with 2013 levels

We aim for **100%**

electrification of company-owned and operating vehicles

2050

We will take on the challenge of reaching

net zero CO2 emissions

for our entire business to contribute to a carbon-free society

What can we do now?

Energy Efficiency

CHUBU Electric Power

LNG-fired power plant achieves 63% power generation efficiency
Average : LNG 50 % , Coal and Oil 40 %
higher generation efficiency, lower CO2 emissions

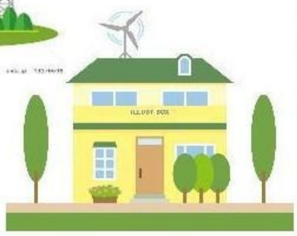
More efficient electricity production and reduced use of fossil fuels. Expectations are growing for the triple combined cycle, which combines a gas turbine and a steam turbine with an option of adding a fuel cell.

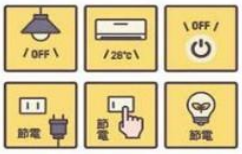
Nagoya west thermal power plant

HVDC (High Voltage Direct Current) transmission Line

MOTTAINAI Don't waste what is valuable

- smart meters 100 % installed
  we aware of how to use electricity efficiency on a daily or monthly basis
- Heat pumps, building efficiency
- Efficient Electric appliances





Digital visualization

CHUBU Electric Power Grid

Transmission Network Initiatives

CHUBU Electric Power

Design and Construction

- Chubu transmission lines were constructed in the 1960s- 1970s, the time has come for the equipment to be renovated
- Although power transmission construction in urban areas involves many challenges, such as narrow sites and site negotiations with local communities, Chubu is moving forward with a refurbishment project to reconstruct pylons and rewire power lines.

⇧ Central Load Dispatching Center/ Power Supply Control Center

⇦ Regularly patrol and service

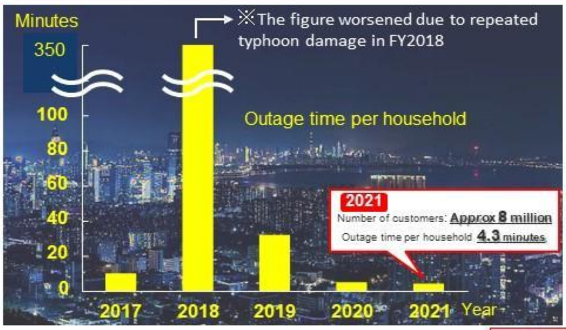
Flawless Operation and Maintenance

- Appropriate power supply to meet fluctuating demand, we stably deliver high-quality electricity with little voltage or frequency variation.
- We regularly monitor and service power lines and substations so that any abnormalities are detected early

CHUBU Electric Power Grid

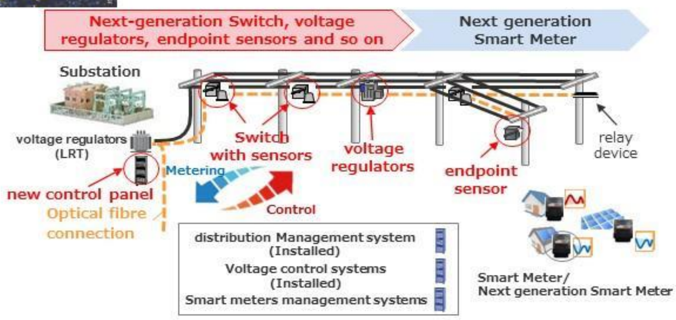
Stable Supply of Electricity ➡ Energy Efficiency

CHUBU Electric Power



- As Chubu Electric Power's supply area is prone to lightning strikes, we have been proactive in advancing lightning countermeasures.
- We have also developed facilities with charging terminals that are less susceptible to contact with birds, snakes, or other animals.
- And work to remove crow nests, which may lead to power failures

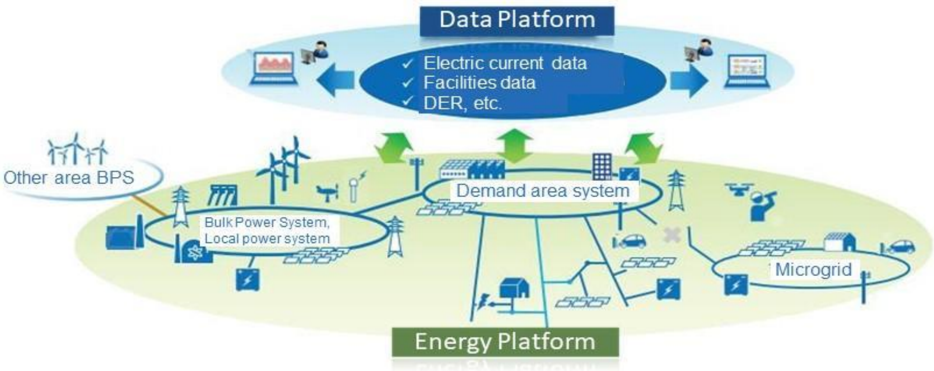
- The introduction of next-generation equipment enables rapid identification of the distribution line disconnection, as well as minimising the extent and duration of power outages.



CHUBU Electric Power Grid

Next Generation Power Grid Plan

CHUBU Electric Power



Decarbonization

- Rationalization of estimated power flow
- N-1 inter-trip scheme
- Non-firm access
- Dynamic Rating

Resilience

- Recovery from natural disaster (typhoons, torrential rains)
- Reinforcement of grid stability functions in the disaster event
- Cyber security

Interregional Interconnection

- Cross-regional coordination
- System development

Digitalization

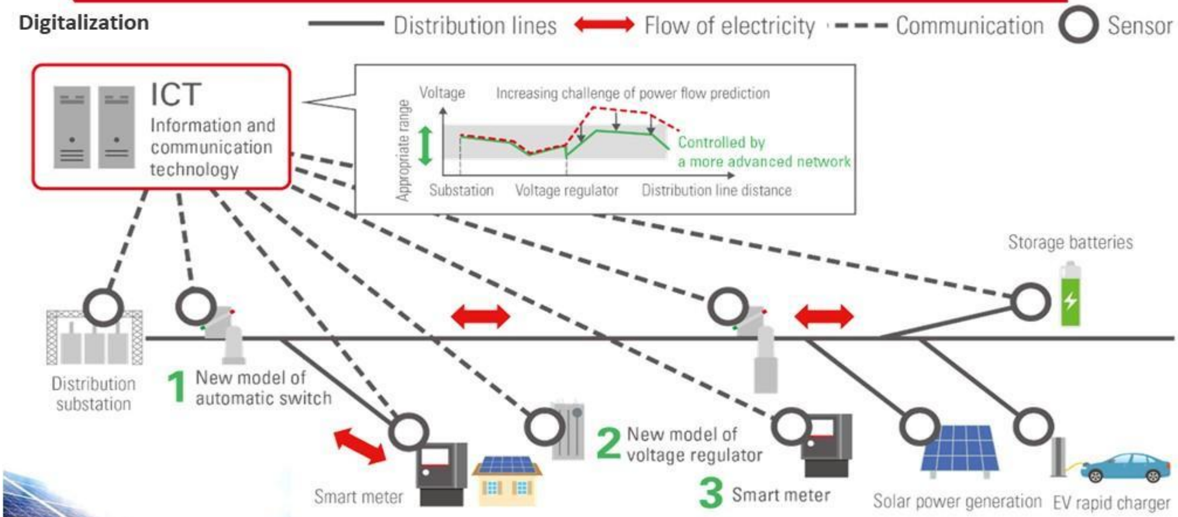
- Utilization of digital technology (Drone, sensor, robot, etc.)
- Improve customer service

CHUBU Electric Power Grid

Transition to a Next-Generation Network

CHUBU Electric Power

Digitalization



- We meticulously control voltage and power flows based on real-time data and respond to the output fluctuations of renewable energy.
- Additionally, by monitoring the grid status in greater detail than before, prompt recovery from power outages has become possible

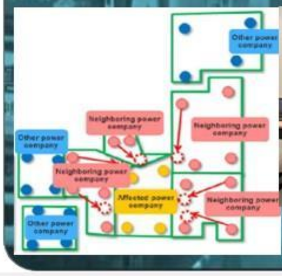
CHUBU Electric Power Grid

Resilience/Interregional Interconnection

CHUBU Electric Power

Resilience

- A total of 10 power transmission and distribution businesses, including Chubu Electric Power, entered into a new agreement in July 2019 to further solidify this system by forming a pact to provide push-type support deployment.
- This arrangement directs electric power companies in close proximity that has sustained extensive damage to take the initiative



Collaborative training with other companies

Interregional Interconnection

- Chubu Electric Power Grid constructed the new Hida Converter Station (900 MW) in March 2021.
- The 50 Hz and 60 Hz systems are linked by four interconnections (**totaling 2,100 MW**) between the Tokyo area and Chubu area networks
- We are proceeding with a project to further expand the frequency converter(600MW) by 2028

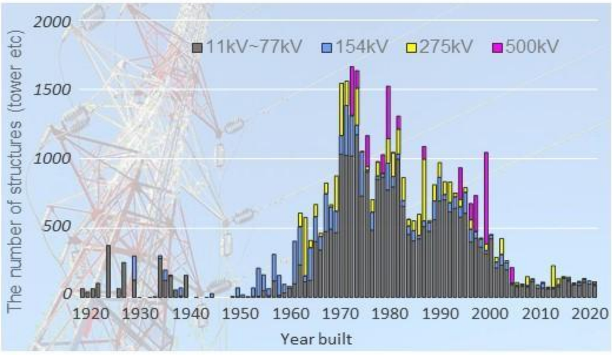
New Hida - Shinano converter (900MW)

Thyristor valve

CHUBU Electric Power Grid

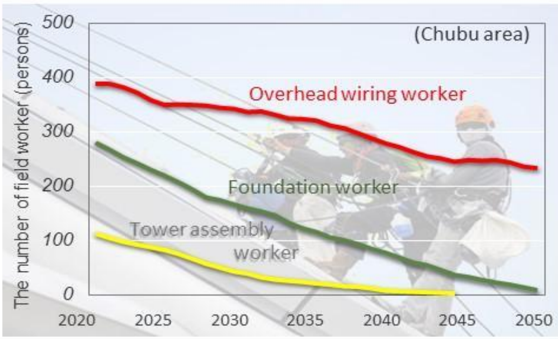
Our challenges

CHUBU Electric Power



- We need to renovate aging facilities and at the same time build new ones to connect to renewable energy
- To appropriately handle the increased volume of work as facilities age and require repairs and upgrading, we have worked to standardize the level of construction carried out annually

- At the current rate, the number of field workers will decrease in the future.
- Power transmission work requires unique skills and experiences, which are challenging to pass on.
- Chubu is promoting labor-saving and mechanization of power transmission work.



