

A Journey to Digital Utility

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SUSTAINABILITY REPORT 2018 Provincial Electricity Authority

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A Journey to Digital Utility

In the digital age is used as an implement to drive the country in all dimensions. PEA in the role of the electric power provider has adapted itself to be a digital utility provider. Aiming to be an excellent organization in the electric power business and respond to be convenient for Thai people's lifestyle. Looking around in a responsible manner for communities, society and environment under the business, service, and technology development to be modern and effective to drive the current route for creating the future sustainability.



Message from Governor [102-14]

In 2018, PEA set forth its 2018 - 2022 master plan on digital operation and utilized it as a framework to improve its business and technology areas, so as to steer them in the same direction. There are three operational strategies:

1. Digital Service - this will improve quality of life by integrating digital technology into database system development used to analyze customer data, with the goal of increasing efficiency, providing services to approximately 19.4 million customers.

2. Digital Operational Excellence - transforms work processes through information and communication technology to develop and modernize the distribution system, while enhancing our personnel's digital literacy.

3. Digital Business - implements digital technology to increase new business opportunities, productivity and service provision, resulting in new products, services, and business opportunities.

Our important policy, titled "Keep improving existing business, Enhance new business, Employ innovation and technology, and Nourish human resource (KEEN 14)," aims to make PEA ready to become a digital utility leader. The organization strongly emphasizes that all work processes in our department and divisions must be digitally driven. These processes must be standardized, stable, and safe. This is to ensure the efficiency in our service provision, the increase in security and stability of energy distribution systems, the improvement of the quality of life of PEA customers, stakeholders and officers, and the establishment of new businesses.

With these determinations, all PEA officers are committed to adjust to the challenge of becoming an utility that can satisfy customer's expectations, and sustainably bring value to the society and environment through digital technology.



The Provincial Electricity Authority (PEA) has set goals for the organization to successfully become a leader in digital utilities by 2022. In order to achieve these goals, PEA has already proceeded to transform the organization into a digital utility by restructuring organizational operations and strategies in which rapid changes in energy technology are taking place.

S. Jur.

(Mr. Sompong Preeprem) PEA Governor

Provincial Electricity Authority (PEA)



Getting to know Provincial Electricity Authority

Organizational background

The Provincial Electricity Authority was established as an independent organization formerly known as the Provincial Electricity Organization in accordance with the Royal Decree on March 6, 1954. It was subsequently published in the Royal Gazette on March 16, 1954, with its operations overseen by the Department of Public and Municipal Works, the Ministry of Interior, and the Government of Kingdom of Thailand. The Minister of Interior has a general range of supervisory powers, with an initial legal capital of five million baht and a total of 117 electricity authority offices within its jurisdiction.

It was not until September 28, 1960 that it was officially established as the "Provincial Electricity Authority" under the Provincial Electricity Authority Act B.E. 2503, continuing the mission and operations of the Provincial Electricity Organization. [102-1]

PEA's businesses

The Provincial Electricity Authority (PEA) is an energy state enterprise under the Ministry of Interior, whose primary business operations are focused on supplying electrical power, providing electrical power services, and conducting other supporting businesses covering different areas: electrical power systems construction, supply rentals, repair and maintenance, inspection and analysis, personnel development workshops, consulting and design services. [102-2] [102-5]

PEA is regarded as a leading electrical power service provider that has transmission and distribution networks covering a total of 74 provinces, or the equivalent of 99.99 percent of all areas in Thailand. [102-4]

Organizational profile

Number of personnel : PEA had 29,659 employees and 5,873 workers.

Power users : PEA distributed the highest amount of electricity totaling 134,661.55 million units per four types of power users: 19,766,030 users. [102-6]



PEA has conducted business in accordance with the provisions of the PEA Act (4th Edition) B.E. 2542, and has implemented charters, principles, and domestic and international requirements to develop the organization in ways that allow its operations to run effectively.

In addition, PEA collaborated with various public and private entities to add value to the organization and society, so as to move towards sustainable development. Those entities are as follows:

Primary operations include Engineering Institute of Thailand under Royal Patronage, Energy Regulatory Commission, Energy Efficiency Resource Standard, Energy Police and Planning Office, and Ministry of Energy's Permanent Secretary Office.

Other operations include Personnel Management Association of Thailand (PMAT), Department of Skill Development, and Association of Provident Fund.

PEA affiliates [102-45]

PEA ENCOM International Company Limited (PEA ENCOM) was established in line with the cabinet resolution dated June 3, 2009 in order to invest in domestic and international power business and to provide workshops on electrical power systems to private and public sectors in Thailand and internationally. It was registered as a juristic person on October 14, 2009, whereby the PEA held all shares. Its initial capital was 100 million and has now risen to 1,441.28 million baht.



Number of PEA's public service offices [102-4] [102-6] [102-7] [102-10]

North -



Service areas

Head Office : 200 Ngamwongwan Road, Ladyao Sub-district, Chatuchak District, Bangkok 10900, Thailand [102-3] Electricity Authority Offices : Provides services for 74 provinces of Thailand (except Bangkok, Nonthaburi, and Samut Prakan). [102-4]

Provincial Electricity Authority (PEA)



Remark : Volicy **Peedback**







Transmission line system : PEA had the total transmission line system of 798,653.47 circuit-kilometers, which could be divided into transmission line system of 12,764.57 circuit-kilometers, high-voltage distribution system of 313,424.44 circuit-kilometers, and low-voltage distribution system of 472,464.45 circuit-kilometers.

PEA had expanded its underground distribution system to 10,111.29 circuit-kilometers or 1.226%, with an increase of 201.15% from 2017 to increase stability and reliability of the electrical system, reduce problems and obstacles in maintenance and safety operations in city or tourist destination areas of local administrative organizations whose landscape needs improvement.



Sustainability Report Guidelines

Stakeholder engagement

PEA identified stakeholders through stakeholder mapping to select people with three major characteristics, namely expertise, willingness, and influence. [102-42] Therefore, PEA stakeholders can be classified into five main groups [102-40], which are regulatory agencies; employees and workers; suppliers, trading partners, and collaborators; customers/users; communities, society, and environment.

In 2018, PEA reviewed its identification of customers/ users based on three dimensions of needs/expectations, which were products, services, and support, using the KANO Model for classification. Moreover, the PEA Strategic Plan for 2014-2023 (4th edition, 2018), missions, visions, business direction, electrical industry market analysis results, electricity use pattern and behavior, electricity demand, electricity consumption growth rate, revenue from electricity, important information from public hearing, and what had been learned from the experience of those involved with customers were used to support the identification of PEA customer groups and markets. Finally, four groups of customers/users could be classified – the residences group, the commercial group, the industrial group, and other groups.

To build the relationships with its stakeholders, PEA has clearly determined responsible agencies, methods, frequency of implementation, and collection for major needs/expectations of the stakeholders to be used for forming a guideline for responding to such needs/ expectations both in the form of organizational strategies or work plans of different departments.

Needs/ Expectations of the stakeholders [102-44]

Guideline for building relationships with the stakeholders [102-43]

PEA's responses to the needs/expectations of the stakeholders in 2018

2018 Outcomes

Regulatory agen	cies		
 Developing readiness of the electric power infrastructure Promoting the effective use of energy Being 	 Communicate important information/ provide explanation to relevant sectors. Communicate information via Line group : PR Mahadthai. Communicate information via Line@ 	 Implement the project to expand the electric power distribution systems to new electricity users inclusively and continually, for instance, New Rural Household Electrification Project, Remote Rural Household Electrification Project, etc. Issue a policy and prepare a management plan for energy-saving and eco-friendly office buildings. Participate in the Energy Efficiency Resources Standard (EERS) Project of the Ministry of Energy to promote 	 Households with electricity accounted for 99.76%, with an increase of 0.01% compared to 2017. The four PEA offices were certified as green buildings according to the LEED Standard by the U.S. Green Building Council
 equipped with the system to handle disasters or energy crisis Having measures to ensure reliability of electric power systems 	 Ministry of Interior. Hold meetings/seminars to follow up works. Hold meetings/VDO conferences on other special occasions. Hold meetings/ seminars to present the annual operational performance. Organize public hearing on PEA strategic plans. 	 (EERS) Project of the Ministry of Energy to prohibite energy saving for both temporary and permanent systems. Develop projects/plans to promote and encourage effective use of energy by providing knowledge and advice on electric power systems and energy conservation through documents or seminars on different topics, such as energy saving, using electricity safety, electric power system maintenance, etc. to relevant stakeholders continually. 	 There was a clear guideline for improving the Grid Code to support the alternative energy policy and increase the efficiency of the PEA distribution system development planning.



Needs/ Expectations of the stakeholders [102-44]	Guideline for building relationships with the stakeholders [102-43]	PEA's responses to the needs/expectations of the stakeholders in 2018	2018 Outcomes
 Holding on to the good governance principle Adopting knowledge management in the organization Supporting the application of innovations and technology Monitoring service standards and quality 		 Upgrade the development of processes to handle disasters or energy crisis according to ISO 22301 Standard to cover the whole organization (in both central and regional areas), as well as practice the Incident Management Plan (IMP) and the Business Continuity Plan (BCP) regularly in all offices in order to systematically and continuously improve the following year's BCMS system plan based on the problems and obstacles found. Maintain electric power systems to be ready for effective use, reduce power losses, and fix power outages to resume power distribution condition based on the safety requirements. Monitor electricity quality and control operations on electric power systems to ensure safety and standard voltages. Become a sustainable transparent organization by developing a master plan on good governance to prevent and suppress corruption in PEA using the criteria of the Integrity and Transparency Assessment Project run by the National Anti-Corruption Commission (NACC), and drive the operations by setting clear goals on efficiency and effectiveness in order to improve the good governance and anti-corruption operations procedure. Analyze internal and external factors, along with problems and obstacles and compare them with the current work procedures in order to determine projects/work plans to solve such problems or obstacles. Have a clear knowledge management approach consistent with PEA strategic plans and digital operation plans to encourage all the departments to be equipped with a knowledge management organization. Create the atmosphere of knowledge management organization through various knowledge exchange activities, such as KM Day, Think Tank Project, innovation competitions, or operating skill competitions, or operating skill competitions, or operating skill competitions, or operating skill competitions, and to promote such as innovations and expend the knowledge learning throughout the organization for PEA to a	 There was an increase in the number of business promotion and development projects, for instance, installation of the solar rooftop system at the early stage to promote effective use of energy and develop new business opportunities, and training on how to install solar rooftop panels, etc. Emission of greenhouse gas decreased by 10,213,215.55 tCO_/year, with an increase of 5,048,798.03 tCO_/year compared to 2017. 202 PEA offices (100% according to the target) carried out the BCMS system according to ISO 22301 Standard, with additional three offices practicing the IMP and BCP plans compared to 2017. Electric power system reliability indexes are 1) System Average In t err u p t i on Frequency Index (SAIFI) was 3.81 times/user/year, with a decrease of 0.69 compared to 2017. System Average Interruption Duration Index (SAIDI) was 89.82 minutes/user/ year, with a decrease of 28.88 compared to 2017. 100% standard voltage was achieved (met the target). Information disclosure in important processes of the organization was gradually developed and could be checked by the stakeholders.

Needs/ Expectations of the stakeholders [102-44]	Guideline for building relationships with the stakeholders [102-43]	PEA's responses to the needs/expectations of the stakeholders in 2018	2018 Outcomes
		 Set up a technology research and development fund to support the operations through domestic educational institutions or research institutes to promote and support existing technology research and development, as well as to develop new technology continually, with regular monitoring by top management. Focus on new products and services to consistently satisfy customers/ users, for instance, PEA One Touch Service, etc. Increasingly adopt the information system for daily operations, for example, personnel capacity management and development, Corporate Governance development, development of the energy and resource utilization data storage system, public hearing to listen to customer opinions, etc. with an aim to apply the results, communicate information throughout the organization, and improve operational performance. Facilitate the public to receive fast services, for example, access to remote communities, services via mobile applications, One Touch Service, etc. Consistently improve service quality, for instance, application of queue management system and satisfaction assessment system at the point of service, provision of drive-through payment service, and 24-hour call center services for answering questions, notification of power interruption, and receiving complaints. Maintain service quality based on the GECC Standard, which is a mark certifying convenient, fast and easy-to-access services provided by all government agencies. 	 The Corporate Governance Assessment and Integrity and Transparency Assessment (ITA) scores consistently increased, with the score of 92.92 in 2018. The score of the management's and employees' awareness and application of corporate governance, integrity, and transparency in the operations was 90.85, which was at a high level. The organization received the Outstanding State Enterprise Award 2018 for Outstanding State Enterprise Award 2018 for Outstanding State Enterprise Award 2018 for Outstanding state Enterprise Award 2018 for Outstanding state Enterprise Award 2018 The state Enterprise Policy Office (SEPO). This reflected its success in transparency and anti-corruption operations at a national level. The success of the operations based on the knowledge management process was presented in the KM assessment score of 3.44, with an increase of 0.44 compared to 2017, and 100% of the work functions applied the knowledge management process (met the target). There were 170 pieces of works/innovations from work process improvement, with an increase of 98 pieces compared to 2017. During 2016-2017, there were 140 PEA offices with GECC accreditation. Additional 166 offices were accredited in 2018.

Needs/ Expectations of the stakeholders [102-44]	Guideline for building relationships with the stakeholders [102-43]	PEA's responses to the needs/expectations of the stakeholders in 2018	2018 Outcomes
Employees and	workers		
 Leader's good visions and management Career advancement Good quality of life at work Satisfactory pay and welfare from PEA 	 Organize meetings between executives and operators (through meetings/visits/activity participation). Communicate important information involved with management's decision making. Communicate information via Line@PEAfriends. Broadcast "PEA Governor Meets Employees" Promote operational performance through internal media. Announce the governor's organization management and development policy. Organize a seminar to explain the annual strategic plans by top management. Organize meetings among top management of each work function. Organize meetings to explain strategic plans/ review annual operation plans of each work function. 	 Regularly communicate a guideline for operations and follow-up. Encourage top management to take part in reviewing the human resource management master plan to serve as an important mechanism for driving the organization. Arrange competitions of outstanding personnel, work functions, and electricity offices, and organize relevant activities to create a model of Best Practice to be used as a mechanism for improving personnel capacity. Create clean, comfortable, and safe work environment, and encourage the employees to join training to improve skills and knowledge consistently. Ensure fair selection, assignment, appointment, transfer, and consideration of promotion without the patron-client system or hidden agenda, and allow opportunities for employees to meet their supervisors in case of having personal problems. 	 The average employee satisfaction on leader communication was 3.69, with an increase of 0.02 compared to 2017. The average opinion of the employees on top management role was 4.11, with an increase of 0.03 compared to 2017. The average employee satisfaction on the organization was 4.40 out of 5. The average employee attachment to the organization was 4.49 out of 5. The e m p l o y e e satisfaction on privileges and welfare increased in all ages, with an average of 4.27, and increase of 0.02 compared to 2017.
Suppliers, tradir	ng partners, and collaborate	Drs	
 Fair competitions Transparency in joint business operations Negotiate contracts/ agreements in a fair manner Compliance with the terms and conditions agreed upon in 	 Communicate information which is important for decision making or which can impact the stakeholders and PEA. Communicate information through newsletters/ journals/ news and scoops on radio, television, newspapers, and magazines. 	 Announce the PEA Transparency and Sustainability Policy, and encourage the executives and employees from all levels to perform transparent, equitable, and verifiable works as well as be fair to both internal and external stakeholders. To ensure no collection, acceptance, or payment of any dishonest benefits to suppliers, trading partners, and collaborators. In case of information on collection, acceptance, or payment of any dishonest benefits, it must be disclosed to suppliers, trading partners, and collaborators for joint solutions in a fair and fast manner. Strictly follow the agreed upon conditions. In case of failure to follow any condition, notification had to be 	 The average stakeholders' attitude towards PEA operations was 4.38, with an increase of 0.15 compared to 2017. The survey was divided into three aspects as follows: For alternative energy, the average was 4.37, with an increase of 0.04 compared to 2017. For services, the

made in advance for joint consideration on solutions.

contracts

5. Exchange of

within an

period of

time to

information

appropriate

develop work

collaboratively

3. Communicate

information via Line

4. Organize joint activities

trading partners, and

5. Organize public hearing

PEA strategic plans.

to receive opinions on

Official account.

with suppliers,

collaborators.

- 2) For services, the average was 4.42, with an increase of 0.17 compared to 2017.
 - 3) For organization strategic objectives, the average was 4.36, with an increase of 0.25 compared to 2017.

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Needs/ Expectations of the stakeholders [102-44]

Guideline for building relationships with the stakeholders [102-43]

PEA's responses to the needs/expectations of the stakeholders in 2018

2018 Outcomes

Customers/ use	rs		
 Coverage of electricity in all areas Sufficient and continuous electric power, and power quality in accordance with the standard Standard and safe electric power system Reduction of work procedures to achieve timely and standard services Convenience in power outage notifications/ following-up and fast fixing of power outages Service with transparency and fairness Convenient, fast and easy-to-access services 	 Communicate information which is important for decision making or which can impact the stakeholders and PEA. Communicate information via newsletters/ journals/ news and scoops on radio, television, newspapers, and magazines. Communicate information via Line Official account. Communicate information via Line PEAfriends. Communicate information via Application PEA Smart Plus. Visit small power users/ organize seminars among large power users to analyze complaints, behavior, needs/expectations. Organize public hearing to receive opinions on PEA strategic plans. Survey customer satisfaction and loyalty. 	 Run projects to expand the electric distribution systems to new power users thand continually. Regularly organize seminars on the diricular industrial businesses and energy security as a platform for exchanging knowledge plan to upgrade the quality of power systervices for entrepreneur in industrial estatareas. Maintain electric power systems to be effective use, reduce power losses and outages to resume power distribution based on the safety requirements. Survey and improve high-voltage power cato buildings or construction regularly. Encourage the employees to improve sthigh level management, for example, making level Agreements (SLA) and extended it the organization with regularly monitoring. Arrange services of notifications of caus guideline for solutions in case of power catases on social network to increase cor and speed. Assign officers to be ready for fixing power 24 hours a day, and assign officers to provid during lunch break. Provide fair services for all customers/u the same standard. Facilitate the public to receive fast services provision of drive-through paymer and 24-hour call center services for a pulication, one Touch Servir a questions, notification of power and 24-hour call center services for a questions, notification of power interrup receiving complaints. Maintain service quality based on the GECC which is a mark certifying convenient, easy-to-access services provided by all go agencies. 	cpower horoughly1.Households with electricity accounted for 99.76%, with an increase of 0.01% compared to 2017.ection of to serve about the e and EEC100% standard voltage was achieved (met the target).3.The number of accidents from PEA electric power systems per user kept decreasing. In 2018, it was at 0.0021 times/user/year, with a decrease of 0.0184 compared to 2017.bles close ervices by ready for fix power condition4.The service outcomes met the standard at 100%, and the Service Level Agreements (SLA) were achieved 100% (met the target)g.5.Electric power system reliability indexes include; 1) System Average Interruption Frequency Index (SAIFI) was 3.81 times/user/year, with a decrease of 0.694 compared to 2017.sers using s, services, for s, services, for s, services, for s, service, answering tion, and6.Information disclosure in important processes of and could be checked by the stakeholders.7.The Corporate Governance Assessment and Integrity and could be checked by the stakeholders.7.The celectricity request process conforming to Ease of Doing Business of the World Bank was promoted, where electricity metres could be installed within 2-25 calendar days, from formerly 2-55 working days, in all areas.

Sustainability Report 2018

Needs/ Expectations of the stakeholders [102-44]	Guideline for building relationships with the stakeholders [102-43]	PEA's responses to the needs/expectations of the stakeholders in 2018	2018 Outcomes
			 9. The electricity request process was improved to start new businesses for customers requesting electricity in industrial estates and ECC areas to enable the construction and connection of electrical systems, and installation of electricity meters within 30 calendar days, from formerly more than 55 working days. 10. During 2016-2017, there were 140 PEA offices with GECC accreditation. Additional 166 offices were accredited in 2018. 11. The overall customer satisfaction was 4.47%, with an increase of 0.18 compared to 2017.
Communities, so	ociety, and environment		
 Safe electric power systems No adverse environmental impacts Support in sustainable social and environmental affairs from PEA 	 Communicate information which is important for decision making or which can impact the stakeholders and PEA. Communicate information via newsletters/ journals/ news and scoops on radio, television, newspapers, and magazines. Communicate information via Line Official account. Communicate information via Line Official account. Communicate information Via Application PEA Smart Plus. Organize joint activities with suppliers, trading partners, and collaborators. Organize public hearing to receive opinions on PEA strategic plans. 	 Regularly carry out public relations and pass on knowledge on safety in electric power use. Monitor the work on Corporate Social Responsibility by high level management in accordance with ISO 26000 Standard, and encourage personnel from all levels to have knowledge and understanding about the principles and practice of Corporate Social Responsibility in process based on ISO 26000. Announce the Corporate Social Responsibility Policy to encourage personnel from all levels to focus on reducing adverse impacts on the society effectively and tangibly. Allow opportunities for the public to take part in expressing opinions on any operations which might impact the environment, health and sanitation, quality of life, and livelihood of communities or local areas. Disclose the operations on responsibilities towards communities, society, and environment through the Annual Sustainability Report. Determine a clear preventive/corrective measure for social and environmental impacts caused by the company operations. 	 The stakeholder's satisfaction on PEA Corporate Social Responsibility was at a high level, accounting for 87.97%, with an increase of 2.12% compared to 2017. The organization received Outstanding State Enterprise Award 2018 for Outstanding Social and Environmental Operations from the State Enterprise Policy Office (SEPO). This reflected its success in participation in communities, society, and alliance; clear operation approach taking into account needs/problems of communities, and special abilities of PEA.

Remarks : Different font colors represent different operation frequencies [102-43].

- Regularly/Consistently/Every month
- Quarterly
- Yearly

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Sustainability materials topics

PEA considered and screened related material topics through selection of topics based on the GRI Standard in order to identify PEA's sustainability material topics [102-46] as follows:

Identification of material topics

PEA considered significant information from both internal and external factors, as well as the scope of both positive and negative impacts which might have an influence on sustainability of the organization, and analyzed such significant information based on the stakeholder inclusiveness and the sustainability context principles covering economic, social, and environmental dimensions as follows:

- Significant information from internal factors: Major or urgent needs/expectations of the stakeholders, impacts from operations, strategic plans, threats and opportunities, and value chain of the organization.

Significant information from external factors:

Legal requirements, National Economic and Social Development Plan, mega trend, Sustainable Development Goals (SDGs) of the United Nations, and the Dow Jones Sustainability Index (DJSI).

Prioritization

PEA used material topics of the stakeholders and organization to compare against the GRI Standards. It was found that there were 30 topics the stakeholders needed/expected from PEA. When they were prioritized using the Materiality Matrix, with the horizontal axis showing the significance of economic, environmental and social impacts, and the vertical axis showing influence on stakeholder assessments and decisions, 19 sustainability topics of PEA were identified, which can be divided into 1 economic topic, 8 social topics, 4 environmental topics, and 6 electric utility business topics [102-47] [102-49].

Economic	Social	Environmental	Electric utility business
1. Economic performance	 Employment Training and education Provision of information Customer health and safety Customer privacy Occupational health and safety Local communities Non-discrimination 	 Emission Environmental compliance Effluents and waste Energy 	 Demand-side management Availability and reliability System efficiency Research and development Disaster/emergency planning and response Access

Materiality matrix for assessing material topics



Significance of economic, environmental, and social impacts



Validation of PEA sustainability material topics

The top management has jointly considered PEA sustainability material topics based on the completeness principle to ensure that they were correct, complete, and consistent with the needs/expectations of major internal and external stakeholders.

Preparation of sustainability report

• About this report [102-48]

The Sustainability Report 2018 is the second edition after the Sustainability Report 2017 [102-51] prepared by PEA based on the GRI Standards to disclose the annual operational performance of the organization in economic, social and environmental topics, with the annual reporting period [102-52] from January 1 to December 31, 2018 [102-50] based on the GRI Standards and GRI Electric Utilities Sector Disclosures.

This report has been prepared in accordance with the GRI Standards: Core option. [102-54]

Moreover, to show its determination in sustainable development, PEA has linked its operations to a set of 17 Sustainable Development Goals (SDGs) of the United Nations and presented in this report.

• Scope of report [102-45]

Information disclosure in this report presents information and impacts from operations throughout the PEA value chain, with the report scope covering central and regional offices, power plants, power stations, as well as related stakeholders, except for affiliate companies.

• Report's quality assurance [102-56]

PEA's top management has the duty to monitor, provide advice, grant approval, and examine accuracy of the information in this report to ensure that the report is complete, accurate and inclusive of all of the material topics to all groups of stakeholders.

In addition, to show its determination in consistently improving the report, PEA has planned to invite third party entities with expertise to perform an independent audit and assurance of the operational performance to ensure confidence, reliability, and transparency in report preparation in accordance with the GRI Sustainability Reporting Standards.

Upgrading report quality

PEA allows opportunities for all groups of stakeholders to express their opinions on the annual sustainability report through a questionnaire at the back of the report. The opinions will be used by PEA to develop and upgrade the preparation of the next annual sustainability report to meet the needs/expectations of the stakeholders.

• Contact channels [102-53]

Should you have questions or need additional recommendations, please contact the Department of Corporate Social Responsibility, Provincial Electricity Authority, Head Office, 200 Ngam Wong Wan Road, Ladyao Sub-district, Chatuchak District, Bangkok 10900, Thailand. Tel: (66) 2590 9916, Fax: (66) 2590 9919

PEA sustainability material topics

Category	Sustainability material topics [102-47]	Impact boundaries [102-46][103-1]		Significance	
		Within organization	Outside organization	[103-1]	
Economic	Economic performance	PEA	Regulatory agencies	To maintain business operation stability and promote continuous growth.	
Social	Employment	PEA	-	To ensure that PEA manpower management is consistent with the current situations both inside and outside the organization, and that operations can be carried out continuously.	
	Training and education	PEA	-	To improve knowledge, capacity, and skills of employees to be ready for responding to PEA short-term and long-term operation strategies and direction.	
	Provision of information	PEA	Regulatory agencies/ suppliers/trading partners/ collaborators/ customers/ users/ communities and society	To enable customers/users to access important information and news in terms of products, services, and information related to health and safety.	
	Customer health and safety	PEA	Customers/ users	To reduce accidents from electric power use and promote operation safety.	
	Customer privacy	PEA	Customers/ users	To protect customer privacy and prevent customer data violation or losses.	
	Occupational health and safety	PEA	-	To create a standard for safety, occupational health, and work environment, and to minimize losses which might occur to PEA personnel.	
	Local communities	PEA	Communities and society	To provide using electricity safety for communities and reduce risks from accidents which might occur to people living in the communities around the operation areas.	
	Non-discrimination	PEA	Customers/ users	To tangibly create a standard for operations based on equality and non-discrimination to cover all the processes from recruitment, employment, procurement with trading partners, and customer services.	



Reported content	Operation monitoring	Page
Distribution of economic value to communities, society and stakeholders	• The PEA Strategic Plan for 2014-2026 (4 th edition, 2018)	43-51, 90-91, 101, 122
Employment, privileges, welfare and leave, recruitment, hiring, positioning, and new personnel retention	 Human Resource Master Plan for 2010-2020 (6th edition, 2016) Organizational Value and Culture Promotion Operations Plan for 2018 (short-term plan) 	45-50, 90-91, 93-96, 122-124
Promotion of human capital development, process improvement and upgrading learning system and personnel development standard, reviewing, evaluating, and measuring effectiveness of the learning system and personnel development	• Human Resource Master Plan for 2010-2020 (6 th edition, 2016)	45-46, 48-50, 90-91, 98-101, 124-125
Improvement of communication and promotion channels to be convenient, fast, up-to-date; promoting information and providing consultation and useful knowledge to electricity users and general public	• Customer Service Master Plan for 2017-2021	44, 90 - 92, 122
Focus on electricity user safety and confidence in using PEA power supply	• PEA Safety, Occupational Health, and Work Environment Master Plan for 2014-2018	45-46, 90-92, 122
Protection of customer personal information and information safety management system	Customer Service Master Plan for 2017-2021	44, 88-91, 122
Management of safety, occupational health and work environment, personal health risk assessment, and statistic of death and injury at work	• PEA Safety, Occupational Health, and Work Environment Master Plan for 2014-2018	45-46, 90-91, 93, 122, 126-127
Participation in community and social development to bring about using electricity safety through various projects which focused on activities to build relationships with the communities around the operation areas to listen to their opinions, concern, and recommendations for improving operations	• PEA Safety, Occupational Health, and Work Environment Master Plan for 2014-2018	45-46, 90-91, 102-103, 122
Determination of a good practice for employees, suppliers, trading partners, customers/users to achieve fair, equitable and non-discriminating conduct and operations	• PEA Corporate Governance and Anti-Corruption Master Plan for 2017-2021	45-46, 90-91, 97, 122



Catagony	Sustainability material topics [102-47]	Impact boundaries [102-46][103-1]		Significance
		Within organization	Outside organization	[103-1]
Environmental	Emission of greenhouse gas	PEA	Communities and society	To mitigate the current environmental impacts caused by climate change and to up-grade the office standard to be more environmentally friendly and to prepare for international environmental standards.
	Environmental compliance	PEA	Communities and society	To ensure that the organization operations comply with environmental requirements, regulations, and laws, and to reduce the impacts on communities and society.
	Effluents and hazardous waste	PEA	Communities and society	To prevent toxic leakage caused by incorrect disposal, which might impact health and safety of people in the surrounding communities.
	Energy	PEA	Communities and society	To upgrade the organization's power consumption efficiency and to promote energy conservation and mitigate environmental impacts.
Electric utility business	Demandside management	PEA	Customers/ users / communities and society	To use the existing electric energy most effectively and usefully, and to encourage electricity users to change power consumption behavior.
	Availability and reliability	PEA	Customers/ users / communities and society	To create security and electrical system reliability among stakeholders to ensure that there will be sufficient electric energy for current and future needs.
	System efficiency	PEA	Customers/ users / communities and society	To ensure that electrical services will be effective and power can be distributed continually, which is PEA's important mission.
	Research and development	PEA	Customers/ users	To promote development of innovations used for improve power distribution services to obtain the highest efficiency and to become an innovative organization in compliance with the policy of Thailand's energy regulatory agencies and the country's direction in power consumption.
	Disaster/emergency planning and response	PEA	Customers/ users / communities and society	To ensure that electric power systems can distribute sufficient power to meet the needs of people in case of unexpected incidents.
	Access	PEA	Customers/ users / communities and society	To ensure fairness in accessing electric power systems, which are regarded as a basic infrastructure and a starting point for developing quality of life, education, and economy.



Reported content	Operation monitoring	Page
Development of energy and resource utilization databases using a modern information system in order to use such information for calculating the value of greenhouse gas emission and analyzing Eco Efficiency value to be used as information for serving the effectiveness of energy management and resources utilization	• PEA Corporate Social Responsibility Master Plan for 2017-2021	45-46, 90-91, 106-113, 122, 129-132
Analysis, assessment, and preparation of a report on environmental impacts before, during, and after the construction of electric power systems	• PEA Corporate Social Responsibility Master Plan for 2017-2021	45-46, 90-91, 106-109, 122
Management of effluents and hazardous waste of the power transmission and distribution systems and office buildings	• PEA Corporate Social Responsibility Master Plan for 2017-2021	45-46, 90-91, 106-116, 122-132
Energy saving, renovation of office buildings to be eco-friendly, electric power and fuel consumption of the organization	• PEA Corporate Social Responsibility Master Plan for 2017-2021	45-46, 90-91, 110-114, 122, 128-129
Demand-side management, promotion of effective power consumption, implementation of projects to change power consumption behavior to be consistent with production, and promotion of energy conservation	• Electric Power System Development Plan during the 12 th National Economic and Social Development Plan	46-47, 64-66, 90-91, 122, 133-134
Effective power supply services along with continuous organizational development in terms of quality and services, prediction of electric power demand, and investment planning to support future needs of power	• Electric Power System Development Plan during the 12 th National Economic and Social Development Plan	46-47, 54-67, 90-91, 122, 135-137
Implementation of projects to increase the power distribution efficiency and electric power system relibility, and to reduce power losses	• Electric Power System Development Plan during the 12 th National Economic and Social Development Plan	46-47, 68, 90-91, 122, 138
Promotion and encouragement to apply research results in practice, consideration of research results which can be applied for long-term commercial purposes to increase the organization's competitiveness, and studying a guideline for improving electrical systems to support purchase of alternative energy which is likely to increase in the future, and continuously upgrading operations and services	 Electric Power System Development Plan during the 12th National Economic and Social Development Plan Electric Power System Research and Development Plan for 2016-2020 	48-50, 68-75, 90-91, 122
Operations based on the Load Shedding Scheme in case of errors in electric power to maintain balance of electric systems to meet the standard criteria and to minimize impacts on customers in case of unexpected incidents	• PEA Risk Management Plan for 2018	37-39, 90-91, 122, 138
Expansion of power distribution systems to cover every household in the service areas	• Electric Power System Development Plan during the 12 th National Economic and Social Development Plan	46-47, 64, 90-91, 122, 139



Corporate governance and anti-corruption

PEA is determined to conduct its work operation based on the principle of corporate governance to be a transparent organization which focuses on anti-corruption, ethical standards, professional code of conduct, and takes every sector of stakeholders into consideration. Introducing policies to propel its work regarding good governance, PEA has announced the "Corporate Governance Policy" and "Anti-Corruption **Policy**" [102-16] in order for its members of the board of directors, executives and employees of all levels to operate the work according to corporate governance code, ethical standards and professional code of conduct based on the Core Value of "Modernization, Good Services, Good Governance", and it has announced the "PEA Sustainable Transparency Policy" [102-16], in order to encourage its executives and employees to work in accordance with the principle of fairness, transparency, verifiably and fairly work with both internal and external stakeholders of the organization. PEA has also had the **"PEA Corporate Governance Handbook"** [102-16] published to serve as guidance and standard of operation according to the principle of corporate governance.

In addition, PEA has formed a committee responsible for corporate governance and corporate social responsibility. The duty of the committee is to be in charge of governance, introduce policies, make suggestions, and monitor the work to ensure that it is operated in accordance with the policies and Operational Plan based on corporate governance and corporate social responsibility with highest efficiency and effectiveness. In 2018, PEA delivered key operation results according to the Action Plan based on corporate governance, prevention and anti-corruption in different aspects in conclusion as follows;

	Governance and promotion	Prevention	Anti-corruption
1.	Uplifted the intention of PEA	1. Developed the standard of	1. Developed process and
	board of directors and PEA	corporate governance and	mechanism of suppression,
	sub-committee on corporate	proactive system to prevent	tracking, inspection and
	governance, prevention and	corruption as outlined below;	punishment to become efficient
	suppression of corruption for	- Participated in the	and accepted at the international
	the 4 th year in a row.	"Assessment Project of	level as outlined below;
2.	Built and supported the society	integrity and transparency in	- Upgraded the operation of
	and culture of anti-corruption	the operation of government	"PEA's Transparency Action
	throughout the organization as	agencies" of the Office of	Plan" by the seminar of "13
	outlined below;	the National Anti-Corruption	Networks of Transparent PEA"
	- The Governor approved the	Commission by the use of	under the concept of "PEA is
	policy not to receive gifts	assessment result in the past	committed to Zero Tolerance
	during 2018 new year festival	year to perform Gap Analysis,	against corruption", via VDO
	(No Gift Policy) in order to	in order to provide guidelines	Conference system to 12
	respond to the prevention	for continuous improvement	PEA area offices and 189 PEA
	and anti-corruption policy,	and development of	(Class 1-3) offices nationwide.
	and to declare the intention of	operation for the 5 th year in	And there was exchange of
	PEA with its determination to	a row in 2018.	opinions, comments and
	conduct its operation without		suggestions hearing related
	any corruption.		to transparent operation

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Governance and promotion

- 3. Organized activities to build and ensure integrity, ethics and transparency working operation in order to foster and support the Core Value of "Modernization. Good Services, Good Governance", and to adopt the principle of the Sufficiency Economy Philosophy applied for executives and employees throughout the organization, with topics of the training to disseminate extensive knowledge such as the principle of Sufficiency Economy Philosophy, corporate governance, ethics, integrity and transparency at the work operation, good governance, prevention of conflict of interest, prevention and suppression of corruption, transparent procurement, and etc.
- 4. Organized activities to encourage and emphasize organization culture and value for all employees throughout the organization.