Internal Efforts to Solve the Challenges

CHUBU Electric Power Grid

CHUBU Electric Power

Mechanization/Labor Saving

- Use of drones for transporting materials and equipment and extending lines.
- Use of heavy equipment for steel tower assembly.
- Improving operations through TPS. (Toyota Production System)

Education

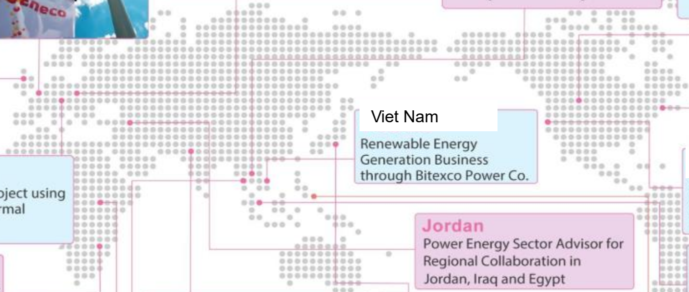
- On-site instruction by skilled staff.
- Chubu Electric Power Grid corporates with the Transmission line Construction Society to improve the technical skill of overhead transmission line construction.
- Safety training.

Work style reform/ Appeal

- Improving the working environment for site workers.
- Promoting the appeal of power line construction through website and YouTube.
- We share brave disaster recovery activities on social media.

Project List

CHUBU Electric Power



Netherlands
Renewable Energy, Electricity Retail and New Services Business
Integrated energy business through Eneco

UK
Submarine Power Transmission Business for offshore wind power plants

Germany
World's first commercial project using Eavor's closed loop geothermal utilization technology

Mozambique
Project for Improvement of Energy Loss Reduction on Distribution Network

Uganda
Capacity Development Project for Improvement of Protection of Transmission Systems

Germany
Submarine Power Transmission Business for offshore wind power plants

Myanmar
Power Distribution Improvement Project
in Yangon and the regional cities

Viet Nam
Renewable Energy Generation Business through Bitexco Power Co.

Jordan
Power Energy Sector Advisor for Regional Collaboration in Jordan, Iraq and Egypt

India
Renewable Energy based Mini Grid Business through OMC Power Private Limited

Japan and Asia
MOU with bp to evaluate decarbonisation opportunities
(Nagoya Port CCUS Project)

Thailand
New cooperative framework
(Cooperative Project Investment) with PEA beyond Technical Cooperartion

Canada
Global business development of closed loop geothermal utilization technology through Eavor Technologies Inc.

Canada
Uisce Tapa Tidal Energy Project
Joint Development Agreement(JDA) with DP Energy and Kawasaki Kisen Kaisha, Ltd.

The United States
Promoting Development/ Commercialization of Small Modular Reactors through NuScale Power Corp.

Singapore
Project Investments, Incubation, and Human Resource Development
Establishment of Greenway Grid Global Pte. Ltd. (GGG)

the Philippines
Power Distribution and Retail Business in the development of New Clark City

: Investment project
: Consulting project

【Major recent consulting project records】

Country	Project	Period
Laos African countries	Cooperation program on electricity business management	2020.12~ 2021.3
Sri Lanka	The project for capacity development on the power sector master plan	2020.3~ 2023.3

New Clark City Distribution Business (The Philippines)

CHUBU Electric Power

- On September, 2019, Chubu joined the New Clark City Distribution Business with Marubeni, Kansai, and Manila Electric Company, MERALCO. Our aim is to learn about the Smart Grid City structure and integrated energy system , which includes EV, battery and distributed, power supply and so on.

Overview	
Location	In Clark Special Economic Zone, Tarlac Province, Luzon Island, The Philippines
Established	2019(25 years)
Business Partner	MERALCO, Marubeni, Kansai Electric Power Company
Investment ratio	MERALCO：60%、Marubeni：20%、Chubu：10%、Kansai:10%
Owner	BCDA（Bases Conversion and Development Authority)
Main facilities	One 69kV/13.8kV distribution substation (total: 33MVA x 1 bank), etc.69kV overhead and underground transmission lines, 13.8kV underground distribution lines, smart grid facilities, etc.

【Business Sites】

Local production and local consumption project (India)

CHUBU Electric Power

- OMC Power Private Limited (“OMC”) operates renewable energy based power plants for supply of energy via mini-grids* and provides a reliable supply of clean power, mainly solar power to areas with limited or no electricity access in India.

【Overview of OMC】

Company Name	OMC
Location of Headquarters	Gurugram, Republic of India
Established	2011
Representative	Rohit Chandra (MD&CEO)
Business Activities	Renewable energy based power plants with “ABC business model providing energy to telecom towers, small and medium enterprises and communities in rural India
Business Sites	Uttar Pradesh, Bihar

* Small-scale power generation, transmission and distribution facilities that are not connected to the existing large-scale transmission system, and that perform all processes from power generation to transmission and distribution on its own.

【Business Sites】

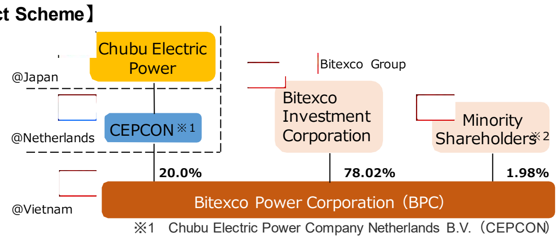
【Image of Mini-grid Business】

Renewable Energy project (Viet Nam)

【Vietnam Renewable Power Company "Bitexco Power Company"】

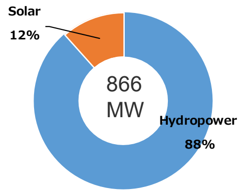
Company Name	**Bitexco Power Corporation（BPC）**
Purpose	• Promoting the expansion of renewable energy business, to create a platform of the energy business in Viet Nam. • Assisting the growth of the company through utilizing the technology and expertise for renewable power, especially hydropower.
Head Office	Hanoi, Viet Nam
Business	Operation and development of renewable energy power generation projects Hydro: long-term PPA with EVN, Solar: FIT scheme
No. of power plants	22 hydroelectric power plants and 2 solar power plants
Equity capacity	866 MW（Hydro 766 MW, Solar 100 MW）
Sponsors	Chubu Electric Power Co., Inc. 20%, Bitexco Group 80% (One director was to be appointed and one engineer is assigned from Chubu)

【Project Scheme】



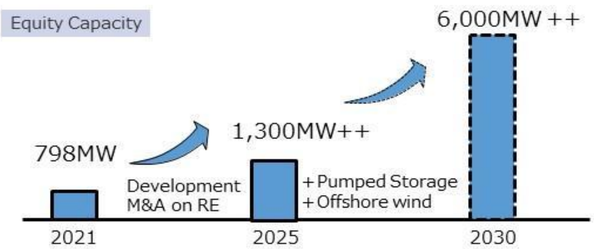
※1 Chubu Electric Power Company Netherlands B.V.（CEPCON）
※2 Vu Quang Sang, Vietnam Leather and Footwear JSC

【Equity Capacity】
(as of the end of March,2023)



Development

➢ In addition to hydro and solar power, onshore and offshore wind and pumped storage power will be developed
➢ Joint Crediting Mechanism



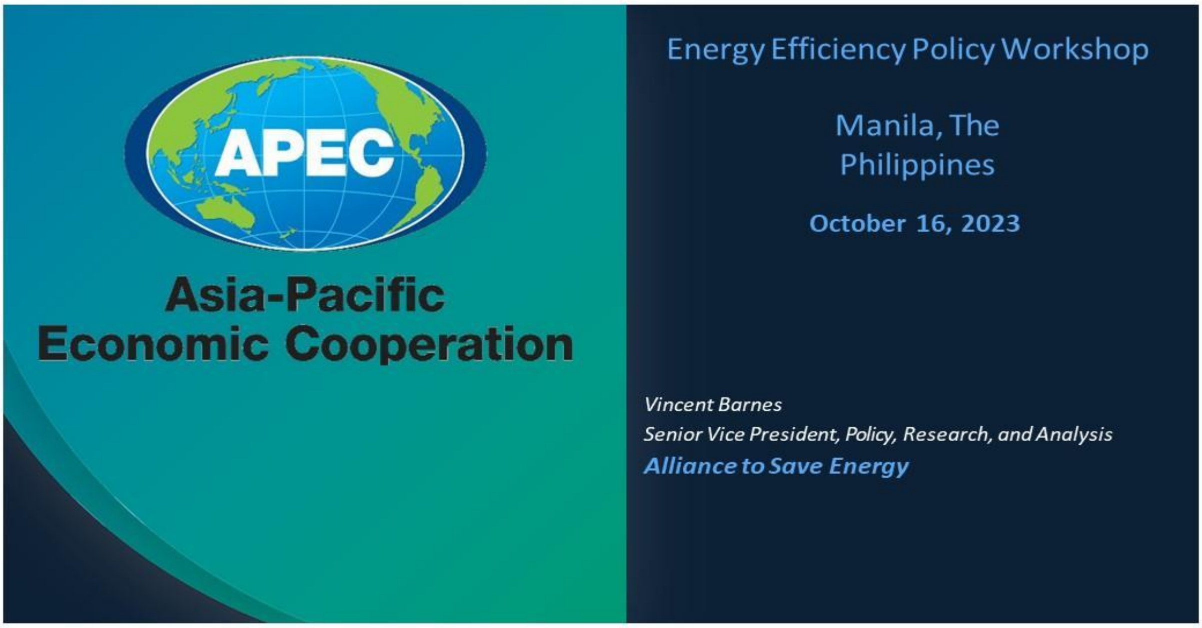
Supply

➢ Supply of renewable electricity through Corporate PPA

Collaboration with Bitexco Group

➢ Hydrogen production project
➢ Smart city development, etc.