Prevention

- 2. Developed modern information technology system for the development of the Corporate Governance process (CG e-System), regarded as an innovation in the form of process development which consists of;
 - 1) Awareness result assessment regarding the promotion of corporate governance, culture and value of honesty, ethics, integrity, transparency and anti-corruption at the working operation (CG Testing).
 - 2) Report of conflicts between personal interest and corporate common interest of PEA (COI Reporting)
 - 3) Signing to acknowledge the Corporate Governance Handbook (CG Acknowledgement).
- 3. Analyzed risks and risk management regarding conflict of interest in 2018 which was found in low level.
- 4. Established 597 PEA Electronic Information Centers on the database of the Office of Official Information Commission (OIC), Office of the Permanent Secretary, the Prime Minister's Office. And, in 2018, 7 commemorative plaques of outstanding center of official information commission are awarded to PEA.

from PEA's Transparency Networks both inside and outside the organization, in order to mutually carry out the operation regarding the prevention and suppression of corruption, and to build up relationships among members of PEA's Transparency Networks.

Anti-corruption

- 2. Developed PEA information technology system called PEA VOC System (PEA-Voice of Customer System) into the complaint management to filing and tracking the complaints within PEA head offices and provincial offices located in 958 locations nationwide with complete and comprehensive work functions in every aspect. The system could also collect information, track and report the operation results on the same database throughout the organization, consequently, complaint management of PEA become faster and more efficient. To ensure that every complaint in the system was handled and managed, PEA had therefore set up the standard of complaint management as follows; Complaints of services
 - General complaints could be resolved within 30 working days (100%).
 - General complaints could be resolved within 30 days (at least 95%).
 - General complaints could be resolved within 15 working days (50% of all general complaints).





Effectiveness of corporate governance and anti-corruption

PEA had set the major indicators to assess the effectiveness of the overall operation regarding corporate governance. The results of the assessment which PEA received would be used to improve and develop operation process for continuous higher efficiency. Such the working operation would usher in the upgrade of Corruption Perception Index: CPI, which was significant to the development of the country in the overall picture, therefore, PEA has developed key indicators of process effectiveness as follows;

1) Participation in activities regarding corporate governance of PEA board of directors and sub-committees



- 2) Dissemination of information and knowledge of corporate governance
 - 2.1 Number of executives and employees participating in activities



^ر 25

2.2 Signing to acknowledge the Corporate Governance Policy



2.3 Assessment of awareness and application of corporate governance, ethics, integrity and transparency in the work operation of executives and employees (CG Testing)



3) Annual report of conflict between personal interest and corporate common interest by executives and employees



4) Complaint management



5) Integrity pact project

The committee for the cooperation to prevent corruption has chosen PEA procurement projects with high cost to participate in the Integrity Pact project as follows,



Provincial Electricity Authority (PEA) 🧒



6) Survey project for learning of customers and markets

PEA has assigned the Third Party to conduct survey of organization image in different aspects in order to respond to demands and expectations of its customers, and also to continuously create satisfaction, loyalty and bonding relationship, with survey results of Corporate Governance (CG) image in the customers' perspectives from the sample groups of current customers nationwide as follows;



The pride of PEA in the good corporate governance

<u>In 2018</u>

- State-Owned Enterprise Excellence Award 2018 (SOE Award), "Outstanding Transparency Information Award" from the State Enterprise Policy Office (SEPO), the Ministry of Finance (awarded for 2 consecutive years).
- Commemorative Plaques of outstanding center of official information commission, 7 awards received from the Office of Official Information Commission.
- Educational field trips were made to PEA to study the work of PEA Corporate Governance from other agencies, such as the Political Development Council, King Prajadhipok's Institute, and the Ministry of Finance in cooperation with Sripatum University.







Organizational Risk Management and Opportunity

Organizational risk management

PEA realizes that economic, social and environmental changes, as well as the phenomena of emerging new technology with its fast development, may affect the sustainability of the organization, leading to drastic changes in energy business (Disruptive Innovation), and factors of cost and energy price which determine the success of business administration. PEA therefore places importance on risk management of the organization by the management of factors which control activities and different operation processes to prevent or alleviate huge impact and reduce causes of damage to the organization, to ensure the ability of PEA to adapt quickly to the changes for sustainable business administration.

- Structure of organizational risk management

PEA has appointed the committee of risk management and internal control to be responsible for the governance, control and delivery of all comprehensive risk management policy which may occur to the organization in every aspect, including the consideration in the efficiency of internal control system and risk management to enable the response to comply with the law, regulation and policy of the government. The meeting to consider the operation result of risk management is held at least once in every guarter, and the annual meeting to consider risk management plan is held every year, with the Risk and Safety Management Department as the main sector to take responsibility and coordinate with the sub-committees of risk management in every division, and the deputy governors of each division preside and become Risk Owners for the operation to be implemented accordingly as planned.

- Promotion of risk management culture

PEA promotes the culture of risk management, with the Risk and Safety Management Department as the key sector to take responsibility and coordinate in the operation as follows;

• The annual organizational risk management plan shall be assigned to the involved Risk Owners

to implement accordingly as planned, and under the consideration of divisional risk management subcommittee, the divisional risk management plan shall be developed accordingly to support and constitute the achievement of the organizational risk management plan.

• The Governor approved the revision of risk management guidelines in 2018 for every division to implement according to the determined guidelines. The Risk and Safety Management Department disseminates implementation guidelines via appropriate communication media channels such as brochures, posters, circulated record notifications in the sector, and information technology system within the organization, etc.

• Meetings shall be arranged to continuously give guidelines of risk management.

• Risk management shall be determined as criteria to assess operation results of every division. In 2018, there were all departments in PEA head office and 268 divisions in PEA provincial offices carried out risk assessment, made internal control plan, and reported the results completely.

• Training workshops in risk management program shall be organized for the board of directors, executives and employees at all levels such as in 2018, the training of Risk Management Program for Corporate Leaders (RCL) for the board of directors and executives who need to understand the role and duty for the governance of different types of risks, including the governance and management of Opportunity and management of Crisis arising in the organization. This curriculum reflected the perspectives of the organization leaders who have to be in charge of governance and monitoring the work of executives directly dealing with risk management, and to give training workshops in this program to broaden knowledge, understanding and realization in risk management for employees at all levels from every division, etc.

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Framework principles on PEA risk management _

PEA has adopted the COSO ERM universal standard, the guidelines of risk management as prescribed by the State Enterprise Policy Office (SEPO) and based on ISO 22301 universal standard, to apply for risk management and development of operation in every level of the organization, by setting "Risk Management Policy" and "Internal Control Policy" [102-16] as code of practice for the board of directors, executives and employees at all levels to support and put the application of risk management and internal control into practice for the operation.

In 2018, PEA used strategic objectives of PEA strategic plan 2014 - 2023 (4th revision in 2018), operation results according to 2017 PEA strategic plan and operation results of 2017 PEA risk management as the framework to assess and analyze risks and prepare PEA risk management plan of 2018, in order to help the risk management system achieve the risk management goal of the organization and continue to become an apparatus or tool to add value for PEA.

Moreover in 2018, PEA has developed information technology system to support the report, analysis, level of risk impact and Early Warning System of incidents or risks with severe impact which could occur to the organization. This information technology system was used to issue warning of risk management results which were not likely to achieve goals. As a result, the involved sectors could quickly revise the operational plans that suitable to the changing situations, and consequently help achieve goals more effectively.

- Results of risk management

The risk management by PEA covers strategic, operational, financial and organizational reputation risks to enable appropriate and efficient risk management and assessment. The overall results of risk management can be mostly implemented according to the determined Risk Appetite and Risk Tolerance, and some work plans are continuously implemented for risk management in 2019-2020.

Risk issues	Significance		Management	Results
Asset management to	Assets owned by PEA are	-	Make Asset Management	- The ratio of the Return on
generate maximum	still not utilized up to		Roadmap of electrical	Asset (ROA) stood at 5.09
efficiency	optimum efficiency, with the		system and systematically	(very good) - a decrease
	lack of asset maintenance		implement the plan	of 1.94 compared with
	in electrical system in		accordingly.	2017.
	line with conditions of	-	Launch strategy	
	assets, therefore, asset		of maintenance for	
	management with maximum		assessment of the	
	productivity in order to		conditions of electrical	
	prolong the lifetime of		power transformers.	
	assets in use will reduce	-	Provide/develop software	
	unnecessary investment,		for load management	
	and can generate income		of distribution system	
	for PEA.		transformers.	

Economic Risk [102–15]



Risk issues	Significance	Management	Results
Success of investment in relevant business (Business Model)	Emerging changes in electrical business, digital technology and structure of electrical system prompt the organization to be prepared and ready, and seek opportunity to invest in relevant business both in the country and abroad for the sustainability of the organization.	 Arrange brainstorm meetings to monitor business information and to seek additional information from related sectors for the analysis of business model regularly. Arrange meetings to survey executives' opinions and comments regarding guidelines to develop the new business and related affiliate business regularly. Support the employees to study new technology related to both domestic and international businesses, and cooperation with allied partners regarding guidelines to do business. 	 Operate the relevant businesses such as Smart Home project, Smart Rooftop project, and etc. The success of operational plan for these relevant businesses stood at 100%. Appoint the team to study electric vehicles business' trend that helps PEA making the decision to start up a new business line effectively. Appoint the team to research and develop a new business regarding in information service provider called "PEA Information Service" supporting in-depth industrial business' information to the customers.
Transformation of organization with digital technology (Digital Transformation) 32 Sustainability F	The transformation to become Digital Utility needs the development of database, analytical system for customer information, as well as the improvement of communication channels and customer services, the use of digital technology to support and encourage the improvement of operation process to be quick and efficient, including the increase of employee	 Develop digital action plan and put the plan into practice. Revise personnel operation plans (HRM, HRD) that relevant to digital action plan. 	- The success of PEA digital action plan at the quarter 4/2018 stood at 80.60%. The progress report of PEA digital action plan is reported monthly to PEA Digital Steering Committee and Information and PEA Communication Technology Committee.

Risk issues	Significance	Management	Results
	performance efficiency in order to usher in higher productivity and the use of digital technology to increase the efficiency of current products and services and lead to design new products or services in the future.		
Analysis of competitive capacity and loss of income from large and medium enterprises opting to use renewable energy	As PEA is directly affected due to the government policy to encourage the usage of renewable energy from both self-production and distribution into the system, PEA has to be prepared and ready to be able to analyze competitive capacity, as well as the loss of income occurring from large and medium enterprises opting to use renewable energy. Consequently, the organization has to place importance on this issue to enable continuous response to demands/expectations and continuous support for the government policy to promote renewable energy as well.	 Develop work plan to serve risk group customers, and develop process to support alternative energy. Set up projects to promote and develop alternative energy business. Revise the process to analyze load forecast according to the direction of energy use of large and medium enterprises. Create the System Average RMS Variation Frequency Index (SARFI) at electric power station in industrial and business district area in order to bring the information for analysis and make proposal of guidelines to solve electrical quality problem. Study guidelines of premium power contract to seek opportunity for operation. 	- The success of the supporting work plan to maintain customers from large and medium enterprises from opting to use renewable energy stood at 87.77%.





Risk issues	Significance	Management	Results
The upgrade of services and continuous distribution of electricity	Continuous ongoing services and distribution of electricity with quality are the main mission of PEA and key factors in response to demands/expectations of key stakeholders of the organization.	 Revise and improve operation process affected from the Government Procurement and Supplies management Act B.E. 2560 (2017), causing the construction of electrical system to miss the targeted goal. Revise maintenance plan of electrical system and improve quality of system information regularly. Organize training workshop course to repair power interruption and failure, and supervise project management work to increase skills of employees. 	 The System Average Interruption Frequency Index (SAIFI) stood at 3.81 times/account/year- a decrease of 0.69 compared with 2017. The System Average Interruption Duration Index (SAIDI) stood at 89.82 minutes/account/year- a decrease of 28.88 compared with 2017.
Overall power loss management	The reduction of overall lost units contributes to cost management of the organization, reflecting in the reduction of income loss from electrical distribution.	- Develop U-CUBE Program for meter check to analyze inaccuracy of electrical power consumption measurement, such as incomplete meter installation not complying with standards, failure of meter devices and tools, violation or illegal electrical power consumption, and errors in unit record of small electric power users, etc.	 Percentage of total loss stood at 5.36, an increase of 0.24 compared with 2017, due to the available operational plan to reduce additional lost units. Information and communication and communication network condition ready to provide services stood at 99.66%.


Risk issues	Significance	Management	Results
		 Develop AMR monitoring system program to analyze inaccuracy of electrical power consumption measurement of large electric power users. Plan and provide equipments according to function plan. Provide/develop software for load management of distribution system power transformer. Apply Geographical Information System (GIS) to assist load management. 	
Development of personnel potential to support work operation of core business and relevant business	Competency and manpower of PEA employees have not conformed to the direction of the organization for the use of digital technology to develop the capability of the organization and utilize the potential of employees up to the optimum use for the organization.	 Call for revision of working functions and framework of manpower, and prepare personnel development plan in key work position with digital competency passing the assessment criteria at the level of the organization's expectation. Develop talent management according to the roadmap to develop talent person. Develop apparatus and tool to assess successor quality of each division, and perform assessment to deliver actual results as is. 	 Personnel with competency as expected by the organization in different aspects as follows; Digital Use and Problem Solving - 80%. Information Handling - 72% Digital Intelligence Communication - 85%. Digital Content Creation - 67%. Digital Safety - 84%.



Risk issues	Significance	Management	Results
		- Prepare work plan for the analysis of personnel readiness to support direction determination for the development of relevant business, and analyze special capacity of the organization in the future to determine competitive potential of the organization.	
Cyber security	The importance placed on cyber security is an essential key factor to be focused on in the operation by the organization in order to promote and develop digital technology management to international standard in practice, management and services, with a focus on development and promotion of Information Technology Governance (IT Governance) to be put into practice strictly.	 Develop safety and security system plan for information technology and perform organization assessment based on ISO/IEC 27001:2013 international standard. Develop the system to support work operation, such as user management system, database of IT Service Management: ITSM, SSL Traffic Visibility, Security Risk Control and Network Assurance, Access Monitoring and Recording, etc. Perform maintenance of Data Center on a regular basis. Establish the action center to monitor cyber security threats and monitor the operation. 	 The success of digital action plan stood at 80.60%, with the progress of work plan operation/ project according to the plan reported to the Digital Steering Committee of PEA and Information and Communication Technology Committee of PEA. Standard of security and safety (ISO 27001) in preparation ready for surveillance audit and internal audit to access and check additional assessment. Control measure against external intrusion with system to monitor safety and network gap, with network security to replace and improve safety structure of information and communication technology system.



Environmental risk [102-15]

Risk issues	Significance	Management	Results
Work operation in line with the reduction of environmental impact and emission of greenhouse gas	PEA encourages the operation of the organization to reduce environmental impact and emission of greenhouse gas, and prepare for environmental standard up to the international level.	- Apply Green Office guideline of the Department of Environmental Quality Promotion, the Ministry of Natural Resources and Environment, as well as introduce the Green Office Policy of PEA to encourage office operation to be environmental-friendly, such as reducing the use of electrical energy, fuel, water, recycling, reusing, reducing and eliminating hazardous chemicals and products in the offices, procurement of environmental-friendly office supplies or with green labels, etc., and to set up green office intention or attitude of the personnel to save energy and resources while using them up to maximum use and	 In 2018, PEA offices in the total of 32 locations of participated in the project to develop PEA offices into green office, assessed and certified as green office by the Department of Environmental Quality Promotion. According to the assessment in the excellent (G Gold) level, 30 locations scored higher than 90%. In the excellent (G Silver) level, 2 locations scored 80-90%. Offices of PEA participating in the project since 2014-2018 can continue to operate the project with sustainability, and consequently reduce the emission of greenhouse gas from the offices up to 10,213,215.55 tons carbon dioxide equivalent (tCO₂e).

Business continuity management [EU21]

PEA has developed the Business Continuity Management System: BCMS based on ISO 22301:2012 international standard in order to be prepared and ready for disaster or emergency which may occur to work systems and workplaces [103-1], with analysis, preparation of plans, exercise/test of plans and systematic assessment of the effectiveness of the process, including the continuous improvement of process, in order to enable PEA to manage and solve disaster or emergency problems efficiently by the governance structure of Business Continuity Management and responsible sectors as follows, [103-2] [103-3]



PEA applies overall work system based on value chain for Business Impact Analysis: BIA to determine key work system/working functions (Critical Business Process) for the delivery of merchandises and services to meet ongoing demands/expectations of stakeholders continuously and safely. It also brings the information into consideration to indicate the scope of Business Continuity Management and uses such information for highest acceptable interruption time period of key process, time period target of operation restoration, acceptable longest time period of damaged information, and lowest level of Business Continuity objective, including analysis of necessary resources used in emergency, in line with personnel demands, buildings, premises, information technology and equipments.

In addition, the Business Continuity Management system of PEA is integrated with administration policy of the governor with the emphasis on setting excellent standards in electrical system, safety and operation process to be accepted in the regional and international level. In 2018, PEA carried on of the Business Continuity Management system development based on the framework of ISO 22301 standard to increase efficiency in continuous electrical energy management without any interruption in compliance with strong grid operational plan of the governor.

- Operation guideline to brace for disaster or emergency is divided into 3 steps as follows,

• Bracing for disaster and emergency with prevention and preparation - Every sector of PEA assesses the risk of threats affecting main working functions by using information regarding disaster and emergency in the past and present to assess probability or chance of occurrence and impact. If probability of occurrence is low but the impact is high, PEA will make Incident Management Plan: IMP to prepare for prevention and respond to such possible emerging threats.

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• Management in emergency - Every sector of PEA makes Business Continuity Plan : BCP in order to recover key working functions back to continuous ongoing operation within designated time period (Recovery Time Objective: RTO), with PEA operation handbook in case of irregular circumstances which specifies clear operation guidelines.