CHUBU
Electric Power



APEC
Asia-Pacific Economic Cooperation
Energy Efficiency Policy Workshop
Manila, The Philippines
October 16, 2023
Vincent Barnes
Senior Vice President, Policy, Research, and Analysis
Alliance to Save Energy

Honorary Board of Advisors
Sen. Jeanne Shahee (D- NH)
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Sen. Lisa Murkowski (R- AK)
Rep. Paul Tonko (D- NY)
Sen. Mark Warner (D- VA)
Sen. Peter Welch (D- VT)
Sen. Ron Wyden D- OR
Kandeh Yumkella Sustainable Energy for All (Former CEO)


Board and Associate Member Companies


1.5° C
The U.S. Goal:
Reduce Net Greenhouse Gas Emissions (GHG) by 50%-52% from 2005 Levels by 2030.
Net-Zero Emissions Economy-Wide by 2050.
100% Carbon-Free Electricity by 2035.
PATHWAYS 2050
2050 Net Zero
2030 50% - 52% Below 2005
2020 17% Below 2005

BARRIERS TO 2050
The U.S. Will Need
Unprecedented and Accelerated Adoption of Emissions Mitigation Solutions Across Every Economic Sector.
Past U.S. Strategies
Have Primarily Focused on Supply- Side Solutions for Low-Carbon Energy Generation and Emission Removal Technologies.
Past U.S. Strategies
Have Not Focused on Demand-Side Solutions—Including in Buildings.

DEMAND-SIDE SOLUTIONS
ESSENTIAL FOR CLIMATE MITIGATION
The U.S. Building Energy Consumption is a Significant Driver of C02 Emissions.
1.7 Gt CO2 in 2022
35% Total U.S. CO2 Emissions
Buildings Equal:
74% of the U.S. Electricity Sales
42% of the U.S. End-Use Natural Gas
Demand-Side
Decarbonization Improves End Use Efficiency; Flexibly Manages Building Loads and DERs; and Improves Power Grid Reliability.
Energy Efficiency
Demand Flexibility
Building Electrification


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DEMAND-SIDE SOLUTIONS
ESSENTIAL FOR CLIMATE MITIGATION
BUILDING ENERGY EFFICIENCY: Most Extensively Studied Solution of the Three, and Widely Considered a Low-Cost Option to Mitigate Climate Change.
DEMAND FLEXIBILITY: Complimentary Solution that Leverages Demand-Side Assets (thermostats, connected appliances and equipment, behind the meter storage and generation) to Reduce Peak Building Demand and Shift Demand to Times of High Renewable Generation, Flattening the Overall Shape of Building Load on the Grid.
BUILDING ELECTRIFICATION: Key Pillar of Economy Wide Decarbonization. The Cost and Performance of Electrification Technologies Have Improved During the Same Time that Ambitious Targets for the Power Sector Have Been Announced.


The U.S. Will Need to Triple its Retrofit Rate to Achieve Net-Zero Targets.
According to the IEA: Net-Zero by 2050 Hinges on a Global Push to Increase Energy Efficiency. (2021)
90%
Office Stock Over 10 Years Old (10 major cities across Europe and North America)
80%
Office Buildings Stock that Exist Today and Will Exist in 2050.
3%-3.5%
Annual Retrofit Rate to 2050

Building Sector Solutions are the Pathway to Economy-Wide Decarbonization

LAWRENCE BERKELEY NATIONAL LABORATORY-BRATTLE GROUP

WHY: "Pathways for building energy and emission reductions are currently unexplored at sufficient levels of detail to understand cross-sectoral linkages and inform holistic energy system decarbonization strategies that leverage both supply- and demand-side assets toward achieving climate goals."

WHAT: "Address this knowledge gap by modeling The U.S. building energy demand, energy related building CO2 emissions, and power systems cost through 2050 under multiple scenarios of building energy efficiency, demand flexibility, and end use electrification, as well as multiple levels of grid decarbonization."

BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization

Low

Demand-Side Measure Deployment:

- High rate of building electrification to heat pumps (HPs) only
- No additional efficiency or demand flexibility deployment beyond reference case

Grid decarbonization: GridSIM Reference Case.

Moderate

Demand-Side Measure Deployment:

- Moderate rate of building electrification to HPs
- Building technologies with breakthrough performance/cost enter the market by 2035
- Elevated building codes/standards take effect in 2030
- Additional deployment of building controls that enable demand flexibility packaged with equipment and envelope efficiency, efficiency-only retrofits for existing building envelope, and moderate rate of resistance heating/water heating conversion to HPs

Grid decarbonization: 80% CO2 reduction vs. 2005 by 2050.

Aggressive

Demand-Side Measure Deployment:

- high rate of building electrification to HPs
- building technologies with breakthrough performance/cost enter the market by 2030
- elevated building codes and standards take effect in 2025
- additional deployment of efficiency and flexibility as described for moderate scenario group but with high rate of resistance heating/water heating conversion to HPs

Grid decarbonization: 100% CO2 reduction vs. 2005 by 2035.

BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization

91%

There Exists the Potential for Up To 91% Reductions in Buildings CO2 Emissions from 2005 Levels by 2050 Without Corresponding Increases in Building Sector Electricity Use, Given Aggressive Deployment of Demand-Side Measures and Full Decarbonization of the Electricity Supply by 2035.

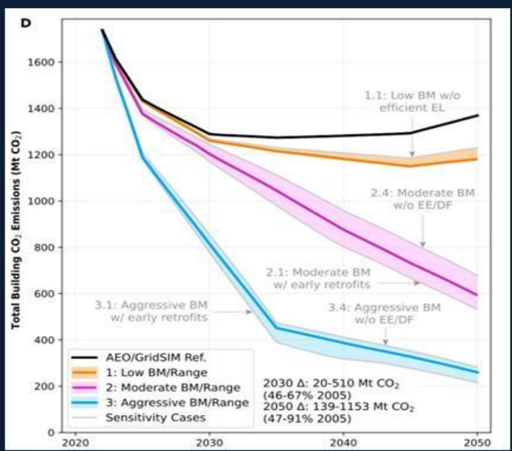
45%

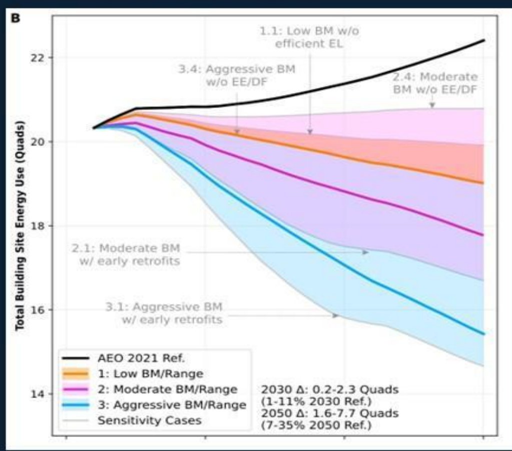
According to the Study, Demand-Side Measures in Buildings Account for Up To Nearly Half of Total 2050 CO2 Reductions Beyond the Reference Case, With the Remainder Attributable to Decarbonization of the Electricity Supply.

$107 Billion

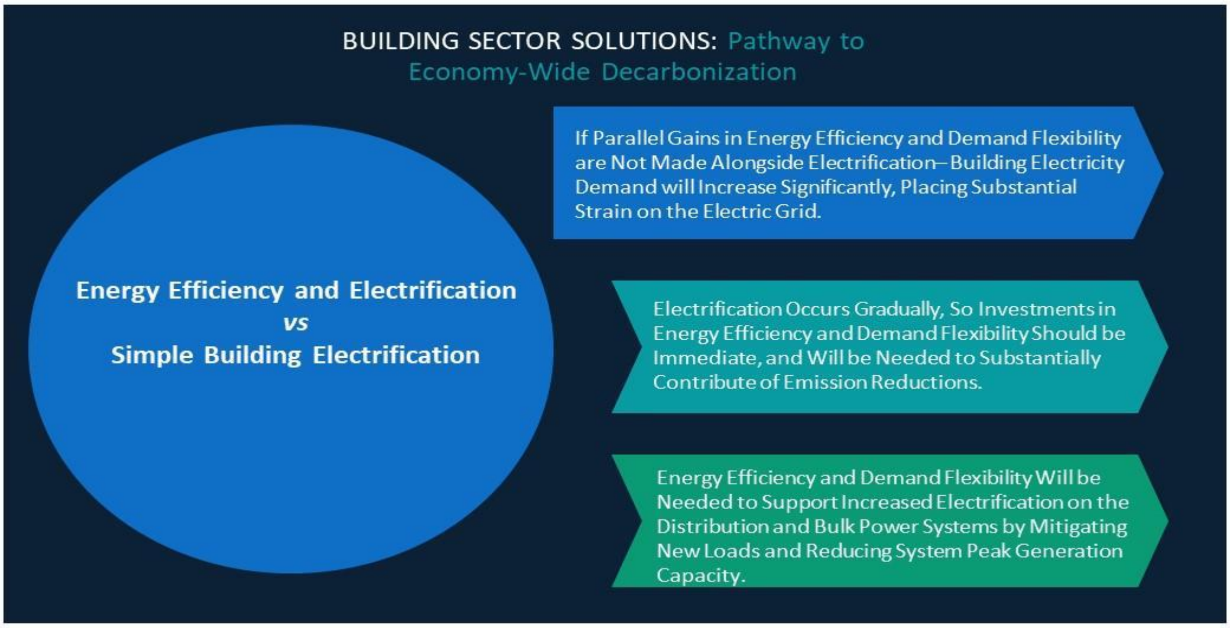
Aggressive Deployment of Building Efficiency and Flexibility Generates Up To $107 Billion in Annual Power System Cost Savings by 2050, Offsetting More Than 1/3 of the Incremental Cost of Full Grid Decarbonization.

BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization






BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization
"A strategic reduction and management of the US building energy demand alongside full grid decarbonization could sharply decrease building sector CO2 emissions by mid-century up to a 91% reduction from 2005 levels."
This Avoids Nearly ¼ of Total Energy System CO2 Emissions Projected for 2050.
This is More Than 1 GT CO2 (absolute terms).
91%
"Results demonstrate that demand-side solutions in buildings greatly reduce the costs of power sector decarbonization, avoiding up to well over $100 billion per year in power system costs by 2050.
$100 Billion+ Annually


BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization
Energy Efficiency and Electrification
vs
Simple Building Electrification
If Parallel Gains in Energy Efficiency and Demand Flexibility are Not Made Alongside Electrification– Building Electricity Demand will Increase Significantly, Placing Substantial Strain on the Electric Grid.
Electrification Occurs Gradually, So Investments in Energy Efficiency and Demand Flexibility Should be Immediate, and Will be Needed to Substantially Contribute of Emission Reductions.
Energy Efficiency and Demand Flexibility Will be Needed to Support Increased Electrification on the Distribution and Bulk Power Systems by Mitigating New Loads and Reducing System Peak Generation Capacity.

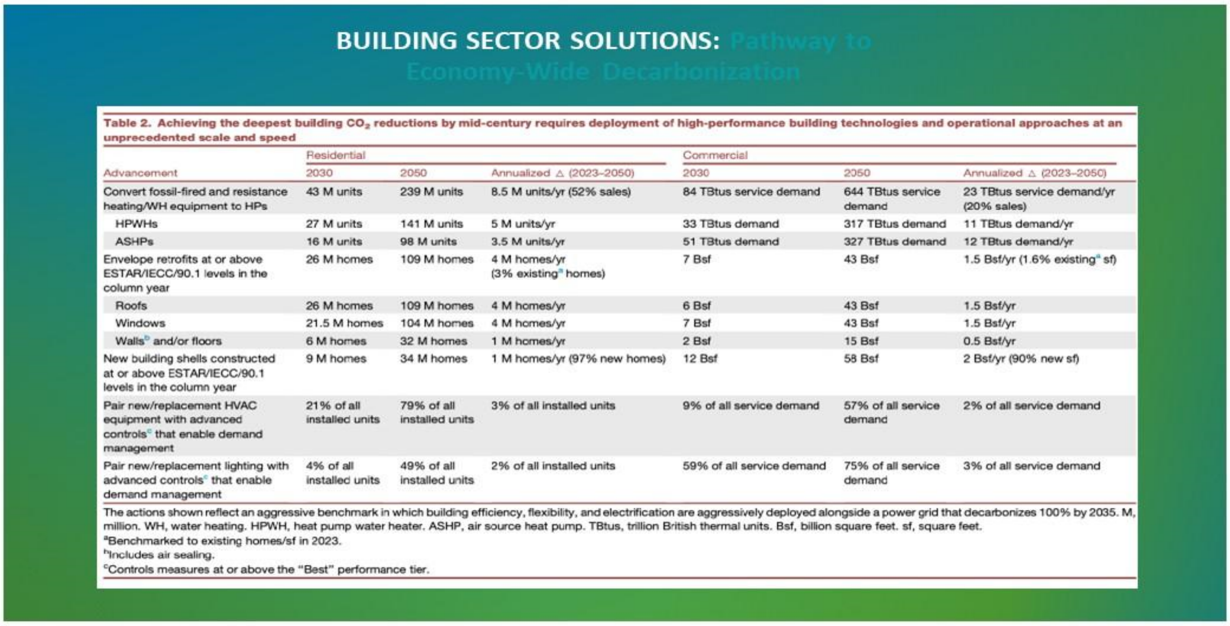


Table 2. Achieving the deepest building CO_2 reductions by mid-century requires deployment of high-performance building technologies and operational approaches at an unprecedented scale and speed

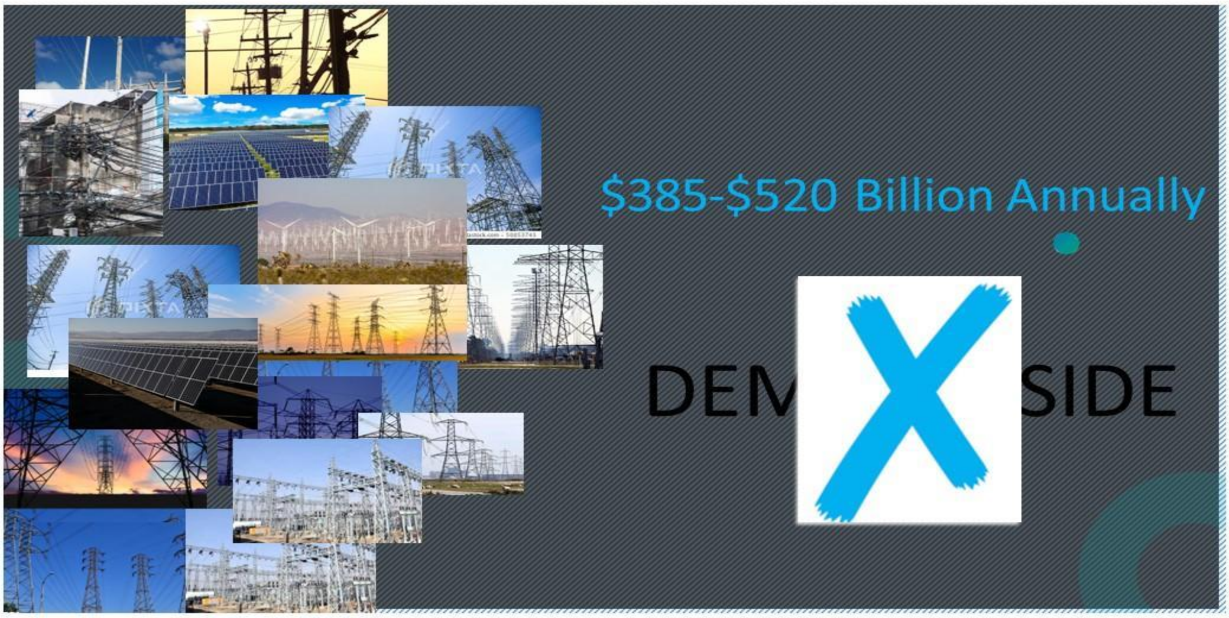
	Residential			Commercial		
Advancement	2030	2050	Annualized △ (2023–2050)	2030	2050	Annualized △ (2023–2050)
Convert fossil-fired and resistance heating/WH equipment to HPs	43 M units	239 M units	8.5 M units/yr (52% sales)	84 TBtus service demand	644 TBtus service demand	23 TBtus service demand/yr (20% sales)
HPWHs	27 M units	141 M units	5 M units/yr	33 TBtus demand	317 TBtus demand	11 TBtus demand/yr
ASHPs	16 M units	98 M units	3.5 M units/yr	51 TBtus demand	327 TBtus demand	12 TBtus demand/yr
Envelope retrofits at or above ESTAR/IECC/90.1 levels in the column year	26 M homes	109 M homes	4 M homes/yr (3% existing[a] homes)	7 Bsf	43 Bsf	1.5 Bsf/yr (1.6% existing[a] sf)
Roofs	26 M homes	109 M homes	4 M homes/yr	6 Bsf	43 Bsf	1.5 Bsf/yr
Windows	21.5 M homes	104 M homes	4 M homes/yr	7 Bsf	43 Bsf	1.5 Bsf/yr
Walls[b] and/or floors	6 M homes	32 M homes	1 M homes/yr	2 Bsf	15 Bsf	0.5 Bsf/yr
New building shells constructed at or above ESTAR/IECC/90.1 levels in the column year	9 M homes	34 M homes	1 M homes/yr (97% new homes)	12 Bsf	58 Bsf	2 Bsf/yr (90% new sf)
Pair new/replacement HVAC equipment with advanced controls[c] that enable demand management	21% of all installed units	79% of all installed units	3% of all installed units	9% of all service demand	57% of all service demand	2% of all service demand
Pair new/replacement lighting with advanced controls[c] that enable demand management	4% of all installed units	49% of all installed units	2% of all installed units	59% of all service demand	75% of all service demand	3% of all service demand

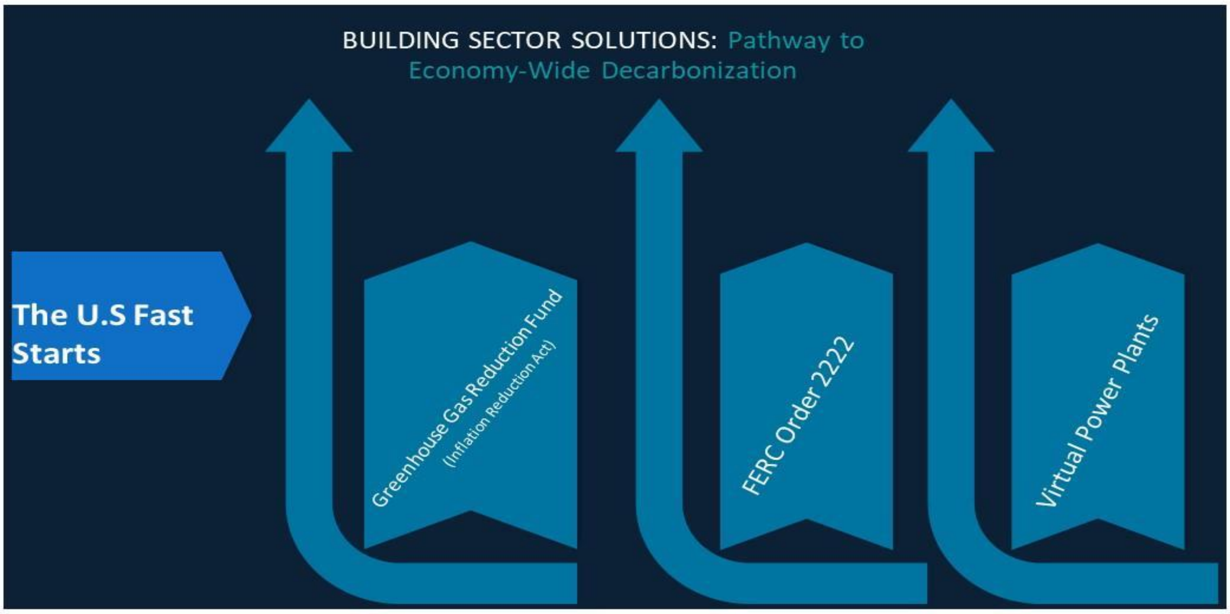
The actions shown reflect an aggressive benchmark in which building efficiency, flexibility, and electrification are aggressively deployed alongside a power grid that decarbonizes 100% by 2035. M, million. WH, water heating. HPWH, heat pump water heater. ASHP, air source heat pump. TBtus, trillion British thermal units. Bsf, billion square feet. sf, square feet.

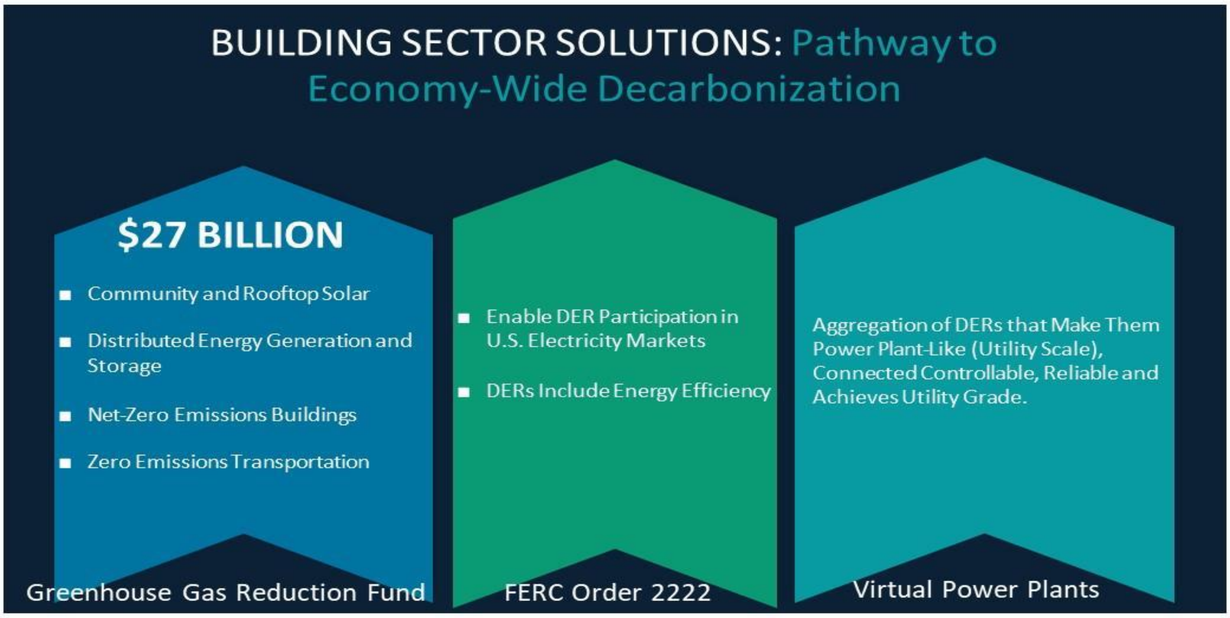
[a]Benchmarked to existing homes/sf in 2023.

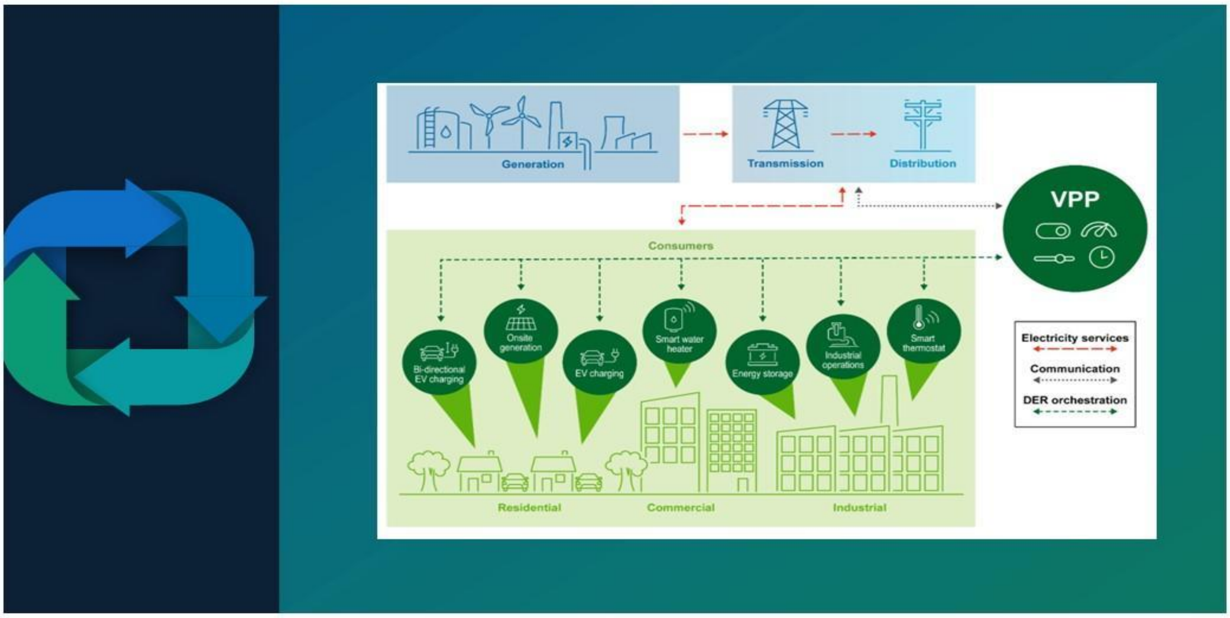
[b]Includes air sealing.

[c]Controls measures at or above the "Best" performance tier.


$385-$520 Billion Annually
DEM
SIDE


BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization
The U.S Fast Starts
Greenhouse Gas Reduction Fund
(Inflation Reduction Act)
FERC Order 2222
Virtual Power Plants


BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization
$27 BILLION
Community and Rooftop Solar
Distributed Energy Generation and Storage
Net-Zero Emissions Buildings
Zero Emissions Transportation
Greenhouse Gas Reduction Fund
Enable DER Participation in U.S. Electricity Markets
DERs Include Energy Efficiency
FERC Order 2222
Aggregation of DERs that Make Them Power Plant-Like (Utility Scale), Connected Controllable, Reliable and Achieves Utility Grade.
Virtual Power Plants


Generation
Transmission
Distribution
VPP
Consumers
Bi-directional EV charging
Onsite generation
EV charging
Smart water heater
Energy storage
Industrial operations
Smart thermostat
Residential
Commercial
Industrial
Electricity services
Communication
DER orchestration


BUILDING SECTOR SOLUTIONS: Pathway to Economy-Wide Decarbonization
Next Steps: Equity
Inclusion of Communities and Workers Who Have Been Excluded or Could Be Excluded From the Energy Transition and Expansion:
■ Low-Income and Disadvantaged Communities
■ Displaced Energy Workers
■ Workforce Diversity
Next Steps: Policy
■ Incentives to Accelerate Front-of-the-meter Demand Flexibility Investments.
■ Manufacturing Incentives to Drive R&D and Demand Flexibility Enabled Devices.
■ Incentives to Accelerate Building Envelope and Other Behind the Meter Investments.


THANK YOU

Potential for EVs to reduce APEC energy intensity

Finbar Maunsell, Asia Pacific Energy Research Centre (APERC), Researcher

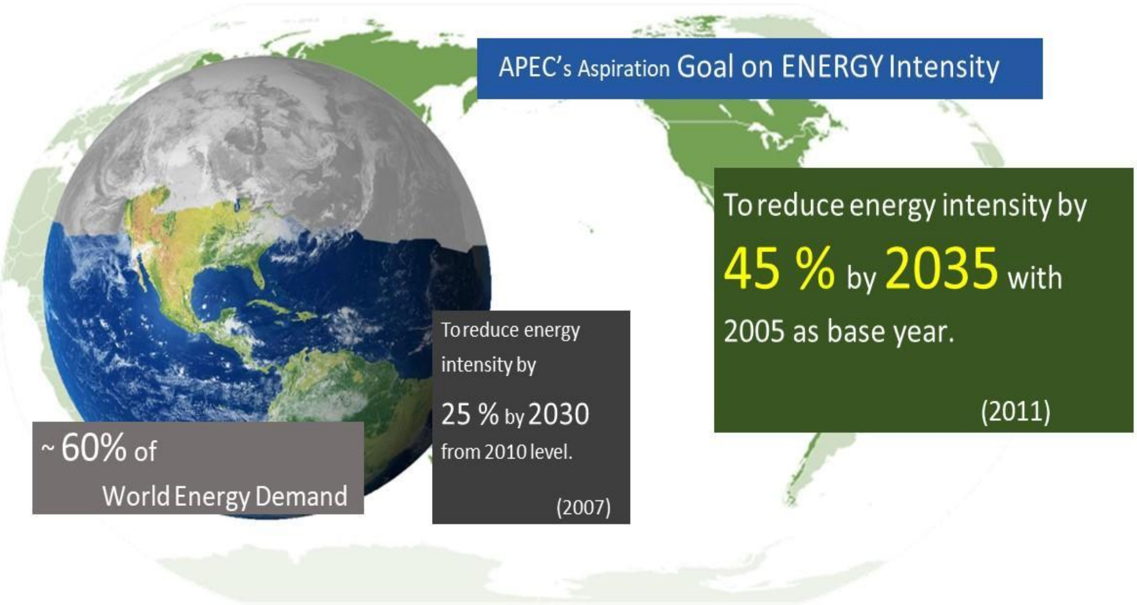
Energy Efficiency Policy (EEP) Workshop
Manila, the Philippines, 16 October 2023