In case the circumstances turns critical and makes wide impact to electric power users, the governor will become the commander of the PEA Control Center for Irregular Circumstances Support in head office and the directors of electrical district offices will become commanders in responsible area as centers of coordination and resource collection from PEA sectors and external sectors and agencies in nearby areas for assistance and recovery of distribution system/damaged locations of operation back to continuous ongoing regeneration of electricity/services within designated time period with the secretary of the War Room Center as the coordinator via different channels.

• Management after disaster or emergency

- BCM working groups from each sector consider damages and determine guidelines/methods to recover or repair distribution system/locations of operation with damages from disaster or emergency back to normal condition quickly.

- Operation results based on Business Continuity Management Plan

• PEA has had its BCMS certified based on ISO 22301 standard within head office area on April 3, 2018.

• Organize training workshops to disseminate comprehensive knowledge and understanding of BCMS to executives and employees in both the head office and provincial offices covering every sector.

• Arrange meetings to inform and clarify guidelines and framework of operation time period in line with BCMS for every sector to conduct strict and systematic operation.

• Develop and perform annual exercises of IMP/BCP in the form of Table Top Exercise and Full BCP Exercise in case of each PEA sector's circumstances or risks of disaster or emergency chosen from the assessed and prioritized risks of circumstances, and report the results of IMP/BCP exercises to the Risk and Safety Management Department to proceed with subsequent implementation. In 2018, every PEA sector performed IMP/BCP to brace for disaster and emergency which may occur based on risk assessment of threats in each PEA sector.

• Provide media channels to disseminate BCM news and information to the public via the website of PEA.

• Expand the scope area with requests for certified BCMS based on ISO 22301 standard to provincial area as representatives of the 4 Regions, consisting of 8 locations of PEA Area Offices and PEA Class 1 as follows,

Order	Under	Sector			
Order	Onder	PEA Area Office	PEA Class 1		
1	Region 1	PEA Area 3 (North) Lopburi province	PEA Office, Nakhon Sawan province		
2	Region 2	PEA Area 3 (Northeast) Nakhon Ratchasima province	PEA Office, Nakhon Ratchasima province		
3	Region 3	PEA Area 1 (Central) Phra Nakhon Si Ayutthaya province	PEA Office, Rangsit		
4	Region 4	PEA Area 1 (South) Phetchaburi province	PEA Office, Phetchaburi province		

Sustainability Strategy

6 Decades of PEA



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6th Decade, Quality development of electrical system



PEA is a leading organization in region, which focused on providing efficient, reliable electricity services and related business for developing quality of life, sustainability of economics and society. PEA is responsible for the provision of standardized electricity services and related business to attain the customer's satisfaction on products and services through PEA's continual corporate development plan with the recognition of social and environmental responsibility. Modernization, Good Services, Good Governance.



Competency

Core competency

- Management and providing comprehensive, efficient, secured, safe and reliable services of electric power distribution system.

- Delivery of full comprehensive electrical system services with standards and reliability.

• Required core competency in the future

- Capability in work operation and personnel skills to support the expansion of relevant businesses in the future.

Sustainability strategy

PEA creates sustainability for the organization through the analysis of factors involved with sustainability in every dimension - economic, social and environmental dimensions. According to the analysis of sustainability factors, enabling PEA to indicate the Sustainable Development Framework of the organization consisting of 4 aspects; leading the organization with vision, good corporate governance, organizational personnel development, and declaration of environmental and social responsibility. PEA uses them to determine the direction in the strategic planning process, and strategic objectives, provide operation guidelines according to the action plans, define indicators of the organization/divisions, and develop the organization to truly achieve sustainability.

The process of PEA strategic planning is systematically operated by analyzing an internal and external environment, strength - weakness and opportunities - obstacles of the organization in order to determine and introduce the strategy into operational level according to the hierarchy from divisional level to individual level. The board of directors and executives play roles with participation in every process to determine strategy for sustainability in line with the structure of management as follows, [102-19] [102-26]

Policy level

PEA board of directors

Determine strategic policy, goals, and give opinions and comments.

Executive level

High-level excutives

Consider sustainability factors to develop strategic plan, define indicators, monitor operational results, give observation/ recommendation to solve problems/obstacles, revise and introduce the plans into practice operated by employees.

Operational level

Subcommittees, working groups and responsible sectors Survey demands/ expectations of stakeholders, survey related information, perform different operations and report to highlevel executives.



PEA provides overall direction and strategic position in a period of 10 years, and revises and develops 2014-2023 Strategic Plan of PEA (4th revision in 2018) in accordance with the principle framework, standards and related context of changes in both domestic and international level such as a 20-year National Strategic plan, 12th National Economic and Social Development Plan, 2015-2036 Electric Power Production Development Plan of Thailand, 2015-2036 Renewable Energy and Alternative Energy Development Plan, 2015-2036 Energy Conservation plan, Dow Jones Sustainability Index (DJSI) and the United Nations Sustainability Development Goals (UN SDGs), etc., in order to be a guideline for corporate sustainability management.



The 2014-2023 Strategic Plan of PEA (4th revision in 2018) focuses on the upgrade of the organization's capability in every dimension, covering electrical distribution system, development of an appropriate Business Model to support work operation in relevant business, emphasis on responses to demands/ expectations of customers, work operation with good corporate governance, and responsibility to communities, society and environment.



Enhancing the quality of electricity users life and services in order to increase service efficiency [103-2] [103-3]



(Target 5.1of SDGs)

Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
The emphasis on responses to demands of every group of customers	Establish relationships with customers.	 Study factors and levels of each customer group's demands and expectations affecting the customers' satisfaction from the surveys of customers and markets learning to analyze information and summarize the suggestions for operation improvement of the organization. Establish an appropriate relationship with each group of customers by incorporating the digital technology system to support and increase efficiency of customer services, integrating of customer database leading to Customer Data and Analytics, and designing the strategy for services which appropriate for each group of customers. Upgrade customer services with Digital Service by using the technology and digital equipment to support the operation of officers and various channels for customers to access the products, services and information of PEA. Focus on the development of customer services system (CRM Software), as it is a key system for integrated database management leading to comprehensive planning and decision covering every customer group. Define a clear role between the front office and the sector in charge of digital technology as the administrator who takes charges and updates system information for management. Design the promotional measures appropriate to each type/each customer in order to build a loyalty of each type of customers. Use the voice of customer feedbacks as an input information for improvement to upgrade services to become full comprehensive services, and put emphasis on the establishment of lasting relationships with customers, such as an improvement of process to take care of large-scale customers (Key Account), a revision and dissemination of handbooks to organization employees, including continuous monitoring and assessment. Manage complaints by improving the channel of complaints to be convenient and easy to contact in every channel including an effectiveness annual assessment of each channel, an addition of problem screening process and classificatio	 Upgrade the standards of products and services for customers. Establish long term relationships with customers 	 Overall satisfaction of customers stood at 4.47%, an increase of 0.18 from 2017. Satisfaction of key customer group (Key Account) stood at 4.47%, an increase of 0.14 compared with 2017. Resolved complaints according to SLA stood at 99.76%.



Reforms and modernizes operation process, altogether with development of personnel potential. [103-2] [103-3]



(Target 7.1, 7.3, 7.b, 9.1, 12.7, 16.5 of SDGs)

Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
Business administration based on good corporate governance for sustainable growth	Promotion and encouragement of sustainable growth for the organization according to framework of SDGs and DJSI.	 Focus on the analysis and determination of driving factors to move forward to sustainability in the organization, including communication and application of the factors to determine work plans toward sustainability within the organization with key targets to achieve goals in 3 dimensions. These are the Economic dimension in response to government policy to focus on the strategy of energy to support the growth of the country while the organization can still maintain its Economic Wealth, the Social dimension as the establishment of good relationships with every party of stakeholders to enable involved people to deserve good quality of life and Social Well-Being, the Environment dimension with care and responsibility for Environmental Wellness and the emphasis on good corporate governance. Move forward to the international standard of OECD Principles within 2020 to promote good image and reliability to the stakeholders of the organization. Focus on the transparent operation in every PEA office including the upgrade of integrity and transparency of government agencies according to assessment guidelines of the office of Public sector Anti-Corruption Commission (PACC). Put the guidelines or the international standard in practice ushering in sustainable development by applying ISO 26001, UN SDGs, and DJSI in the promotion of participation activities with responsibility to the society, communities and environment. Set the standard of safety and system of safety management in the operation within the organization and every group of stakeholders. Monitor the validity of supply chain. Operate work with care and place importance on the environment altogether with the development and promotion of the projects to enhance the quality of life of society and communities. Create the environmental balance and the accessibility of organization, merchandises and services by upgrading the safety standard of electrical use for the	 Establish relationships with stakeholders. Promote and develop the organization to sustainability. Support the energy efficiency. 	 Results of the survey on satisfaction in PEA operation in response to demands/ expectations of stakeholders stood at 4.23. Assessment score of ITA (Integrity & Transparency Assessment) has continued to rise. In 2018, the score stood at 92.92. The success of an operation based on OECD standard plan stood at 100%. Disabling Injury Index: √DT stood at 0.0994, a decrease of 0.0022 compared with 2017. The success of an operation according to the guidelines of SDGs and DJSI stood at 100%. The success of an operation based on ISO 26000 standard of social responsibility stood at 100%.

Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
	Emphasis on importance and response to groups of stakeholders.	 Establish good relationships with every party of stakeholders as the foundation for sustainable growth of the organization by the emphasis on the response to demands of both internal and external stakeholders of the organization, in order to elevate the satisfaction and bonding of every group of stakeholders and place importance on balance management of demands and expectations of the stakeholders. Upgrade the services to become full comprehensive services, including researches and analysis of demands and expectations of stakeholders, process to gain participation and acceptance (Stakeholder Engagement) in order to move the organization forward to achieve its vision and targeted goals. Support energy efficiency and conservation in response to government policy as for the measure that requires electricity producers or provider to help the services or electricity users increase efficiency of electrical use (Energy Efficiency Resource Standard: EERS). 		 The operation of Energy Efficiency Resources Standards: EERS for producer and distributor of energy is achieved at 100 %. The number of accumulated electric power saving units stood at 43.61 kWh, an increase of 11.74 compared with 2017.
Determination to become an excellent organization of electrical distribution by developing the efficiency in every operation system	Distribution of quality electricity at the level of a leader in the region.	 Increase capability of efficient and thorough electrical distribution system for the development of electrical system and construction of power stations to enable sufficient, secured and reliable electrical distribution, satisfy the increasing demand of electricity, and reduce the operational and maintenance problems and loss in distribution system. Improve and connect the electrical distribution system in the business and industrial areas, industrial estates and key areas, and expand the economic areas and strategic areas of the country with sufficient and reliable electrical infrastructure with quality throughout the country. Establish the policy/measure to reduce impact of stability and reduce Loss in electrical distribution, electrical field work to be up-to-date, modern and efficient in the analysis to solve problems of electrical system must be able to work automatically with the emphasis on the ability of different equipments and appliances to communicate correctly and safely with one another (Interoperability) in order to support new technology and Smart Grid in the future. 	 Increase efficiency and credibility of distribution system. Develop the potential of distribution system by Smart Grid. Increase efficiency in asset management. Improve operational processes to be efficient and covering the entire supply chain. 	 The System Average Interruption Frequency Index (SAIFI) stood at 3.81 times/ account/year, a decrease of 0.69 compared with 2017. The System Average Interruption Duration Index (SAIDI) stood at 89.82 minutes/ account/year, a decrease of 28.88 compared with 2017. Percentage of Total Loss stood at 5.37, an increase of 0.25 compared with 2017 due to additional operation plan to reduce Loss.
46 Su	stainability Repor	t 2018		



Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
	Asset management and allocation, and establishment of financial security	 Come up with clear work plan to reduce both Technical Loss and Non-Technical Loss of electric power in distribution units. Develop maintenance of electrical system to be efficient in the form of Condition-Based Maintenance: CBM. Develop intelligent electrical network (Smart Grid), the electrical network with the use of communication and information technology for management, control of production, transmission and distribution of electric power which can support the connection of electrical system from clean and distributed resources of alternative energy (Distributed Energy Resource: DER) to enhance the potential of electrical distribution system. Provide efficient, secured, safe and reliable services for people connected to intelligent advanced meter network with quality of electricity up to international standard. Focus on the development of asset management system to increase efficiency in the use of assets and operation of the organization, including cost reduction in operation, maintenance and the increase of financial return of the organization. Focus on the development of asset management of the organization toward international ISO 55000 Asset Management Standards. Develop electrical system database of the organization (IT/OT Integration). This information will be used to make decisions on key asset management of the organization, both in assessment of stages of health and operational readiness, and sort out priority and plan appropriate maintenance strategy in key assets of the organization. 		 The success of an intelligent electrical network plan stood at 96.80%, an increase of 7.70 compared with 2017. The success of the operation according to Asset Management Roadmap stood at 100%. The success of an operation as determined by SLA in the supply chain stood at 100%. Decreasing operation expenses from the improvement of main process achieved targeted goal (very good level). The operation results of 17 key processes that applied ICT to increase efficiency increased compared to 2017.
	Improve operation process according to the demands of business and direction of the organization.	 Focus on the improvement of operation process according to the demands of business and direction of the organization with the emphasis on the improvement of operation process by digital technology (Streamline Process) to enable smooth flow of quick operation, and better responses to demands and expectations of customers as well. Place importance on digital technology which will play an important role in the operation and the increase in the efficiency and effectiveness of the organization. 		



Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
Driving an organization to become modernized with human capital, digital technology and innovations	Upgrade the administration and potential of human resources.	 Focus on Strategic Human Resource Management (Strategic HRM) to develop efficient and effective human management system to achieve the goals of the organization. Emphasize on the development of competency system as key apparatus or tool to connect vision, mission and strategy of the organization with human resource management in order to analyze necessary characteristics or features for employees in each position, and prepare the personnel to be ready to support the core business of the organization, including relevant business in the future. Revise annual competency in line with the strategy of the organization including competency gap analysis leading to appropriate personnel development. The competency system covering 3 groups of competency, Core Competency, Management Competency and Functional Competency, shall be developed/ revised to conform to special talent and ability necessary for the future of the organization. The system shall be applied for recruitment and selection, and training and development of employees in order to support the direction/position of the organization for the "Transformation to the Era of Digital Utility". Increase capability and potential of the personnel to support the operation of core business and relevant business in the future with key guidelines such as Talent Management, Screening and Selection to create Talent Pool with quality in the organization. Put emphasis on Knowledge Management throughout the process from the indication of key knowledge body that important for business operation at present and in the future of the organization and the collection of knowledge body. 	 Promote human resource management. Increase personnel capability. Develop the capability of digital technology. Develop the capability of cyber security and digital technology management to international standard. Promote and encourage researches to apply into practice. Promote, research and develop innovations up to international standard. 	 The success of the development of PMS (Performance Management System) according to the plan stood at 100%. Overall satisfaction and bonding relationships of personnel to PEA stood at 4.40 and 4.49, with an increase of satisfaction level of 0.02 compared with 2017. Personnel with competency as expected by the organization at 96.52%. The success of the operation according to KM plan stood at 100%. The success of a digital operation plan of PEA stood at 100%. The success of a digital operation of TRL (Technology Readiness Level) level 5 - 6. The collaboration of 3 electricity authorities on National Energy Trading Platform (NETP) development and the creation of service products or new process from innovation were at level 5 (very good).



Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
	Promote and develop capability with Digital Technology to move the organization forward efficiently (Digital Transformation).	 Focus on capability development of Digital Technology for the transformation to the Era of "Digital Utility" in order to move the organization forward efficiently (Digital Transformation) by improving 3 key aspects, Digital Service, Digital Operational Excellence and Digital Business. Emphasis on database development and improvement of the organization leading to the analysis and management of Data Driven Execution, such as capability development of information and work system with the management of plenty of information for both the information in the database and the information without management system (Unstructured Data). Indepth analysis of large information (Big Data & Analytics), including the integration of all organization information distributed in various sectors to become systematic in order to upgrade the quality of service and management of PEA. Develop information connection system within the organization to be efficient with automatic exchange of information and extensive interconnection among sectors. The development of services with accurate, quick, precise and proactive to response to demands and satisfaction of customers within the organization / employees and customers/ electric power users. Promote and develop the capability of digital technology up to standard with safety, reliability and full coverage, along with transformation and modification of operation from Business Driven Organization which focusing on the use of technology to support the business operation to the "Digital Driven Organization, with the emphasis on mutual work between agencies of Operations and Technology Digital, including the strategy and operation direction which will change continuously according to the direction and Digital Technology Trend. 		



Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
	Sustainable and secured digital technology	 Focus on security, safety and reliability in operation by using digital technology for every party of stakeholders as basic factors to help move the organization forward to Digital Utility covering Standard, Privacy and Cyber Security in order to build confidence in the communication and online transactions (such as service payment system, measure and practice guideline for protection of personal right, protection of personal information of service receivers), and support the growth of digital technology use in the future. Propose appropriate measure to monitor and brace for cyber threats based on international standard, especially the protection of Critical Infrastructure such as SCADA system, etc. Promote and develop management of digital technology up to international standard in operation, management and services by the emphasis on the development and promotion of Information Technology Governance (IT Governance) and put it into practice strictly in order to improve the process of decision making and Digital Technology management of the organization to become efficient based on international standard and truly comply with the driving strategy of the organization. 		
	Promote and establish cooperation in the research and development of innovations for the development of core business and relevant business.	 Focus on the development of researches and innovations by increasing efficiency in both the process and the output. The innovation will focus on the development of electrical system to be secured, efficient and modern, increasing efficiency in customer services, and the improvement of key operation of the organization accordingly up to the changes of technology and changing structure of electricity industry. Create new innovations in response to demands of customers and/or marketing opportunity in new business operation of PEA. Establish cooperation with other organizations, institutes, research agencies both in the country and abroad in order to develop innovations and exchange the use of resources or knowledge bodies among one another, along with the establishment of the institute of research development and innovation of PEA to encourage the development of innovations and magnify the outcome of the use and application systematically to acquire learning and innovations, and support the operation of the organization with higher productivity. Promote and make use of the researches for the screening of researches, innovations or technology to become commercialized in the long run. 		