Outline of this presentation

- We will look at my current projections for the USA in the transport model for the 9th edition of the Energy Outlook. We will use these projections to help analyse the effects of EVs on energy intensity.
- We will utilize the log mean divisia index (LMDI) method to break down changes in energy use into its different drivers and compare the difference in effects between the Target and Reference scenarios in the outlook.
- Please note in the Outlook:
  - *The **Reference** scenario illustrates a pathway where existing policies are retained*
  - *The **Target** scenario illustrates a pathway for each economy towards realizing energy policy targets.*

2

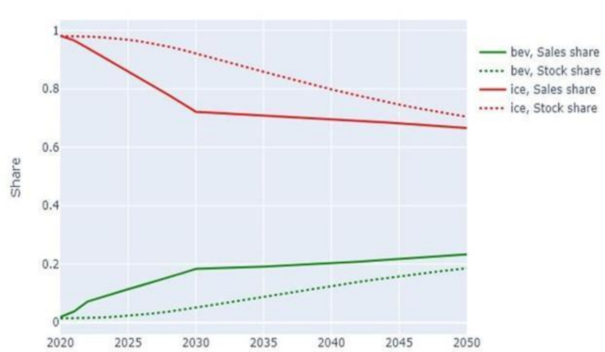
Reminder: APEC energy intensity goal



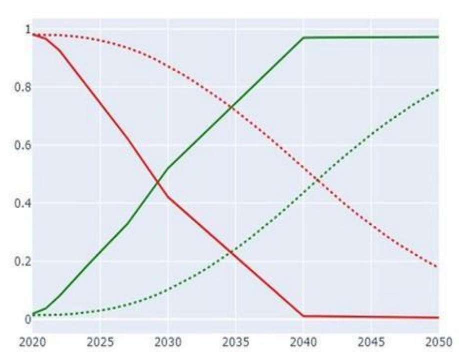
The USA – two major assumptions to consider

- Passenger and Freight Activity is assumed to remain the same in both the Reference and Target scenarios.
- See here the current projections for battery electric vehicle and internal combustion engine sales and stock shares in the USA
  - Notice how stock share lags the sales share.

Sales and Stock share of vehicles (Reference)

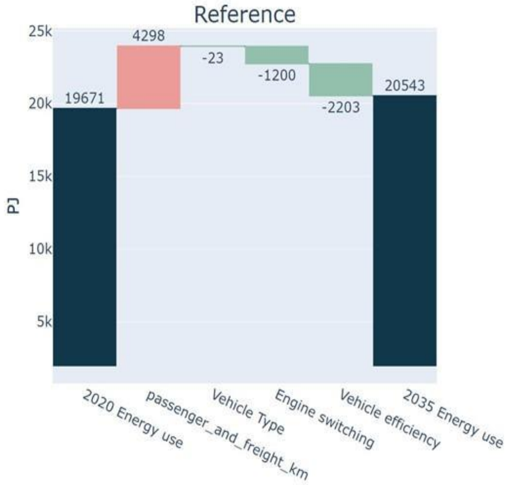


Sales and Stock share of vehicles (Target)



LMDI introduction

- Breaks down changes in energy use into its different drivers.
- In the graph to the right, we see the red bar as an effect that causes an increase in energy use, and the green bars as effects that decrease energy use.
  - **Passenger and freight km** represents the effect of increases in activity, given the existing vehicle composition.
    - *In the graph to the right, increased activity led to an increase in energy use by 4298PJ**
  - **Vehicle Type** is the effect of switching to different modes of road transport, such as from car to bus.
    - *A small increase in the share of bus use helped decrease energy use by 23PJ*
  - **Engine type** is the effect of switching the engine type. For example, moving from ICE to BEV's.
    - *Increased stock share of EV's to around 10% led to a decrease in energy use by 1200PJ*
  - **Vehicle efficiency** captures all else, which, in the case of transport, is mostly from improvements to efficiency of pre-existing engine types (ICE's).
    - *1% annual improvement to the efficiency of all new vehicles led to a decrease in energy use by 2203PJ*



LMDI stands for log mean divisia index. You can find more info at the end of the presentation.
**Activity is assumed to be the same between Reference and Target scenarios*

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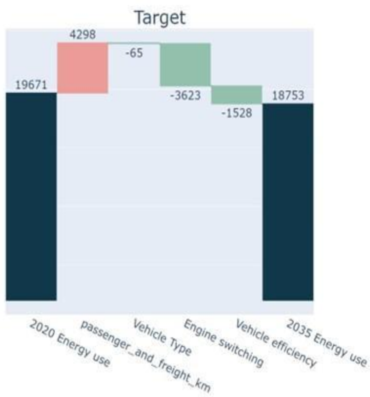
5

The USA in 2035

- The effect of a ~20% stock share of EV's in the Target scenario led to a 3623PJ decrease in energy use, compared to 1200PJ in the Reference scenario.
- Engine type switching in the Target scenario would lead to a ~6% improvement in USA's energy use and intensity, when compared to the projected energy use (58150PJ*) for the whole economy in the Reference scenario, in 2035.
- The vehicle efficiency effect is larger in Reference because of efficiency improvements in new ICE vehicles having more of an effect, because they have a higher sales share.



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6

**Excludes non energy us*

The USA in 2050

- Total effect of switching is now 15,437Pj, which is a ~60% improvement in transport intensity compared to if no EV's were used at all.
- For the USA's whole economy, that would lead to a ~26% improvement in energy use and intensity, given the projected energy use in the Reference scenario in 2050.

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In summary:

- According to the Target scenario, in 2035, the impact of EV's is relatively low. A 3623PJ decrease in energy use only decreases US energy intensity by ~6%. But by 2050, it becomes 4 times larger. This reflects the lag between sales share and stock share.
- In the Reference scenario, the US whole-economy energy intensity is projected to be 2.08 PJ per billion 2018 USD PPP in 2035, compared to 3.57 in 2005 (which is already a 42% drop).
  - A 6% (3623PJ) decrease from increasing the share of EV's would result in a drop to 1.95, which is an increase from 42 to 45% intensity improvement since 2005.

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One alternative:
Improving ICE engine efficiency

- For sake of finding the highest possible improvement, consider the gradual achievement of these until 2050:
  - **Weight Reduction:** A 10% reduction in vehicle weight through material improvements can lead to a 6.8% improvement in fuel economy*
  - **Engine Efficiency:** Let's assume a 25% improvement in thermal efficiency of engines. This will be expensive but is possible.
  - **Eco driving systems:** for example, stop-start and autopilot. I estimated that these systems could improve fuel economy by ~5%.
  - **Hybrid systems:** these allow for regenerative breaking, shutting off the engine when stopped, and some extra power during acceleration. Depending on the design, the efficiency improvement can vary from 25% to 50%. We'll assume 50%.

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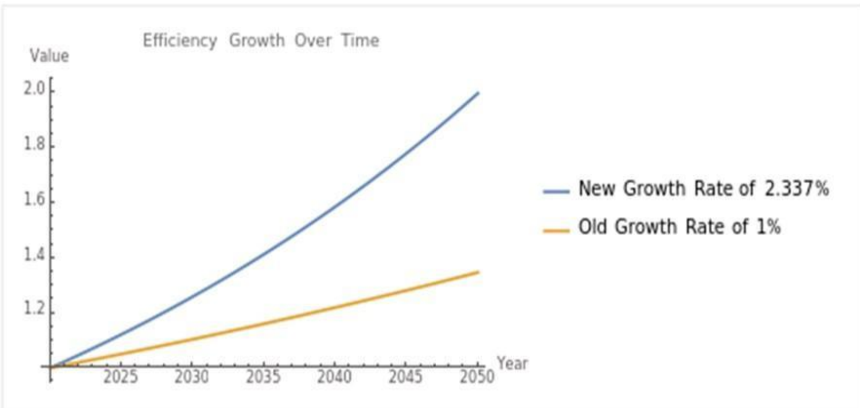
*https://www.energy.gov/eere/vehicles/lightweight-materials-cars-and-trucks 9

Alternative scenario – vehicle efficiency focus

- So, we will consider a future where, **in the Reference scenario**, fuel economy is doubled between now and 2050.



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Note: an improvement to intensity is the same as an improvement to efficiency, they are just inverses of each other. 10

The USA high efficiency growth - 2035

- An increase in vehicle efficiency by a factor of ~1.4 compared to ~1.2 has led the Vehicle efficiency factor in the reference scenario to grow from -2203 in the previously shown Reference scenario to -3383Pj here.
- Still, as you can see in the Target scenario, the effect of engine switching is greater.

The USA high efficiency growth - 2050

- Total effect of Vehicle efficiency improvements is 8110PJ in this Reference scenario. This is significant, but still, less than the effect of EV switching shown in the Engine switching effect in the Target scenario.

So what?

- In summary, it seems the impact of switching to the more efficient EV is better for energy intensity than slowly switching out current ICE's for marginally more efficient ICE's.
- But perhaps there are areas we are overlooking, like heavy freight, where a focus on ICE efficiency, including hybridization, may benefit intensity more. This is because the switch to alternative engine types is expected to be slower, because of the cost of the batteries or hydrogen for fuel cell vehicles.

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13

What about other economies?

- Thailand and Japan are attached. If you contact me, I am happy to show you our results for your economy too.
- Please note that these are just based on our modelling, so they depend on the underlying assumptions we are currently using. I am especially unsure about the underlying assumptions leading to the vehicle type effect for non-US economies.