Creates business opportunity and the form of relevant business in the future. [103-2] [103-3]



(Target 7.1, 7.2, 7.3, 7.a, 7.b, 9.1, 17.17 of SDGs)

Organizational goals	Organizational strategies	Operation guidelines	Samples of related work plans	Operation results
Management of relevant business for sustainability	Seek opportunity for investment in relevant business.	 Promote the investment/joint ventures and business development in order to adapt and support the changes in electricity business by the focus on the promotion of investment and establishment of cooperation with allied partners for the operation of relevant business, including the development of Business Model for products and services with potential business, and the focus on the promotion of investment and the use of cooperation for the development of renewable energy and energy conservation business by the operation/ joint ventures in electrical production from renewable energy as a new form of alternative energy to reduce the use of fuel based on government policy and as the source of green investment to help reduce the emission of greenhouse gas which causes global warming as well. Restructure the organization or establish subsidiary companies to support the operation of relevant business, analysis of administrative structure, determination of strategy and governance among PEA and its subsidiary companies to support the operation. Review the laws, and regulation to support the operation of relevant business, as well as the operation of subsidiary companies to support the support the operation. 	 Promote investment and make use of cooperation to develop relevant business. Promote investment and make use of cooperation to develop renewable energy and energy conservation business. Change Management Review laws, and regulation to support the operation of relevant business, as well as the operation of subsidiary companies to create synergy. 	 The success of a relevant business operation plan stood at 10%. The success of a subsidiary companies operation stood at 100%. The success of an organization restructuring or the subsidiary companies establishment to support the operation of relevant business stood at 100%. The success of an internal and external laws and regulations improvement to support the relevant business operations stood at level 5 (very good).



Digital Operational **Excellence**

Developing "Energy 4.0" platform for Thailand to advance globally. Through the creation stable electrical system, technology development, linking the customer database as a single. Under the direction of PEA DX, which is a strategy for digital transformation to the Thai's modern organization ready to advance globally.



PEA and Sustainable Development

Excellent electrical system that enhances economy nationwide

Electrical system management for future availability and reliability [103-2] [103-3] [EU6]

Nowadays, electricity is one of the important factors for living and the main variable in increasing productivity in both agricultural and industrial sectors. Moreover, it is a key factor for income distribution, and production and sales competitiveness enhancement, which is the important target for country's economic development. From the electricity demand forecast for the first five-year period (2018-2022) of the National Strategic Plan (2018-2037), the electricity demand will be 151,347 million units, maximum electric power demand will be 23,808 MW and the number of electricity consumers will be 21.62 million users, with the average growth rate per year at 2.97%, 5.19%, and 2.58% respectively.

As a state enterprise under the Ministry of Interior, PEA's main responsibility is distributing electricity to citizens in 74 provinces throughout the country excluding Bangkok, Nonthaburi, and Samut Prakarn provinces. Moreover, as part of the government's policy, PEA also buys electricity from renewable energy sources via Very Small Power Producer (VSPP) and includes them into PEA network, especially from the solar rooftop project and solar farm project. PEA is determined to provide efficient power supply service together with continuous organization development in both quality and service. It aims to be excellent in electricity business, response to customer's expectation, help create value to the society and environment by using digital technology, and drive the organization to PEA digital utility.

PEA conducted systematic operation in analyzing external and internal environment, SWOT (Strength, Weakness, Opportunity, and Threat) analysis, government's policies and policies from other relevant government agencies that have impact on PEA's operation such as the 12th National Economic and Social Development Plan, Energy 4.0 Strategy, Alternative Energy Development Plan (AEDP) 2015-2036, and Thailand's Smart Grid System Development Master Plan (2015-2036), as well as customer's higher expectation in both the stability of the electricity network and other services.

The Disruptive Technology that occurred was the reflection from the changes in three main areas as follows:

- Electrification: the change in energy consumption pattern in transportation sector. Heat production would change from using fossil fuel to electric power supply, such as the evolution of Electric Vehicle (EV) technology, charging station, energy storage, and heat pump.

- Decentralization: there would be more decentralization of electricity production system such as community power plant. Moreover, the pattern in electric power industry would change. For example, electricity consumer would become prosumer (being both buyer and seller for electricity), and there would be peer-topeer commerce and micro grid in energy trading.

- Digitalization: there would be more application of digital technology in electric power system, such as real time communication and operation system, smart meter, smart sensor, automation system, Artificial Intelligence (AI), and machine learning. In addition, the application of big data and data analytics would support the development of services in various areas, which would cause the changes in service and operation pattern.

PEA used the above factors in setting strategy, which was revised annually or whenever there was a significant change. This made the strategies, plans, or projects continuously modern and coherent with the context of the changing operation in electric power business. This basis enabled the organization in providing sustainable electricity service to the people.



PEA managed the distribution system for various important projects or plans under organization's strategy. This was to ensure the stability, reliability, efficiency, and availability of power system in order to accommodate the expansion of special economic zone, and the country's strategic areas. Moreover, it was to prepare and lay the foundation for Thailand to become the developed country. In addition, PEA aimed to develop PEA Smart Grid that utilizes information and communication technology in measuring and controlling power network, as well as automating the system. To achieve this, PEA would develop the electricity infrastructure in a new pattern to support renewable energy and efficient energy management technology and connect all activities in electricity industry together in order to support the future of public utility and industry structure. Currently, there are 2 plans and 16 projects that are ongoing, such as the "Transmission System and Substation Development Project (9th stage)", the "Transmission and Distribution System Development Project (1st stage)", and the "Development Plan for Power Interruption Analysis and Solution Center." The total investment cost is 169.740.74 million baht. There are also 3 plans and 6 projects that are planned initiatives (in the next 3 years) such as the "115 kV Submarine Cable Extension to Samui Island. Surat Thani Province Project for Replacement and Power Reinforcement Project", the "Transmission and Distribution System Development Project (2nd stage)", and the "Power System's Asset Management Development Plan." The total investment cost is 111,336.97 million baht.

Investment plan

In order to be consistent with the national strategic plan and to take into consideration about the continual support for future electricity demand, as well as the financial status of the organization, PEA specified its continuous investment plan according to The National Economic and Social Development Plan as follows,

	Ongoing projects	Objectives	Project details	Investment cost (million baht)	Target Operation results
1.	Transmission system and substation development project, 9 th stage, phase 1	To support the increasing demand for electricity, especially in the large- scale and medium-scale industries	Construct transmission system and substations in Northern region, cover 20 provinces.	7,060	 Construct 115 kV transmission Project progress line for 325 circuit-kilometers 69.59% Construct 115/22 kV substation for 19 substations Install 1,175 MVA power transformer
2.	Transmission system and substation development project, 9 th stage, phase 2		Construct transmission system and substations in Northeastern region, cover 19 provinces.	4,540	 Construct 115 kV transmission line for 325 circuit-kilometers Construct 115/22 kV substation for 19 substations Install 1,175 MVA power transformer
3.	Transmission system and substation development project, 9 th stage, phase 3		Construct transmission system and substations in Central region, cover 20 provinces.	15,085	 Construct 115 kV transmission line for 325 circuit-kilometers 59.40% Construct 115/22 kV substation for 19 substations Install 1,175 MVA power transformer



	Ongoing projects	Objectives	Project details	Investment cost (million baht)	Target	Operation results
4.	Transmission system and substation development project, 9 th stage, phase 4		Construct transmission system and substations in Southern region, cover 18 provinces.	4,485	 Construct 115 kV transmission line for 325 circuit-kilometers. Construct 115/22 kV substation for 19 substations. Install 1,175 MVA power transformer. 	Project progress 56.77%
5.	Power distribution system reinforcement project, 7 th stage	To enhance the distribution system's capacity and adequacy in order to support the increasing demand for electricity	Construct and reinforce the distribution system in 496 substations nationwide so they can provide efficient service.	17,270	 Construct high-voltage distribution system (main line) for 14,430 circuit-kilometers. Install 271,250 kVA power transformer in distribution system. Construct low-voltage distribution for 1,365 circuit-kilometers. 	Project progress 100%
6.	Distribution system reliability improvement project, 3 rd stage	To increase stability and reliability of the distribution system in business, industrial, and industrial estates areas	Install high quality equipment, improve the efficiency of power system connection, and construct switching substation.	15,155	 Improve the existing distribution system by using insulated cable for 4,970 circuit-kilometers. Upgrade distribution system by using underground cable for 101 circuit-kilometers. Construct 115 kV transmission line as well as incoming bay connected from EGAT's or PEA's substations for 194 circuit-kilometers. Improve the efficiency of 23 substations. 	Project progress 78.00%
7.	New rural household electrification project	To expand distribution system to the new households lacking electricity in respond to government's policy	Construct high-voltage / low-voltage distribution systems, install power transformers and meters.	3,687	 Construct distribution system to 131,629 new households. Construct high-voltage distribution system for 2,300 circuit-kilometers. Construct low-voltage distribution system for 10,770 circuit- kilometers. Install power transformers for 90,300 kVA. 	Already done for 130,054 households or 102.74%
8.	Remote rural household electrification project	To expand the area of distribution system to remote household, to be completely electrified according to government policy	Construct high-voltage/ low-voltage distribution systems, install power transformers and meters.	1,215	 Construct distribution system for 11,602 remote household. Construct high-voltage distribution system for 1,236 circuit-kilometers. Construct low-voltage distribution system for 1,919 circuit-kilometers. Install power transformers for 36,350 kVA. 	Already done for 9,186 households or 97.03%



	Ongoing projects	Objectives	Project details	Investment cost (million baht)	Target	Operation results
9.	Distribution system dispatching center improvement project	To develop and enhance efficiency of 12 distribution system dispatching centers, to improve the communication backbone's efficiency and management	Improve hardware and software in accordance with smart grid development concept.	4,530	 Improve hardware and software efficiency in 12 regional dispatching centers and 13 central dispatching centers. Install 4,570 sets of Feeder Remote Terminal Units (FRTU). Install 5,370 sets of MAR remote. Install 200 sets of MAR Master Radio. Install CCTV at 400 unmanned substations. Improve efficiency of 20 substations to meet IEC 61850 standard, construct 1 data center building. Install Network Control Center. 	Project progress 22.63%
10.	Smart grid development project in Pattaya, Chonburi province	To study the technology and test the design and the implementation of Smart Grid in various areas	Develop and install Smart Grid equipment.	1,069	 Install 116,308 sets of smart meter. Install 1 smart system for power interruption solution. Install 3 automatic substations. Install 1 IT integration system. 	During contract bidding process. Project progress 27.35%
11.	Transmission and distribution system development project, 1 st stage	To develop power system to sufficiently serve the increasing demands, to increase stability and reliability of the system	Develop power system, construct substation, install high quality and high standard power transformer and other electric equipment, improve and connect distribution system in important areas.	62,679	 Construct 72 substations/ switching substation. Improve 18 existing substations. Construct 115 kV transmission lines/loop lines for 1,598 circuit- kilometers. Add/change power transformer for 1,475 MVA. Purchase land for constructing 54 substations. Construct 22-33 kV high-voltage distribution system for 7,787 circuit-kilometers. Improve 22-33 kV high-voltage distribution system for 9,685 circuit-kilometers. Construct low-voltage distribution system for 3,353 circuit-kilometers. Improve low-voltage distribution system for 8,777 circuit-kilometers. 	Project progress 7.45%



	Ongoing projects	Objectives	Project details	Investment cost (million baht)	Target	Operation results
12.	Power system development for special economic zone project, 1 st stage (Tak, Sa kaeo, Trat, Mukdahan, Songkhla, and Nong Khai provinces)	To support government's policy in setting up the 1 st phase of special economic development zone	Construct 115 kV substation, 22-33 kV distribution system, low-voltage 380/220 V distribution system, and install distribution transformers.	3,140	 Construct 6 substations. Add a power transformer into the existing substation. Construct 115 kV transmission lines for 148 circuit-kilometers. Construct 22 kV high-voltage distribution system for 323 circuit-kilometers. Construct 33 kV high-voltage distribution system for 64 circuit-kilometers. Install distribution transformers for 36,830 kVA. Construct low-voltage distribution system for 787 circuit-kilometers. 	Project progress 15.49%
13.	Distribution system extension for agricultural areas project, 2 nd stage	To provide electricity for agricultural areas in order to support farmer to be able to use electricity as one of the agricultural input	Construct high-voltage and low-voltage distribution system, install power transformers, and meters.	2,030	 Construct distribution system for 40,600 households. Construct high-voltage distribution system for 2,500 circuit-kilometers. Construct low-voltage distribution system for 3,800 circuit-kilometers. Install transformer for 2,200 kVA. 	Project progress 101.09%
14.	Major cities power system development project, 1 st stage	To increase stability and reliability of the power system, reduce problems and obstacles in maintenance and safety operation	Construct and improve power system as well as install additional equipment in project area.	11,670	 Construct 115/22 kV or 33 kV substation for 4 substations. Construct 115 kV transmission line (overhead line and underground system) for 56 circuit-kilometers. Construct underground cable for 119 circuit-kilometers. Construct low-voltage distribution system for 771 circuit-kilometers. Improve electric system and install 278 sets of unit substation to support the underground distribution system. Build overhead distribution system for 460 circuit-kilometers. 	Project progress 3.36%



	Ongoing projects	Objectives	Project details	Investment cost (million baht)	t Target Operation results
15.	Micro grid development project at Mae Sariang district, Mae Hong Son province	To procure energy source for the remote area with insufficient energy supply, in order to reduce the investment cost for peak load management	Install energy storage system and Micro Grid system	265	 Install Load Break Switches with protection equipment system for 13 sets. Construct a control building with Micro Grid system installed. Install a 3 MW/1.5 MWh battery Energy Storage system.
16.	Geographic information system development plan, 3 rd stage	To develop geographic information system for electrical system to cover users nationwide with the stable and safe system	Improve and design Data Model to support various operations and link to other information systems and communication system, prepare hardware and software for PEA offices nationwide.	2,090	 Install a Main site with GIS software. Install a Disaster Recovery Site with GIS software. Develop a GIS application program. Install 2,497 sets of computers at PEA office nationwide. Under the process of delivering computers with the installation of software and other related parts.
17.	Underground cable construction long- term plan	To increase the stability and reliability of the electrical system, and improve beautiful landscapes	Construction and improvement the electrical systems to extensive PEA's 12 areas nationwide.	2,350	 Construction underground high- voltage distribution system length 34.41 circuit-kilometers.
18.	Development plan for power interruption analysis and solution center	To develop the efficient power interruption solution center, which	Renovate/construct building, procure computer equipment, software, and navigation and tracking system.	22.44	- Building renovation/construction, procurement of computer equipment and software, and car navigation/tracking system for outage maintenance vehicle in PEA's 12 areas.
	covers 12 PEA area offices, increase operation efficiency, and improve employees'	area offices, increase operation efficiency, and improve employees'		128.30	- Building renovation/construction, procurement of computer equipment and software, and car navigation/tracking system for outage maintenance vehicle in PEA's 23 areas.
		work life.		705	 Renovate/construct 145 buildings. Procure 120 sets of computer hardware. Procure 72 sets of navigation and tracking system. Procure servers and web/map & tracking server and database for 1 set. Procure software and application program for solution center for 15 sets. ^{3rd} phase: from 144 centers, 27 centers have already been completed.

Ongoing projects	Objectives	Project details	Investment cost (million baht)	Target O	Operation results
19. Power system development for special economic zone project, 2 nd stage (Chiang Rai, Narathiwat, Nakhon Phanom, and Kanchanaburi provinces)	To develop power system by constructing substations, 115 kV transmission system, expand the 22-33 kV distribution system to be able to adequately and reliably supply electricity	Construct 4 substations, install power transformer in the 4 existing substations, construct 115 kV transmission system for 130 circuit- kilometers, and construct 22-33 kV distribution system for 939 circuit-kilometers, also install power transformer and construct low-voltage distribution system.	4,000	 Construct substations 1.1) a 115-22/33 kV substation 3.8 1.2) install 200 MVA power transformer Add/change power transformers for 200 MVA totally at substations. Construct/improve 115 kV transmission system for 150 circuit-kilometers. Install distribution transformer for 38,560 kVA. 	roject progress .85%
20. New rural household electrification project, 2 nd stage	To expand distribution system to new households in response to the government's policy	To expand distribution system to new households under PEA's responsibility area (74 provinces) nationwide.	6,565	 For 141,960 households Pro- Expand the area of high-voltage system amount 3,550 circuits-kilometers. Expand the area of low-voltage system amount 21,220 circuits-kilometers. Install power transformer for 156,530 kVA. 	roject progress .62%

Total budget for ongoing projects

169,740.74 million baht

	Planned initiatives in the next 3 years	Objectives	Project details	Investment cost (million baht)	Target	Operation results
1.	PEA small hydropower development at water gate of Royal Irrigation Department Project (10 power plants in Lampang, Chiang Mai, Rayong (2 plants), Sakon Nakhon, Phtchabun, Songkhla, and Trat (3 plants))	To encourage electricity generation from clean renewable energy instead of using fossil fuel and help reduce global warming	Construct 10 potential- energy hydroelectric power plants, and install 2 kinetic-energy hydroelectric power plants pilot project.	807.97	 Potential energy (10 places) Kinetic energy (2 places) 	 Consultants had already done feasibility study. According to the study, there are 2 suitable areas, which are Kiew Lom Dam in Lampang and Mae Kuang Dam in Chiang Mai Proposing to the Royal Irrigation Department for approval



	Planned initiatives in the next 3 years	Objectives	Project details	Investment cost (million baht)	Target	Operation results
2.	The 115 kV submarine cable extension to Samui Island, Surat Thani province project for replacement and power reinforcement	To replace the 33 kV submarine cable that have reached its end of lifespan of 30 years in 2017 and the damaged 115 kV oil filled submarine cable in order to support the continually increasing demand for electricity	Construct 115 kV submarine cable from Khanom substation to Samui island substation 1.	2,130	 Construct 115 kV, 500 sq.mm. submarine cable for 26 circuit- kilometers. Install Distributed Temperature Sensing (1 set). Install Synchronous Closing Breaker (1 set). Install Bay at Samui island substation 1 (3 sets). 	Proposing to the cabinet for approval
3.	Transmission and distribution system development project, 2 nd stage	To enable PEA to distribute enough electricity, to create reliable and stable power system, to be able to support increasing demand for electricity, to decrease the problems of operation and maintenance, to reduce the loss unit in distribution system	Develop power system and construct substations throughout the country.	77,620	 Construct 62 substations/ switchyards. Add transformer to 19 existing substations. Construct/improve 115 kV transmission line for 43 circuit- kilometers. Construct/improve 22-33 kV distribution system for 1,726 circuit-kilometers. 	Proposing to the governor for consideration in requesting for the PEA board of directors's approval
4.	Renewable energy generation development project on Kut island and Mak island, Trat province	To develop the efficient power generation model in remote areas and to procure energy source for remote areas with insufficient energy supply which could reduce investment cost for peak load management	Develop power generation model for remote areas and procure energy source for remote areas with insufficient energy supply, PEA Area 2 Central (Kut island, Mak island, Trat province).	322	 Install photovoltaic system (2 sets). Install hydro power plant (1 set). Install energy storage system (1 set). Install control system (1 set). 	Relevant agencies provided comment on changing area of operation. Currently, the Micro Grid project, on Paluay island in Surat Thani, is being proposed to PEA's governor for approval.