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14

References:

- https://aperc.or.jp/reports/outlook.php - All published Outlook editions are here. A very interesting read from a group of very interesting researchers!
- https://github.com/asia-pacific-energy-research-centre/PyLMDI - my code and documentation for producing LMDI analysis. It's a bit old but I think it will still provide a good starting point for learning about it.

Contact me:

Finbar.maunsell@aperc.or.jp

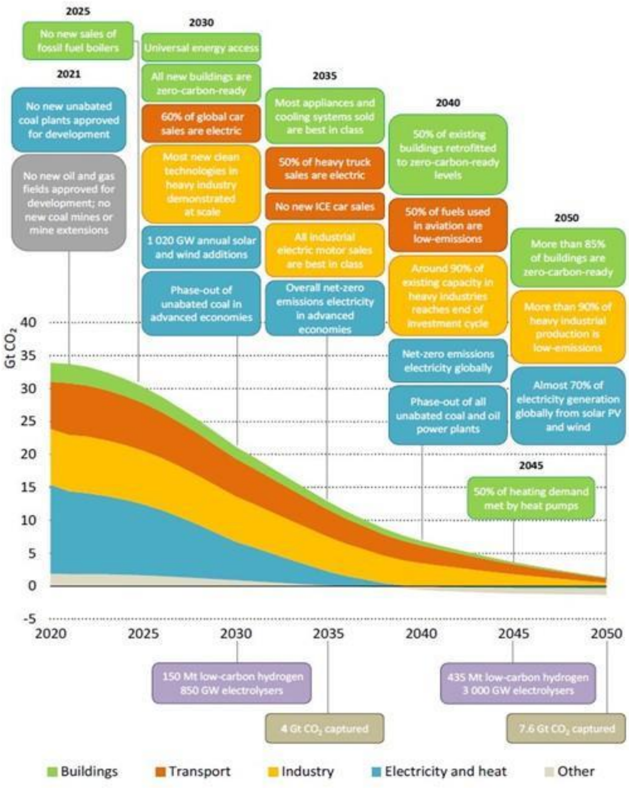
To be presented at the 61st Meeting of
APEC Expert Group on Energy Efficiency & Conservation

Setting Energy Efficiency Programs for Local Communities Under the Electrification Trend

October 16, 2023
Makati City, Metro Manila, The Philippines

Younsung Kim, PhD
George Mason University

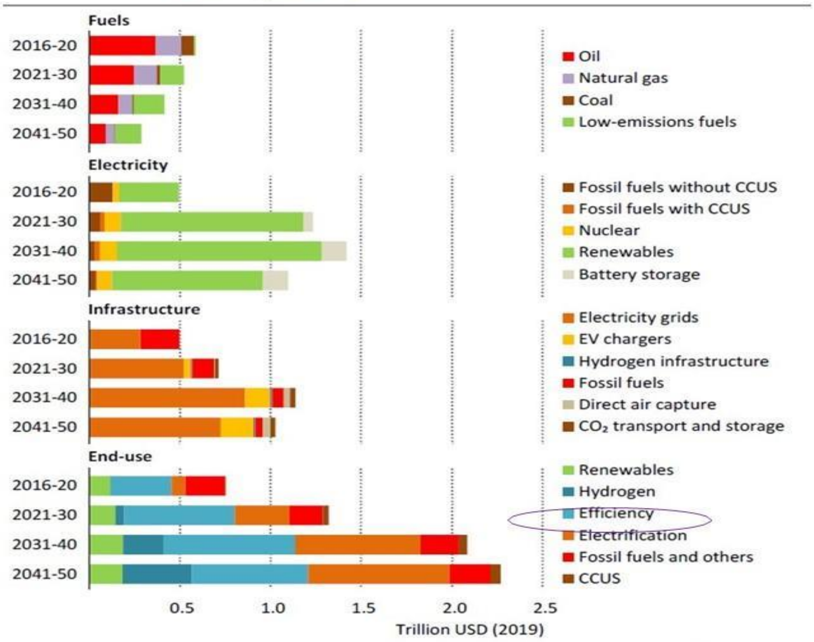
Key Milestones In the Pathway to Net Zero (IEA)



Source: IEA (2021)

Global investment needs for efficiency

Figure 4.2 ▷ Global average annual energy investment needs by sector and technology in the NZE

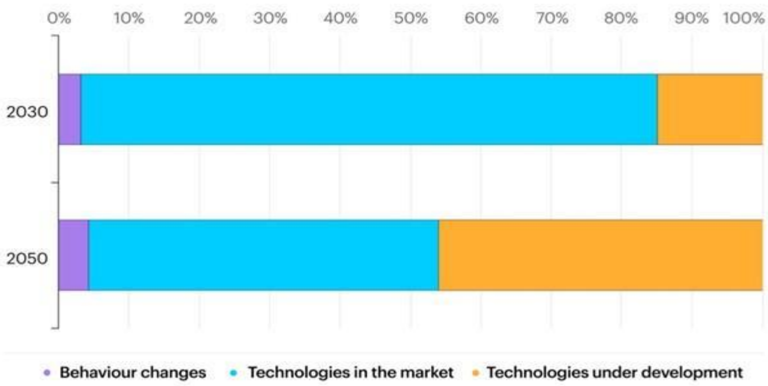


Source: IEA (2021)

Policy Pushes are Critical for 2050 NZE

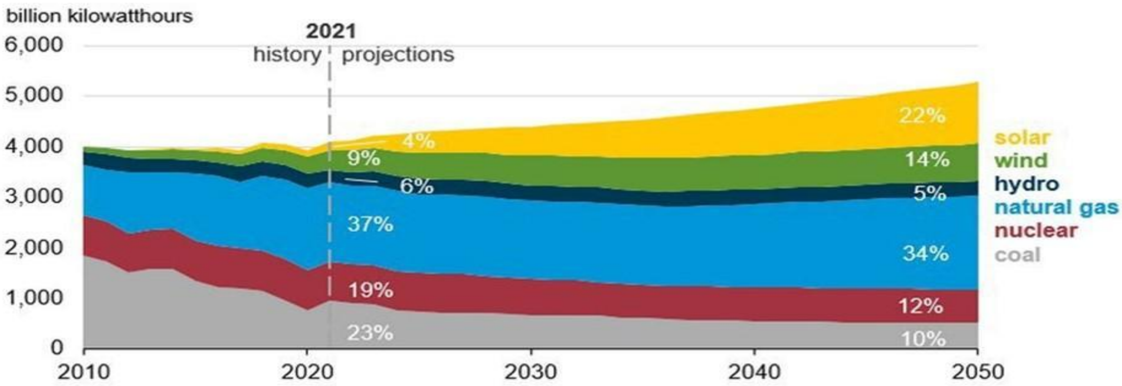
- All the technologies needed to achieve the necessary deep cuts in global emissions by 2030 already exist, and the policies that can drive their deployment are already proven

Annual CO_2 emissions savings in the net zero pathway, relative to 2020



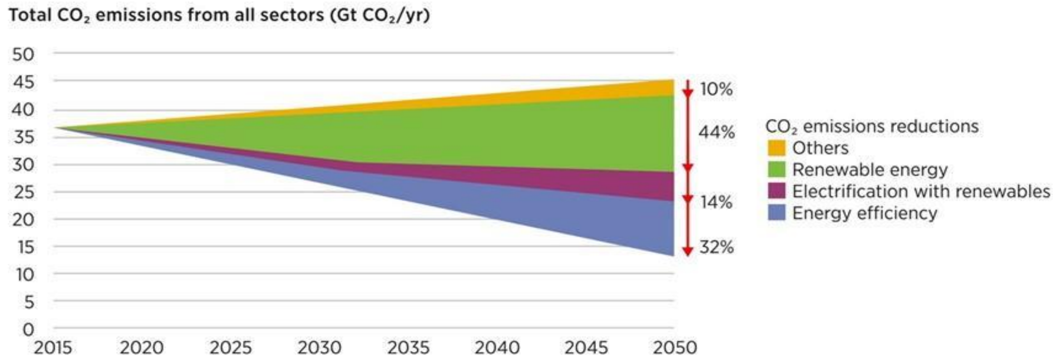
Source: IEA (2021)

The US Electricity Generation Forecast (2010-2050)



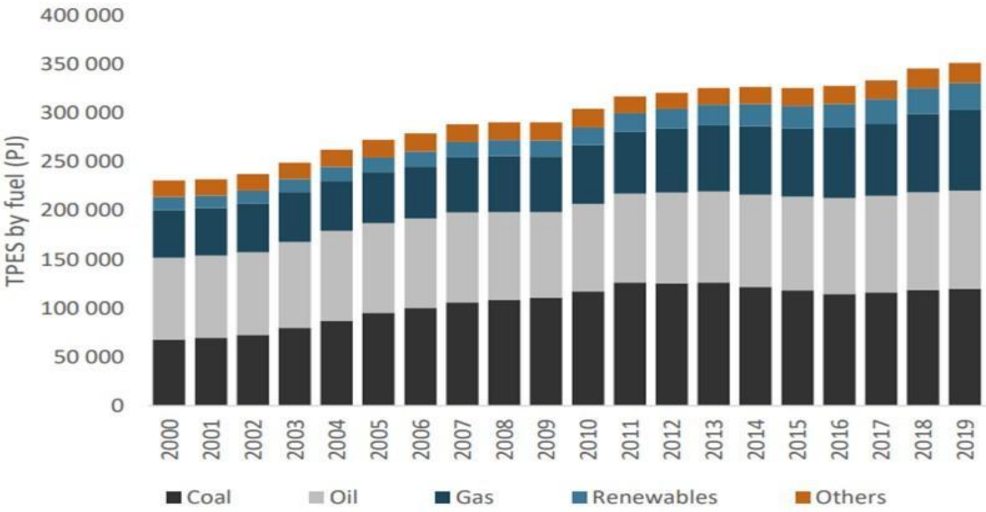
Source: ACEEE (2023)

Total Projected CO2 Emissions from All Sectors including Energy Efficiency



Source: ACEEE (2023)

APEC Total Primary Energy Supply by Fuel (2000~2019)



Source: EGEDA (2021)