	Planned initiatives in the next 3 years	Objectives	Project details	Investment cost (million baht)	Target	Operation results
5.	System voltage conversion plan in the Southern region, from 33 kV to 22 kV, 1 st stage	To improve the reliability of power system and increase the efficiency of the system administration	Adjust distribution transformer and distribution system.	1,065	 Change power transformer. (16 sets) Change distribution system from 33 kV to 22 kV for 1,050 circuit-kilometers. Change distribution transformer (11,110 sets). 	Under consideration about the suitability of the operation
6.	Micro hydro power plant for community project	To procure energy source for remote areas with insufficient energy supply, as well as to be a micro grid model in the future	Procure energy source for remote areas with insufficient energy supply in the northern region.	300	- Construct 3 micro hydro power plants.	Conducting feasibility study
7.	Power system development on islands project	To develop power system in order to increase capacity and stability of power distribution system in response to the increasing demand for electricity in the islands which are major tourist attractions and have quite high economic growth rate	To develop power system in order to increase capacity and stability of power distribution in PEA Area 2 Central (Chonburi province, Chanthaburi province), PEA Area 1 South (Ranong province), PEA Area 2 South (Surat Thani province, Phuket province, Phang-nga province, Krabi province), PEA Area 3 South (Satun province)	6,630	 Install submarine cable for 176.90 circuit-kilometers. Install 33/0.4 kV transformer for 3,720 kVA. Install 22/0.4 kV transformer for 370 kVA. Install high-voltage distribution system for 79.15 circuit-kilometers. Construct low-voltage distribution system for 64.70 circuit-kilometers. 	Conducting feasibility study
8.	Major cities power system development project, 2 nd stage	Construct and improve power system, as well as install additional equipment in the target area in order to increase stability and reliability of power system, and reduce problems and obstacles in operation, maintenance, and safety	Construct and improve power system in: 1) Nakorn Sawan Municipality 2) Khon Kaen Municipality 3) Hua Hin City 4) Phuket Municipality	7,900	 Construct high-voltage underground distribution system for 117 circuit-kilometers. Construct low-voltage underground distribution system for 789 circuit-kilometers. Improve high-voltage overhead distribution system for 408 circuit- kilometers. 	Conducting feasibility study

	Planned initiatives in the next 3 years	Objectives	Project details	Investment cost (million baht)	Target	Operation results
9.	Power system reinforcement by using submarine cable to electrified island project	To develop power system in order to increase both capacity and stability for power system in islands which are major tourist attractions and have quite high economic growth	 Develop power system in: 1) Sri Chang island, Chonburi province 2) Sa-met island, Rayong province 3) Ko-kao island, Phang-nga province 4) Phe-Phe-Don island, Krabi province 	2,165	 Construct 120 and 240 sq.mm. submarine cable for 62.50 circuit- kilometers. Construct and improve 22-33 kV distribution system for 35.00 circuit-kilometers. 	Conducting Environmental Impact Assessment (EIA) study
10.	The expansion of electricity system installation for various islands project (Panyi island, Phang-nga province)	To develop electric power systems in order to increase power distribution capacity and stability to meet the likely increasing demand for electricity in the future.	Construct submarine cables to Panyee island, Phang-nga province.	221	Construction of submarine cable (33 kV) to Panyee Island, Phang Nga province amount 7.20 circuits- kilometers.	Proposing to the cabinet for approval
11.	Geographic information system efficiency improvement plan	To expand the application of Geographic Information System (GIS) in management and operation in various areas	Expand the application of Geographic Information System (GIS) in management and operation in various areas to ensure the system's stability and readiness in response to PEA's strategy.	1,340	 Prepare information of residential area in order to link with HouseID in smart meter system to provide quick and convenient customer service (1 system). Improve/develop service system and power system analysis (1 system). 	Gathering information about existing system and studying new technological trend in order to create the summary report for Geographic information system efficiency improvement plan
12.	Smart grid development project, 1 st stage	To expand and develop Smart Grid infrastructure	Develop smart grid in major municipalities area in 4 regions and the area for very small power producer (VSPP) installation.	6,630	 Install 739,000 smart meters into smart meter system. Construct 8 automatic substations. Install 56 remote control equipment (fast switching type). 	Conducting feasibility study
13.	Advanced metering infrastructure (AMI) for large-scale customers project	To expand and install AMI for large-scale customers throughout the country	Install AMI according to the number of large-scale customers who have not yet installed AMI in 4 PEA's regional areas.	2,150	 Install Time of Use (TOU) smart meter. Install 3 Phases 3 wires smart meters or 3 Phases 4 wires smart meter for 86,000 sets. 	Proposing to the cabinet for approval



Planned initiatives in the next 3 years	Objectives	Project details	Investment cost (million baht)	Target	Operation results
14. Micro grid development plan, 1 st stage	To expand and develop micro grid power system in remote areas	Develop micro grid power system in Muang district and Mae Sareang district in Mae Hong Son province, 3 southern border provinces, and 4 districts in Songkhla province.	1,100	 Improve micro grid system at Mae Sareang district, Mae Hong Son province (1 system). Improve micro grid system in accordance with EGAT's Smart Grid project at Muang district, Mae Hong Son province (1 system). Install micro grid system in 3 southern border provinces, and 4 districts in Songkhla province (1 system). 	Conducting feasibility study by signing MOU agreement between EGAT and PEA
15. Power system's asset management development plan	To develop an asset management system for greater efficiency	In process of considering the operation scope.	956	In process of considering the operation scope.	Preparing TOR for hiring consultant to study CBRM (Condition Based Risk Management) system
Total budget for planned initiatives in the next 3 years				111,336.97 million baht	
Grand total				281,077.71 million baht	

Electricity service access [103-2] [103-3] [EU23]

Thailand is an agricultural country. Nearly half of the population works in agricultural sector, results in the distribution of the population in rural areas all over the country in order to lay claim on the land for agriculture. PEA is well aware that equal access to the basic public utility infrastructure such as electricity service is the important aspect in laying foundation for raising the country to become developed country. The equality is the starting point in developing quality of life, education, and economics for the population.

PEA conducted the "Distribution System Extension for Agricultural Areas Project, 2nd Stage" with the target of 40,600 households. This project aimed to extend electric power service to agricultural areas such as farming, integrated farming system, and agricultural garden in order to support farmers and develop the strength of local economy. Since only registered farmers could participate in the program, initially, there were some farmers who were not qualified (not yet registered) and could not enter the program. Currently, PEA extensively publicized the project to increase awareness to the interested farmers and to urge the farmers to register with Department of Agricultural Extension, resulted in the better outcome of the project.

PEA also conducted "New Rural Household Electrification Project, 2nd Stage" with the target of 141,960 households which will complete within the year 2022. This project focuses on distributing prosperity to the provincial and rural areas by extending the electrification to rural areas so that all the households have access to electric power utilization. There are some requirements for new electric power user application. For example, users have to have permanent residence, real live-in residents, house number, permanent or temporary house registration document, year-round accessible transportation routes, and should not locate in any official restricted area. The average expense that PEA supports in extending the electrification is not exceeding 75,000 baht per case.

Demand-side management [103-2] [103-3] [EU7]

From the continually increasing trend of electric power consumption, using Supply Side Management (SSM)



to cater to users' needs alone might not suffice. Rather, Demand Side Management (DSM) was also used to promote conservation and efficient use of electricity, behavioral changes to establish a balance with supply and distribution capacities. In addition, it was also important to consider the efficiency of the electric power systems to optimize the use of current electric utilities supply, especially during system peak where the marginal cost of production was the highest. In the past, there were some electric system management practices in response to the system peak with restricted supply. For example, operated the power plant that utilized high-cost fuel but had the quick startup procedure, or built additional power plant in order to support the system peak period that occurred only a few hours per year. These practices resulted in higher electricity production cost.

PEA established a working group on electric consumption management, chaired by PEA Deputy Governor for Planning and Power Systems Development Function. Responsibilities include directing the group's work, creating a PEA's DSM plan that was appropriate and in line with PEA Strategic Plan. A sub-working group about electric power consumption management chaired by Deputy Director of the Alternative Energy Encouragement and Efficiency Department. Its role was to deliberate and create DSM work plan, as well as a PR strategy. In 2018, PEA had implemented some important DSM work plans. For example, (1) The Chiller Optimization project at the PEA head office project. The project aimed to install high-efficiency chillers that use the oil-free magnetic bearing centrifugal chiller technology, instead of the oiled bearings that older chillers use. This increased its cooling capacity (0.58 kW/TR), accommodated part load cooling well, and demanded low maintenance cost as well. This project was implemented at Building 3, LED Building, and the SCADA building at the PEA head office. The project duration was initially planned for 36 months (2017-2019) with a budget of 86 million baht. This project completed ahead of the schedule. (2) The Installation of Solar PV Rooftop System on PEA Building Rooftops. At present, the cost for installing such systems to generate electricity from solar energy had decreased dramatically. More importantly, using solar power promoted the use of clean energy, utilized vacant spaces and lessened the

electricity costs. This project was planned for 48 months (2017-2020) with a budget of 460 million baht, which translated to approximately 67,800 baht/kWp. Currently, the installation at headquarter is completed while branch installations are in progress. A Project on Management for Energy Conservation in the Public Sector, Universities and Industrial Sectors. (3) PEA assessed and analyzed energy usage, then made recommendations and evaluated the energy conservation potential for interested government offices, universities and industrial sectors. It promoted using quality appliances, which had high energy efficiency and encouraged the efficient use of energy. The project duration was 48 months (2017-2020) with a budget of 16 million baht. At present, this project is in progress at Ramkhamhaeng University, Provincial Waterworks Authority, Walailak University, Mae Fah Luang University, and PTT Public Company Limited.

PEA also collaborated with the Energy Regulatory Commission (ERC) to implement the "Pilot Project in Demand Response in Critical Peak Pricing (CPP) measure" for the billing of August 2018. This measure aimed to encourage electric power user type 4 (large organization) that used TOU rate and installed AMR (Automatic Meter Reading) to avoid using electricity during the critical peak period. Using Time of Use (TOU) rate aimed to decrease diesel fuel and fuel oil consumption in electricity production. Electric power users who participated in the project but could not avoid using electricity during the critical peak period as assigned would have to pay higher rate for electric energy, but pay for the electricity during peak period at the lower TOU rate and off-peak period at the normal TOU rate. This project objective was to persuade participants to manage their electric power usage by reducing electric power consumption during critical peak period and consuming in other periods instead. There were 47 participants in this pilot project. Together they could reduce electricity demand during critical peak for 39,101.96 kW, and reduce electric power consumption during critical peak period for 1,052,153.03 kWh when compared with the electric power bill for July 2018. Moreover, electricity expense for electric power users also reduced for 7,090,841.04 baht comparing to the normal TOU rate.



Moreover, PEA conducted "PEA LED project for Cultural Tourism Destinations" in order to improve and install lighting system in important historic sites with energy saving LED bulb. Taking into consideration the energy saving aspect as well as expense reduction in bulbs and electric system maintenance aspect, this project resulted in tourism promotion for the nearby areas of the historic sites, religion preservation, and cultural value added for the national heritage historic sites.

In 2018, PEA finished improving and installing electricity system for 5 important historic sites such as Wat Ketkaram in Chiang Mai, Phra That Chae Haeng in Nan, Phra Bhudha Sri Sappanyu in Nakhon Sawan, Prince Chumphon Shrine and Memorial in Chumphon, and Wat Sothon Wararam Worawihan in Cha Choeng Sao.



Management in cases of power interruptions [EU10]



Power generation system

Power transmission system

Power distribution system

In cases of unexpected events associated with power systems, they might render power generation systems unable to accommodate the need for electric power sufficiently, resulting in an asymmetry within electric power systems. These problems reduced the stability of the systems and caused power outages on a wide spectrum. Several factors brought about the unbalance of the electric power systems. Took the case on June 1, 2018 at 01.06 p.m. as an example. The 500 kV transmission lines from both Nan - Hongsa was interrupted from lightning, causing all three Hongsa's generators with the total of 1,300 MW to trip and



disconnect from the system. The electrical system's frequency started to decrease from the normalcy of 50.00 Hz to 49.85 Hz. The automatic frequency response system of other large domestic power plants from both EGAT and private companies started to feed in 550 MW while hydro power plant in Lao PDR also started to help increasing power supply for 280 MW. However, those were still insufficient as the frequency still dropped to 49.75 Hz. This resulted in Thai-Malaysia High Voltage Direct Current (HVDC) systems pulling the 300 MW electricity from Malaysia into the grid as well. While the automatic frequency response system was still at work in order to maintain the system, 37 Small Power Producer (SPP) firms conducted load shedding (by under frequency relay system) causing 2,516 MW more lost. This led to blackout in some parts of the northern, the northeastern, the central regions, as well as some part of Bangkok.

PEA made an action plan on load shedding in cases of power interruptions, which PEA employed to maintain the balance of power systems at a standard level and keep the negative effects that could happen to customers to a minimum. If load shedding likely took several hours, PEA would adopt the principle of Rotational Load Shedding conducted on a rotational basis. PEA would also designate time-period for load shedding to each group as appropriate until power distribution systems returned to normal. This was done in an effort to minimize the impacts that could happen to customers to the minimum level. On top of that, PEA would consider improving its action plan on load shedding in cases of power interruptions that extended to both EGAT and PEA on annual basis in an attempt to tailor it to the current and future conditions of power distribution systems.



Incident started

System efficiency management [103-2] [103-3] [EU12]

PEA provides electricity for up to 19,525,475 people nationwide, covers all kind of usage such as special area. industrial sites, city municipal, municipality, municipal district, and rural areas. Therefore, the important mission is to provide efficient and continuous electricity service. As a result, PEA set up a committee to oversee electrical system reliability, chaired by the Deputy Governor for Operation and Maintenance Function. Responsibilities include policies/operation planning, monitoring and reporting the System Average Interruption Frequency Index (SAIFI) and System Average Interruption Duration Index (SAIDI), as well as overseeing, controlling, and setting measures in improving electrical system reliability index so that they stay within the range of performance evaluations and service quality standards set by the Energy Regulation Commission. In 2018, PEA improved its distribution efficiency and electrical system reliability via the following plans and projects: the Distribution system reliability improvement project, 3rd stage with budget of 15,155 million baht, the Major cities power system development project, 1st stage with budget of 11,670 million baht, the power system development for special economic zone project, 2nd stage (Chiang Rai, Narathiwat, Nakhon Phanom, and Kanchanaburi provinces) with budget of 4,000 million baht, etc.

Furthermore, PEA established a committee to reduce unit losses in the electric power system and improve the power factor, chaired by Deputy Governor for Operation and Maintenance Function. Responsibilities include the setting of operation plans, monitoring and reporting on the unit losses in electric power systems in both technical and non-technical losses. Chairman also assigned a working group to develop and support information system to aid management (U-CUBE) and to work with a working group on analyzing non-technical unit losses in electric power system in developing program for reducing unit losses in electric power systems. The operation style last year had changed due to the integration of U-CUBE program for small-scale users, AMR Monitoring System for large-scale users, together with GIS system database and SAP-ISU system database to be utilized in management last year. Hence, the working groups set measures in reducing non-technical unit losses in electric power system to add to operation plan in 2018. Some of these measures were the "Big Patrolling and Cleansing for Strong Grid" measure, meter inspection measure for the meter with the risk of illegal electricity use or with the history of repeated illegal use, scheduled change meter measure for single-phase meter older than 15 years and three-phase meter older than 10 years, as well as meter inspection training measure and public relation campaign to prevent illegal electricity utilization.

From the operations in 2018, the System Average Interruption Frequency Index (SAIFI) was 3.81 times/ household/year, a 15.33% decrease from 2017. However, when considering only the 12 major cities, the SAIFI was only 1.174 times/household/year. The time used to remedy the interruptions (SAIDI) averaged at 89.82 minutes/household/year in 2018, a 24.33% decrease from 2017. The SAIDI in the 12 major cities is only 14.853 minutes/household/year. Moreover, the total loss in electric power systems in transmission and distribution system was 5.37%, which was 4.69% increased from 2017. This is because the average rainfall in most area of Thailand in 2018 was less than in 2017, causing the average temperature higher than normal almost throughout the year. Most of the technical loss were caused by high-voltage distribution lines, power distribution transformers, low-voltage distribution lines, and connectors, which directly correspond to temperature.

Research and development for innovation in electric power distribution [103-2] [103-3] [EU8]

PEA valued research and development for innovation in electric power distribution. Hence, it established a clear policy for research and development, championing "development of human resources through innovation and operational performance through technology". PEA's vision is to transform itself into

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an innovative organization by utilizing research and development for innovation to drive the corporate strategy toward safe and efficient work, minimizing time and expenses, as well as increasing its personnel capacity. PEA also values intellectual property management by utilizing research and development for innovation to create value added for the organization. PEA supports and promotes developing researchers and inventors. It creates an inclusive participatory environment, allocates sufficient budget and resources, as well as provides guidelines and appropriate communication channels to catalyze the application of innovation, to improve PEA's power distribution services, and to its highest efficiency. This is in line with the policy of Thailand's energy regulatory organization, and the country's future of energy consumption, which emphasizes the importance of using renewable energy and promoting energy sustainability in Thai society.

In 2018, PEA dedicated efforts to promote the utilization of research findings, by focusing on ones that can commercialize in the long term, and research development and innovation on Smart Grid & Strong Grid to ensure power systems are stable, efficient, and up-to-date. Furthermore, PEA studied how to increase power systems' capacities to enable buying electricity from alternative energy source trend, which is becoming more demanding in the future. It would prepare them and foster cooperation with other domestic and international organizations, institutes and research bodies to advance PEA's innovation, facilitate exchange of resources and knowledge, in line with the framework and overall direction of PEA's strategy to promote and cultivate partnerships for research and development for innovation to drive its core and related businesses. PEA allocated budget for the research for 165.579 million baht.

PEA appointed its Research Fund and Innovation Management Division to study, research, experiment, and develop, as well as manage and coordinate with both internal and external research units. The major focus was in conducting prototype research and development, providing technical recommendation about the distribution system in order to strengthen the electrical system to be stable, efficient and up-to-date system, as well as increased business opportunity and user utilization of PEA's electricity network. Some examples of innovation research and development projects in distribution are as follow:

- Condition-based maintenance development and feasibility study on monitoring system installation of power transformer. This project aimed to study and set the condition-based assessment methods, importance assessment, and risk assessment in utilizing power transformer in PEA's system, as well as to set the type of data that was important and necessary from online monitoring system using in assessing power transformer's condition.

PEA had installed and utilized many power transformers. Some of them have been in service for far too long and started to deteriorate as year gone by. This required frequent monitoring process such as Dissolved Gas Analysis (DGA). As a result, the testing and maintenance tasks were likely to increase which was why setting up PEA's power transformer central database according to international standard was necessary. This database would collect information related to all of the power transformers in PEA's electrical system, modernize the information for easy utilization, and enable further analysis for condition assessment and problem forecasting about the power transformer. In addition, it was necessary to develop the power transformer condition assessment program and plan for the maintenance schedule in order to use as an efficient decision-making tool. The database management system included basic technical information, utilization information, and power transformer's testing and maintenance results. From PEA's current testing method



together with visual inspection, the recorded test result would be considered and analyzed systematically in order to assess transformer's problems and readiness in electricity distribution. The assessment will help in prioritizing and monitoring demand and setting efficient maintenance or equipment changing plan. After that, the importance of power transformer to electrical system would be taken into consideration, such as load distribution burden, the importance of load, N-1 criteria, together with the power transformer's condition and electricity distribution readiness that was being assessed prior. The end result was the complete risk management system for power transformer utilization in PEA's system.

- Project on the study and setting of electric system connection code for rail transport system. This project aimed to study the technology and analyze the impact on electricity quality of rail transport system powered by electricity that might have an effect on PEA's electrical system. This project also tried to find a way to prevent the impact on PEA's electrical system and customers from electric-powered rail transport system, as well as to set the suitable connection code between electric-powered rail transport system and PEA's electrical system.

Benefits from this project included (1) maintained reliability, stability, and quality of electrical system when it was connected to the electric-powered rail system transportation; (2) received a report from the study of the technology and impact on electricity quality of rail transport system powered by electricity that might have an effect on PEA's electrical system; (3) received a guideline on the prevention and solution for the impact on PEA's electrical system and customers from electricpowered rail transport system, as well as the practice before the connection in order to prevent the problem that might occur; (4) received the suitable connection code between electric-powered rail transport system and PEA's electrical system.

Furthermore, PEA appointed the Research Fund and Innovation Management Division to oversee the overall operations of PEA's fund for research and technology development. It provides funding in support of both internal and external research units, to further their studies, experiments, and the development of researches related to power systems. PEA's committee for the research and technology development fund had the responsibility to oversee the fund's various operations, such as by setting up various working groups, reviewing research proposals, considering the fund's rules revisions as appropriate, as well as planning for any obstacles or conditions involved in the work of fund recipient-research organizations. In 2018, a total of 76.32 million baht was disbursed to support various innovation research and development projects focusing on other important facets of power distribution, which were adopted for further guality and efficiency optimization. Examples include:

- Project on prototype development of PEA HiVE Platform, a home energy management system. The system aimed to encourage electricity consumers' participation in Demand Response efforts both at present and in the future, and to promote the use of renewable energy in buildings, while also helping to lower energy costs for consumers.

The benefits of the PEA HiVE Platform included (1) provided a model platform for smart energy management (PEA HiVE Platform) that worked perfectly in a local system, and supported cloud systems operation; (2) provided algorithms for efficient home energy management, compatible with the renewable energy production capacity such as through Solar PV Rooftop system; (3) determined a list of smart equipment for relevant units to further research on, for PEA related diversification opportunities; (4) developed PEA human resources to equip them with the basics and capacity to study and develop the PEA HiVE Platform; (5) rendered PEA Smart Home available as an experimental space for exchange or transfer of technology, and as a compatibility testing site for equipment controlled by Internet of Things (IoT) and PEA HiVE Platform in the future.


Cooperation in research and development with educational institutions [103-2] [103-3]

PEA allocated resources toward research and development, to support the work implemented through educational institutions or domestic research and development institutes. The objective was to promote and support research and development of technologies, to ensure continuous development. It aimed to achieve the highest efficiency domestically, to decrease reliance on imported technologies, and to be able to apply those research findings to benefit PEA operations. In 2018, some noteworthy research and development projects supported by PEA included the following:

- Prototype project on movable power generation system from solar cell for communities in rural areas (Solar Move)

This was a research project to develop a prototype of movable power generation system from solar cell. Its objective was to respond to the demand and way of living for the people in rural areas with no access for transmission line, so that they could utilize electric power. This project followed PEA's policy in supporting electricity access in target area, promoted renewable energy source utilization such as solar cell in community area, as well as promoted better living quality for people in remote area, decreased reliance on imported technologies, and applied those research findings to benefit PEA operations.

This prototype of movable power generation system from solar cell was a small-scale islanding power generation system or off-grid. It was designed and tested by Thai researchers. The equipment was designed and installed as a single unit, consisting of power generation, storage and distribution parts. It could be used with both AC and DC Charge. All the required functions such as lighting, equipment status monitoring, reserved power measure system, and increased power distribution system were installed. This prototype was easy to utilize, had no need to install permanent structure, light, easily movable, and easy for maintenance and repair.

Figure on prototype of movable power generation system from solar cell for communities in rural areas



In operating this project, PEA had conducted the survey and collected data of targeted rural areas for the movable power generation system from solar cell, which was Baan Pilokki, Baan Mongkua, Baan Mae Lor, and Baan Kirilom. PEA also conducted trainings on how to use the system for people in the communities in order to promote learning process, and participation between communities and PEA.



- Research project on networks of EV fast-charging stations for PEA smart grid.

PEA implemented this research project to support the usage of electric vehicles (EV) on EV charging stations in Thailand in the future. PEA conducted study and research in partnership with King Mongkut's Institute of Technology Ladkrabang, by conducting researches and public relations efforts simultaneously to provide people with an understanding of the EV technology, which efficiently utilizes energy and was environmentally friendly. This project's objective was to conduct network and locations planning of the EV charging stations, as well as to study technology and establish EV charging station networks and create EV charging machines. The project promoted the development of PEA Smart Grid to support the development of advanced functions in the future. It served as a measure to develop and apply EV charging machines for other types of vehicles in the transport sector, and as a way to promote PEA's business in supplying electricity to EVs.

Under this project, networks were established with 11 EV fast-charging stations, situated on main routes to large cities and key tourist destinations, to support the EV usage that would happen in the future. It utilized online networks and multi-standard EV chargers that could charge EVs in both the AC and DC modalities, according to international standards. The networks covered five following routes:

 Northern route (Bangkok- Phra Nakhon Si Ayutthaya) with two stations, located at Rangsit and Ayutthaya

2) Southern route (Bangkok-Hua Hin) with three stations, located at Samut Sakhon, Khao Yoy, and Hua Hin

3) Eastern route (Bangkok-Pattaya) with two stations, located at Chonburi and South Pattaya

4) Western route (Bangkok-Nakhon Pathom) with one station in Nakhon Pathom

5) Northeastern route (Bangkok-Nakhon Ratchasima) with three stations, located at Pak Chong, Nakhon Ratchasima, and PEA head office







In addition, PEA developed "PEA VOLTA Platform" which was information network of PEA charging station. Its responsibility was to communicate between charging station and central database of electricity provider, where users can access information, such as the charging station location, etc. to support the use of electric vehicles within the country.



- Research and development project on the management system of smart microgrid and power distribution lines in rural areas.

PEA strived to develop electric power systems that were stable, sufficient, and accessible, with a high service quality standard. It aimed to equip PEA's electrical grid with the capacity for electric power generated by renewable energy, and the Micro Grid energy management technology that would be available in the future. Moreover, this project responded to the electric power utilization in remote areas that focused on efficiently utilizing renewable energy in the area. It aimed to generate electric power together with the community's way of living that depended on natural resources in doing agriculture.

To this end, PEA provided financial support to Chiang Mai University to conduct a research and development project on the management system for very small hybrid electricity generation sources and power distribution lines in rural areas at Baan Khun Pae, Jomthong District, Chiang Mai Province. The project site was intended to serve as a prototype for energy management that efficiently and reliably utilized natural resources in the area, and to support the livelihoods and social wellbeing of rural communities. The objective of the project was to distribute electricity with stability and efficiency, to serve as a model for power distribution to rural communities, as well as a learning center to share the management model with educational institutions both domestic and international.

The research under this project also included 90kW Micro Hydroelectric System and existing PEA's power distribution system into Smart Microgrid management system, which consisted of:

- Microgrid controller
- 100 kW Solar photovoltaic system
- 100 kWh Lithium Iron Phosphate (LFP), which is the battery that has high safety, provide high power, has long lifespan.
- 4 sets of load break switch equipment
- Communication system



PEA set the pattern and conditions for Smart Microgrid so that it could work in *PEA grid-connected power transmission pattern* in order to study the operations of the control system in managing the appropriate level of energy transmitted. This included *the islanding power distribution mode* aimed to observe the battery control processing, off-loading and disconnecting the energy source to keep the balance of the power distribution system. Other scenarios included switching from a grid-connected distribution mode to islanding in order to control the generator and electric load to safely reconnect with PEA power distribution system. The Black Start case study was

to observe the start of transmission operation in the event that there was no electricity in the system before, to ensure stable distribution, etc. The joint research group was set up, consisted of researchers from Chiang Mai and PEA in order to conduct 13 research topics. The research findings showed that system was able to operate efficiently and sufficiently, according to the demands of rural communities and to uplift people's quality of life. It also found a suitable operational modality that was applicable to PEA's work in order to set its strategy for planning power systems and operations to support PEA electric power systems in the future. Additionally, it served as an example for replication to another area with similar usage pattern and conditions, to provide the people with access to energy that was readily and inexhaustibly provided by nature and also environmentally friendly.

Currently, this project is ongoing. Researchers are gathering and analyzing information to assess the Microgrid utilization result and preparing the final report. Moreover, the result of all 13 research topics from the joint working group will be included in the final report so that it can be used to further improve and develop PEA's Microgrid system.

Furthermore, PEA also recognized the importance of providing opportunities for its personnel to apply their knowledge and capacity, including their skills and experiences to contribute to research for innovation in power distribution. In 2018, PEA received 18 major research and innovation awards at the international level.

International research and innovation awards

1) 46th International Exhibition of Invention Geneva at Geneva, Swiss Confederation for 4 projects; consisting of 2 gold medals, 2 bronze medals, and 1 special award.

No.	Inventions	Awards
1	Single-Phase Disc Type kWh Meter Connection identification device	Bronze medal award and China's special award
2	Multiple Address Radio System Monitoring for SCADA	Bronze medal award
3	Spaced Aerial Cable Preforming Tool	Gold medal award
4	Guy Wire Bender	Gold medal award

2) 10th International Exhibition of Inventions (IEI 2018) at Foshan, People's Republic of China for 6 projects; consisting of 1 gold medal, 4 silver medals, 1 bronze medals, and 2 special awards.

No.	Inventions	Awards
1	High Voltage Hotline Cable Stripper	Silver medal award and Indonesia's special award
2	One-man Cable Reel Stand	Bronze medal award
3	Steel Aerial Cable Corner Support Bracket Fastening Tool	Silver medal award
4	Smart Extinguish Air-blast	Gold medal award and Iran's FIRI special award
5	Cable Unreeling Tool	Silver medal award
6	Automatic Cable Reel Retarder	Silver medal award

3) The International Trade Fair-Ideas, Inventions and New Products (iENA 2018) at Nuremberg, Federal Republic of Germany for 4 projects; consisting of 4 gold medals and 1 special award.

No.	Inventions	Awards
1	High Voltage Insulated Tape Warping Machine	Gold medal award
2	Suspension Cradle Tool	Gold medal award
3	Steel Wire Mousing Tool	Gold medal award and Poland's special award
4	Fuse Holder Locker Machine	Bronze medal award



4) Seoul International Invention Fair 2018 (SIIF 2018) at Seoul, Republic of Korea for 4 projects; consisting of 4 bronze medals and 1 special award.

No.	Inventions	Awards
1	Digital Smart Warning Box	Bronze medal award for invention
2	360 Degree Pole Adjustable tool and Hydraulic Pole (Hotline Cuttable Tie Stick)	Bronze medal award for invention and special award
3	Optical Ground Wire (OPGW) Stringing Block	Bronze medal award for invention
4	Generator Controller Tester	Bronze medal award for invention

Economic growth

In 2018, PEA's revenue from electricity and other operational sources was at the total of 499,219 million baht, 16,256 million baht or 3.37% increased from 2017. The increased revenue came from electric power consumption in residential customers and commercial customers, from which it still gained better growth rate. In addition, World Cup event, Asian Games, and Tham Luang Khun Nam Nang Non cave events were the cause of more people following the news via various media. Moreover, the increase amount of tourists resulted in more products and services consumption domestically.

However, PEA's net profit was 20,636 million baht, 22.62% decreased from 2017 or 6,033 million baht decrease. The operational expenditure in 2018 was total 478,622 million baht 22,340 million baht more than in the year 2017 or 4.49% increase. The higher expenditure came from higher operation cost. The growth rate of electric power consumption in industrial customers was only 0.43%, mainly due to the intensified international trade war in the second half of the year. Including the result of the loss of industrial customers to small power producers (SPP) significantly. In the year 2018, PEA lost 46 customers, representing approximately 888.23 million units.

Supply chain management [102-9]

PEA managed its supply chain by focusing on the efficient resource management, as well as supporting environmentally friendly procurement. It aimed to create value among organization and stakeholders related to business operation throughout the supply chain and deliver electrical system's value of accessibility, adequacy, safety, as well as convenient, speedy, and fair service.

- Efficient resource management

PEA procured and managed good quality electrical supplies with suitable price that transparently, fairly, and efficiently fulfill demand. Supply management process are as follows:

• Reviewed criteria in resource allocation in order for such resources as tools, vehicles, offices, budget, supplies, and human resource to be sufficient and suitable for customer service according to the specified value.

• Clearly specified responsible person in both central and provincial sectors in making various resource allocation plan in order to comply with allocation criteria, as well as procuring and managing contracts that correspond with project timeframe. • In case of unexpected incident that resulted in insufficient supply, PEA would prepare resources according to emergency plan as necessary, in order to enable continuous, good quality customer service and maintain electrical quality as follows:

° Management of tools, vehicles, and offices: the committee on operation support plan would revise/adjust plan annually in order to procure resource according to all agencies' demand, as well as authorize each agency to procure their tools outside the plan to be able to solve problem in time.

° *Budget management:* every year, PEA reserved budget for urgent cases so that all units would utilize that budget in case of emergency

° *Supply management:* PEA annually revised supply requirement plan in order to adjust supply procurement plan to respond to user requirement adequately. In case there was a need for supply outside of the plan, agencies could transfer supply from other warehouses outside of the area or procure by using reserved emergency budget as authorized.

° *Human resource management:* when the existing human resource was not sufficient for the urgent case, or when the work amount increases during the year, PEA could consider outsourcing its operation or increase its human resource according to the ratio specified by PEA

- Supply procurement in electrical system and PEA operation

PEA set the 2018 criteria for using a pricing basis together with other basis in PEA's procurement by taking into account the organization's benefits and purpose of use based on the efficiency basis used to support procurement consideration in accordance with the Government Procurement and Supplies Management Act, B.E. 2560 as follows:

(1) History of the damage, referring to PEA's database on product damage information in the past3 calendar years (for example, the 2018 procurement relied on the damage history of 2017, 2016, and 2015

for calculation), which can be calculated in percentage based on the following equation;

Percentage of damage = Number of damage (Over the past 3 years)

> Number of procurement (Over the past 3 years)

(2) Products with the license to show industrial standard certification marks or registered with the Ministry of Industry

(3) Products with "Green label" certification or products from ISO 14001 certified factories (Environmental management standard)

(4) Products from ISO/IEC 17025 certified factories (Competence of testing and calibration laboratories standard) covering all topics specified by PEA or products manufactured by factories certified in terms of routine test procedures or whose network testing unit is certified by PEA.

(5) Products in PEA Product Acceptance Lists or Product Capital Letters for substation construction contracts or other certified process specified by PEA.

PEA will consider types of supplies using the pricing basis together with other basis for procurement. The ratio for calculation between the pricing basis and other basis used by PEA can be categorized by significance to electrical systems as follows:

- Group 1: supplies with high level of importance to the electrical system such as already installed supplies. If they were worn out, it would directly cause the loss of revenue or high damage value. Moreover, it would likely have an effect on the stability and reliability of the electrical system. For example, it could cause power outages in a wide area or for a long period, requiring a long time for repairing or changing. The calculating ratio based on the pricing basis and efficiency basis was 40% and 60% respectively.

- <u>Group 2: supplies with moderate level</u> of importance to the electrical system such as already installed supplies. If they were worn out, it would moderately affect stability and reliability of the electric system. For example, it could cause power outages in



some areas for a short time period. The calculating ratio based on the pricing basis and efficiency basis was 60% and 40% respectively.