Biden-Harris Administration Priorities

- Admits **no greater challenge than climate change**
- Turning national and global climate threats to **opportunities** to
  - Revitalize the US energy and manufacturing sectors
  - Create millions high-quality, good paying jobs
  - Address historic environmental injustices and inequities
- 100% clean energy economy and **net-zero emissions** no later than **2050**

DOE Office of State Community Energy Programs (SCEP)

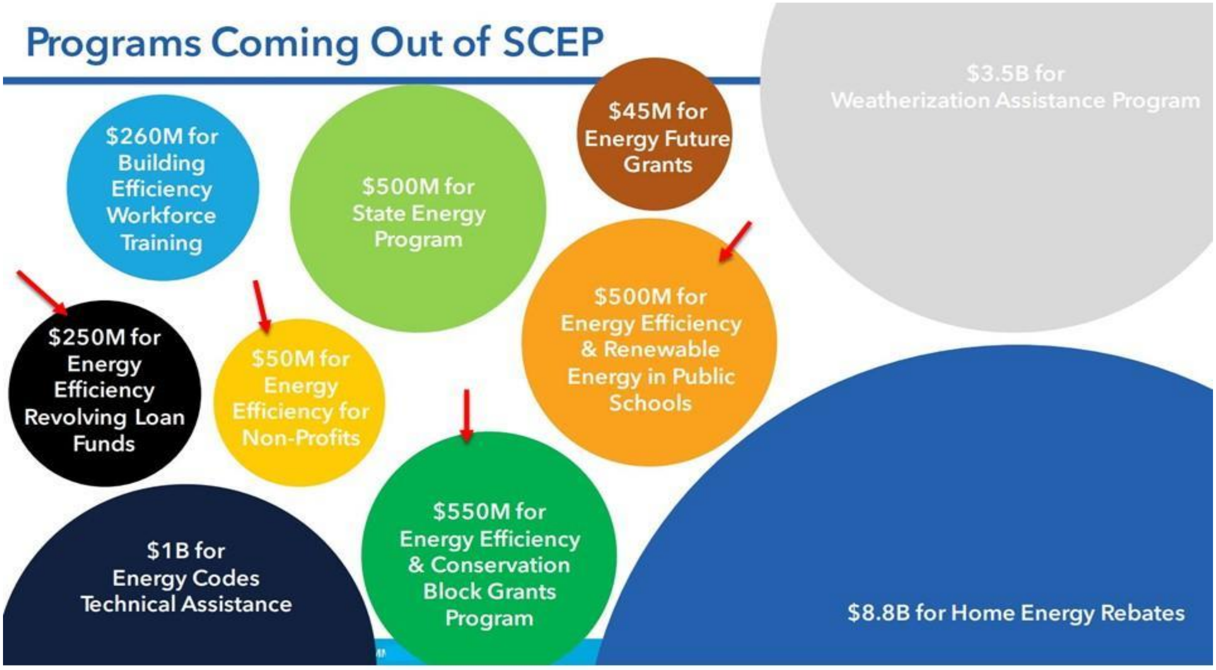
New Office created to implement nearly **$16 billion in programs** from the Bipartisan Infrastructure Law (BIL), Inflation Reduction Act (IRA), and annual appropriations.

SCEP works to:
- Accelerate high-impact, self-sustaining clean energy projects that improve people's lives
- Aid state & local governments, tribes, community-based organizations, & others in deployment
- Center the needs of low-income households and Disadvantaged Communities (DACs)

Deploy clean energy technologies | **Center equity and deliver on J40 priorities** | **Catalyze local economic development** | **Create jobs** | **Avoid pollution through place-based strategies** | **Reduce energy costs**

Office of State and Community Energy Programs (SCEP)

- Grants programs
  1. Building training and assessment centers
  2. Career skills training program
  3. Energy auditor training grant program
  4. Energy efficiency and conservation block grant program
  5. Energy future grants
  6. Renew the US's nonprofits
  7. Renew the US's schools
  8. Revolving loan fund grant program
  9. state-based home EE contractor training grants
  10. Technical assistance for the adoption of building energy codes
  11. Workforce development and business owner training programs



Energy Future Grants

DOE has launched a $27 million grant program to support local, state, and tribal government-led partnership efforts.

The Program will advance clean energy program innovation and ensure benefits flow to disadvantaged communities.

Energy Future Grants: Vision and Goals

Vision: Reward adoption of innovative (novel/early action) planning approaches or strategies across sectors that ensure the benefits of a clean energy economy flow to disadvantaged communities.

Goals:

- Equitable Innovation
- Multijurisdictional Partnerships
- Scalable Outcomes

Technical Review Criteria: Priority Areas

Technical Selection Criteria -- Used to Score Applications

Program: What is the current strategy (baseline)? How is the new or improved strategy innovative? What authorities or structures will ensure the strategy is implemented?

Partnerships: Who is involved? What their roles? How will the team expedite project goals? Does the project have an innovation ecosystem?

Justice40/Community Benefits: What data will be collected (e.g., # jobs, trainings, etc.)? What tools will be used to measures benefits to disadvantaged communities? What support from DOE do grantees need to maximize progress? (i.e., implement the Community Benefits Plan)[1]

Energy and Cost Impacts: What is the potential for energy savings? How has energy affordability and access improved? What are benefits to consumers and ratepayers?

[1] A Community Benefits Plan is required in the FOA to ensure grantee advance workforce, engagement, equity and Justice40.

Local Energy Action Program

- Partnering with low income, energy-burdened communities
- $18 million
- **Technical assistance** to 24 competitively selected communities to develop clean-energy-related economic development pathways
  - National Renewable Energy Laboratory (NREL)

24 Communities Selected

Pathways to a Community Energy Transition

- Carbon capture and storage and critical minerals
- Clean energy and **energy efficiency**
- Clean energy planning and development
- Clean transportation planning and investment
- Community resilience microgrid and energy storage
- **Energy efficient** buildings and beneficial electrification planning and investment
- New or enhanced manufacturing and industry

$1.4 billion for energy efficiency

- $250 m for energy efficiency revolving loan funds
- $50 m energy efficiency for non-profits
- $550 m for energy efficiency and conservation block grants program
- $500 m for energy efficiency & renewable energy in public schools

Energy Efficiency & Conservation Block Grant (EECBG) Competitive Program

- Support state, local, and tribal governments to
  - Reduce fossil fuel emissions & total energy use
  - Improve energy efficiency in transportation, building, and other sectors
- Total Infrastructure Investment and Jobs Act Appropriation (IIJA)
  - **550 million** for states, local, governments, & tribes

Energy Efficiency & Conservation Block Grant (EECBG) Competitive Program

- Prioritize **disadvantaged com**munities (in lined with the Justice40 Initiative)
- Prioritize applicants in **states and territories with less than 2 million people**
  - 14 states including Alaska, Idaho, Maine, Nebraska, West Virginia, Wyoming
  - 4 territories : American Samoa, Guam, Northern Mariana Islands, and US Virgin lands

The US EPA support for local communities

- Focusing on technical assistance
- Informational resources for local governments seeking to promote energy efficiency in their communities
- **Green Power Partnership**

NSW, AU Energy Efficiency Action Plan

- Strengthen energy efficiency market
- Energy efficient homes
- Energy efficient **business**
- Energy efficient government
- Statewide delivery

Energy Efficient Communities Program – 2020 Community Energy Efficiency and Solar Grants

- Provide community groups with grants up to $12,500 for energy efficient equipment, energy generation and storage systems, and energy audits
- Aims
  - To improve energy efficient practices
  - To increase the uptake of energy efficient technologies
- $3.8 m, a max 2 projects funded per electorate
  - Maximum project period <12 months

Victoria Business Recovery Energy Efficiency Fund

- $31m Business Recovery Energy Efficiency Fund
- provides grant funding to businesses
  - for energy efficient capital works and energy demand management technologies

Program Outcome

- 108 energy management projects

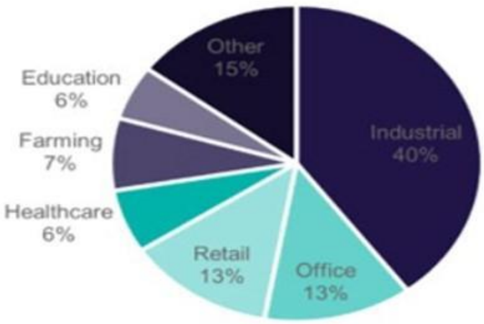


Figure 1 BREEF Projects by Workplace Type

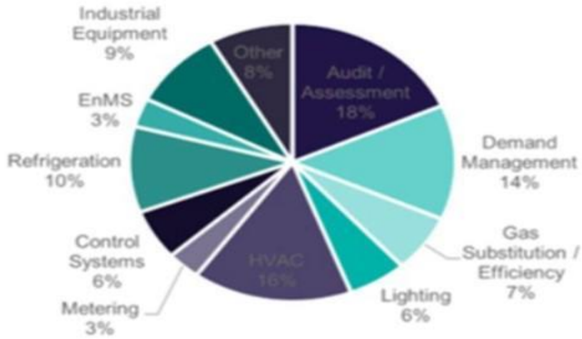


Figure 2 BREEF Initiatives by Project Type

Source: VBREEF (2023)

Victoria's household EE spending

- $333.5 m to replace wood, electric, gas fired heaters with new energy-efficient systems
- $112 m for social housing energy efficiency upgrades
- $5.9 m to introduce a new **7 star energy efficiency standard for new homes**
- $14 m to expand Victoria's retailer energy efficiency scheme, the Victorian Energy Upgrades program

New Energy Efficiency Standards for New Homes from May 1, 2024

- Australia's National Construction Code (NCC): change to the minimum energy rating of new homes from **6 to 7-stars**

Going beyond 7-Stars; zero-energy and carbon ready

Remaining Questions

- Lack of institutional capacity and financial constraints in developing economies
- Equity concerns should be prioritized
  - low-income residents with rebates for energy efficient homes
- Expanding and strengthening voluntary EE policy measures
  - federal governments play a role in effectiveness

Thank You & Questions?

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