- Group 3: supplies with low level of importance to the electrical system such as already installed supplies. If they were worn out, it would barely affect stability and reliability of the electrical system. The calculating ratio based on the pricing basis and efficiency basis was 80% and 20% respectively.

For supplies other than the above 3 groups, the pricing basis was used for procurement.

Moreover, PEA operated "Green Office" project according to standards from Department of Environmental Quality Promotion, Ministry of Natural Resources and Environment since 2014. In 2017, PEA announced its Green Office policy, included environmentally friendly products and services procurement promotion as a part of the policy. It aimed to create behavioral change in procuring products and services that were environmentally friendly according to standards from Department of Environmental Quality Promotion, Ministry of Natural Resources and Environment, which would eventually result in concrete operation and sustainable environmentally friendly procurement. This covered all processes from raw material procurement, hiring, contracting, as well as creating list of environmentally friendly products.

Provincial offices that participated in Green Office project had to conduct environmentally friendly products and services procurement. From 2014 until present, there were 101 certified Green offices throughout the country. PEA planned to increase the number of certified offices. It aimed to extend project operation to headquarter areas within 2019, and 111 more offices within 2021.

Trading partners relation management

PEA improved its relation management and work operation with suppliers, trading partners, and collaborators by using survey information from stakeholder's public hearing as input for revising and creating strategic plan that balanced and complied with demands from all groups of stakeholders, covered opinions from suppliers, trading partners, and collaborators.

After that, responsible agencies informed related operational plans and publicized important PEA's strategic and operational plans to suppliers, trading partners, and collaborators via various channels every year. For example, informed via meetings, and publicized via PEA website, brochures, and electronic mails in order to create awareness of PEA's plans and operation direction to suppliers, trading partners, and collaborators, so that they could prepare resources in accordance with both PEA's short-term and long-term operation directions. Moreover, there were monitoring process to ensure compliance with the contract, or MOU, and frequently report to high-level executive in that area.

Furthermore, PEA also conducted survey on awareness and understanding of action plans in order to use the results as input for revising and creating strategic and action plans. From the survey on awareness of PEA's operation direction, stakeholders had high awareness level while suppliers and trading partners had satisfaction survey result on PEA's operation at 3.85 and 4.08 respectively.

From the result of suppliers, trading partners, and collaborators requirement survey, it identified that PEA should operate business transparently and comply with the terms and conditions agreed upon in contracts. Hence, PEA committed to the development of transparent and fair operation process, to create trust among suppliers, trading partners, and collaborators. The PEA's procurement transparency satisfaction survey for 2018 revealed that overall, suppliers/contractors were highly satisfied with the average of 4.14 points, which was 0.13 points higher than 2017. When comparing satisfaction results for procurement in various areas in 2018, it showed the average score higher than 2017. However, the satisfaction on responsiveness to feedback/ suggestions provided to PEA was a little lower than 2017.

Average score of PEA's procurement transparency satisfaction	2016 (Points)	2017 (Points)	2018 (Points)
Information dissemination about procurement opportunities (via website and other media)	4.00	3.72	4.23
Accessibility of procurement information	3.95	3.66	4.03
Participation in PEA's procurement processes	3.81	3.95	3.97
Quality and fairness of procurement processes	4.30	3.95	4.20
Handling of complaints related to procurement	3.79	3.49	3.87
Responsiveness to feedback/suggestions provided to PEA	4.04	3.93	3.89
Transparency of the overall procurement process	4.15	4.01	4.14

To improve its operation, PEA assessed suppliers, trading partners, and collaborators, as well as exchanged information with them via meetings frequently, in order to improve quality and operation process so that it could deliver value to customers according to their demands and expectations. This could also be criteria in selecting suppliers, trading partners, and collaborators in the future.

<u>Suppliers:</u> PEA utilized vendor lists as one of the measures to help shorten its procurement process, and as a quality assurance process to help suppliers improve and maintain their standards in compliance with PEA's requirement. PEA would specify supplier qualification by using vendor list registration, categorized by supply's technical specification. Moreover, there would be quality assessment of supply and equipment in use, by collecting statistics, utilization history, and quality defect, to use as feedback to suppliers for improvement. However, in case that supplier did not comply with the contract, PEA would put them on a list, which would affect the next procurement decision.

<u>Trading partners:</u> PEA managed trading partners in the similar fashion with suppliers. However, trading partners also had impact on PEA's image, as well as products and services quality. Hence, PEA would closely monitor them by instructing best practice standard to create awareness and skill development continuously.

<u>Collaborators:</u> PEA would set up meetings to exchange necessary data for mutual operation, so that they could specify solution/improve guideline that would develop and improve operational result as a whole.



Sustainable products and services development

In order to improve competitive capacity and create sustainability in the time of leaping innovation and technology development, PEA understood the importance of sustainable products and services development to prepare itself for the pure digital era. PEA expanded its investment in related businesses via its affiliates or joint venture to develop business pattern that correspond with the changing electricity service. In 2018, PEA developed new businesses in response to new generation's electricity consumption lifestyle and electricity utilization trend in the future.

- PEA HiVE platform

PEA invented and developed PEA HiVE platform prototype that focused on the most efficient home and building energy management. Residents could control electric power consumption from both electrical system of electricity service provider and other renewable energy sources at that time such as solar rooftop, wind power, car batteries or other batteries to home via Home Connect application, which was available in both iOS and Andriod operating system, controlled by Internet of Things (IoT)¹ connection. This was to make the energy consumption became Net-Zero Energy or almost there by reducing unnecessary electric power consumption.



¹ Internet of Things (IoT) is when the electronics equipment connected and shared information via automatic or semi-automatic system. Human can control electronics equipment via said connection.

Provincial Electricity Authority (PEA)

PEA HiVE platform would change ordinary household to Smart Home with various Smart Modes for the residents' diverse lifestyle. Smart Modes consisted of (1) Comfort Mode, adjusting temperature from airconditioner, controlling lighting, and managing carbondioxide within household, taking care of the elderly in the house in emergency case, system would send data to related parties such as hospitals and relatives, or sending security alert to police station or other security related party; (2) Eco Mode, managing energy consumption within the house and reduce unnecessary energy consumption; (3) DR Mode, gathering information on household energy consumption statistics and then analyzing utilization data which will help future demand response; (4) Emergency Mode, using reserved energy source the in emergency case.

Moreover, in the home that installed voice communication system, PEA HiVE platform also responded to voice command system, which would reduce the complicated process of inputting password in the application. The system recognized voice command according to the setting of that home or building. For example, if "Good Morning" and "Good Bye" were used as command, system would turn on and turn off electronics equipment accordingly.

PEA developed prototype in order to commercialize this system, by collaborating with real estate entrepreneurs in both home residence and condominium, and electronics appliance entrepreneurs in developing HiVE platform to prepare for the complete smart life society in the future.

- PEA solar hero application

At present, demand for household electrical power continued to increase. Many households were increasingly interested in renewable energy, especially the stable and easy-to-install solar power, in order to reduce long-term expense from electrical power consumption from electricity service provider. This was in contrary with the amount of specialists in the market right now, which created some obstacles such as accidents from under-standard installation, lack of renewable energy knowledge, lack of installation cost, concerns about damage and after sales service.

PEA used the organization's skills on electrical energy management and personnel expertise on electrical system in creating "PEA Solar Hero Public Application" in order to facilitate customers who were interested in installing standardized and safe solar rooftop, as well as recommending the most efficient way in energy consumption, all in One Stop Service concept, started with

(1) Basic data analysis of electric power consumption suitable production capacity installation

(2) Gathered PEA-standard products and installers for solar rooftop installation for the public to choose

(3) Gathered information on source of investment funds from various Thai banks that support people in installing solar rooftop

(4) Monitored operational results from various processes



How dose solar hero application differ from the others?





PEA specified several investment plans covered all demands for people with and without funds, as well as entrepreneurs who would like to invest with partners. In 2018, PEA launched its PEA Solar Hero Application and planned to operate in four provinces within 2019, which were Chiang Mai, Nakhon Ratchasima, Rayong, and Phuket.



- PEA VOLTA platform (Very Open Language for Thailand Application)

The development of PEA VOLTA platform or PEA Charging Station information network was the result of Thailand 4.0 strategy that urged the use of electric vehicle domestically and of e-Government policy that promoted the use of electric cars in the PEA 4.0 era, "Development of human resources through innovation and operational performance through technology, to transform itself into The Electric Utility of the Future." PEA VOLTA platform was developed by PEA, who was the first network operator in Thailand. This platform was the medium for communication and information transfer between charging equipment and central server/central database of electric power service provider. It consisted of two important parts that promoted the use of electric vehicle in the country, as follows:

(1) PEA VOLTA, which were the transfer of information from charging equipment directly to PEA's central database.PEA VOLTA could communicate with any types of charging equipment/charging head. Data transfer happened on real time basis and there were more types of data transferred via PEA VOLTA than other systems. This information was utilized in creating database for charging equipment used in providing service to the electric vehicle users.

(2) PEA VOLTA platform, which were the display of the result via mobile application and web service in the form of user interface between charging station and electric vehicle users which benefited all related parties. This platform also operated on real time basis to reduce the concerns about its complication and difficulty when changing to use electric vehicle. Application's functions were as follows:

- Show locations of charging station
- Show maps leading to the nearest charging station
- Show status of charging stations and status of each charging head
- Show charging status, time duration for charging
- Control the charging equipment function





Moreover, PEA also specified development plan for charging station network, by extending the PEA VOLTA platform operation result from the research, and installing PEA VOLTA kit for 100 sets free of charge for the charging station service providers who were members of PEA charging station network.

In 2018, PEA facilitated the charging payment process of PEA's charging station network by using PEA VOLTA platform in 11 stations, in 9 provinces, situated on main routes to large cities and major tourist attractions, which were as follows:

- PEA Head office, with 1 station
- Northern route (Bangkok- Phra Nakhon Si Ayutthaya), with 2 stations
- Southern route (Bangkok-Hua Hin), with 3 stations
- Eastern route (Bangkok-Pattaya), with 2 stations
- Northeastern route (Bangkok-Nakhon Ratchasima), with 2 stations
- Western route (Bangkok-Nakhon Pathom), with 1 station

Provincial Electricity Authority (PEA)



Digital Service

Various electrical innovations, through service mind, more than 900 service centers, more than 19 million electricity users, PEA is ready to respond to the Thai people's lifestyle thoroughly and rapidly in the digital era through service mind throughout 24 hours.

Create Values for Stakeholders

Responsible customer service

The Provincial Electricity Authority (PEA) focused on responsibly distributing electricity to customers. PEA created Customer Service Master Plan for 2017 - 2021 to improve service and distribution system. The plan covered the process from requesting for electricity to cancelling the service, managing client information, developing channels of payment for electricity service, improving channels of public relations communications as well as customer complaint and suggestions. This conformed to the organization's strategy of being a Customer-Centric Organization, focused on bringing exemplary customer care and service in accordance with client expectation, which increasingly needed convenient and speed in receiving service. [103-1]

From PEA's survey and analysis of customer needs nowadays, the most important factors that customers concerned about were convenience, speed, reliability, friendliness, modernization, and accuracy. This was a significant challenge for PEA in responding to customer's expectation, demand, and improved service for the highest efficiency.



Speed

Fast service and response, directto-the-point problem solving

Friendliness

Customer needs an advisor or a friend to aid in making decisions

Accuracy

2) Mobile application development (PEA Smart

Customers receive services as required, accurate problem solving

Hence, PEA improved and developed its service providing operation in 7 areas as follows;

1) Customer service center improvement; by modernizing both front office and back office and improving them to be energy-saving offices. In 2018, PEA had already improved 98 PEA Offices, 93 PEA Shops, which were front offices located in department stores, and 60 PEA Mobile Shops.

Plus); to provide various services to customers via mobile application such as request for electricity, pay electricity bill and fee, report electricity outages, pay outstanding balance and fee for resetting the meter, submit suggestions/complaints/compliments, as well as receive notifications and publicity. The application was available for download since February 19, 2018, with a target of not less than 500,000 registered users. Currently, there are 881,786 registered users, which is

76.36% higher than target.

3) Customer database management via Geographic Information System (GIS) or PEA Map and Smart Card; by using PEA Map to identify meter location instead of doing real field work, as well as searching for customer's transaction evidence by using only smart identification card.

4) One Touch Service, electricity request system development; by improving time duration for the request for electricity and meter installation from 35 working days to 25 calendar days, developing PEA Customer Online Service (COS) to provide completed services. This service was available throughout the country via www.pea.co.th. Users could track the status and process of all types of requests.

5) Service integration via Front Manager (FM); FM was the person who took care of and provided the best services to customers at the front office, by monitoring front office staff, appropriately solving the problems for customers, acting as representative for customers through coordination, advising and informing customer of rules and regulations, as well as controlling, monitoring, and facilitating customer service. In addition, FM would evaluate service result and analyze problems happened in public relations, payment, customer requests and complaints, and meter-related services.

6) Service development via human resource training; by training employees/workers to have service mind, teaching service talk pattern, instilling good service mind and behavior into PEA staff in order to create good impression and provide good customer service.

7) Customer satisfaction evaluation via Smart Queue and Smile Box; Smart Queue would categorize customer into various types of service, which staff would advise customers in choosing service types at Smart Queue machine. Customers could follow their queue on the display monitor and staff announcement. In addition, customers could examine their expense and provide satisfaction level at the Smile Box.

Customer privacy management [103-2] [103-3]

PEA placed great importance on keeping customers information according to laws such as the Official Information Act B.E. 2540, the Electronic Transactions Act B.E. 2544, and Electronics Transaction Committee Declaration on Government Sector's Data Privacy Protection Policy and Practice B.E. 2553. According to these laws, government sector must provide security system for personal data privacy, both in the access and information usage monitoring.

Moreover, PEA specified PEA's Privacy Policy to protect personal information of users connecting with PEA's website such as personal data collection, personal data utilization, and information security of personal data. PEA set internal regulation for agencies in order to grant access or utilize personal data of users to protect information security. PEA prepared information system and backup system, which was readily available, as well as emergency plan in case an electronic format was not accessible, in order to ensure the use of information as usual. It also monitored and evaluated information risk frequently according to ISO/IEC 27001:2013 Information Security Management System. This system specified that Cyber Security Working Group should be the one who consider and provide recommendation for information security in both Information Technology (IT) and Operation Technology (OT), and report to Information and Communication Technology Committee. In addition, it also prepared policy and practice on information security under the Royal Decree on the Regulations and Method in Government Electronic Transaction B.E. 2549. This policy had been revised once a year to prevent privacy breach. Following the above practices, standards, laws and regulations, in 2018, PEA did not have any complaints regarding customer privacy breach and customers data loss. [418-1]

Customer complaint management [103-2]

PEA prepared a handbook on Efficiency Improvement for Customer Complaint Management that clearly detailed the steps, the responsible parties, and the important factor. The responsible agencies should adhere to and follow this handbook in order to comply with PEA's service quality standards, deliver good quality service, and live up to customer expectation. There were many channels that customer can send complaints, suggestions, requests, reports, and compliments to the PEA as follows:

1) 1129 PEA Call Center

2) Government sectors such as the Damrongdhama Center of the Ministry of the Interior, the Office of the Prime Minister (www.1111.go.th) 3) Through the media, social media such as printed media, TV, radio, online media, and PEA website (www. pea.co.th)

4) Direct petitioning at the PEA office

5) PEA Mobile Application

Moreover, PEA developed PEA-VOCs System, an information database for receiving complaints, responding, and solving problems/complaints for stakeholders efficiently and promptly. The PEA-VOCs system would forward complaints to related sectors throughout the country. The sector that received the complaint should respond and solve the complaint within a specific time.



After the issue was solved, the customer must confirm it in the complaint form. If the complaints was filed in a letter, it must be answered by a written response within 30 days after PEA recevies the complaints.

the complaints

After the related sectors solved the complaint, they must report and record the results in the PEA-VOCs information system.



PEA had surveyed the efficiency of complaint responses within 30 days. In 2018, PEA responded to 99.76% of all complaints. Moreover, PEA also monitored customers' feedback after their complaints were resolved and prepared statistical reports analyzing the complaints, obstacles, and solutions before presenting them to the high-level management quarterly. This allowed related agencies to improve their service efficiency based on the data.

Improving channels of communication and public relations [103-2] [103-3]

PEA provided communication and public relations channels for organization's general data and electricity utilization-related data that was convenient, fast, modernized, and able to receive feedback promptly as follows :



The 1129 PEA Call Center was an important channel for the PEA in communicating and disseminating information 24 hours a day that allowed public relations, making announcements, and giving advice and knowledge to customers and citizens. Channels were in both voice format, such as phone, fax, self-service IVR, web chat, email, and non-voice format, such as social media channels. Moreover, PEA had a plan to use an automated reply chatbot to satisfy customers who use social media through mobile phones. Besides Thai and English, it could also be used in Burmese, Cambodian, and Malay in order to become ASEAN Economic Community and standardize service quality to international level. Service in Burmese and Malay were provided in some area, such as Tak, Satun, Pattani, and Narathiwas provinces. The evaluation of services from 1129 PEA Call Center showed an increasing number of users every year. In 2018, 98.94% of users were repeated users, which meant that this was the important channel for customer service. User's satisfaction level towards 1129 PEA Call Center service was good, or 95.32%.

Furthermore, PEA evaluated effectiveness of customer service in all aspects via survey project for customer and market study in 2018. This survey aimed to study customer demand, to improve operational process, and to plan strategy to respond to customer needs, which would result in higher customer satisfaction and better relationship. In 2018, PEA conducted a survey with a sample group of 7,228 customers divided into 4 aspects, which were satisfaction, dissatisfaction, relationship, and organization image as follows: [102-43]

1) Survey result on overall satisfaction in product and service quality was 4.47 (Full score of 5 points), divided into 6 subcategories:

- Product quality satisfaction; 4.49
- Service quality satisfaction; 4.47
- Environment and workplace facility satisfaction; 4.56
- Value of products and services satisfaction;
 4.51
- Overall satisfaction of customers participated in customer relation activity; 4.37
- Satisfaction level comparing to comparable agencies; 4.37
- Survey result on overall dissatisfaction; 1.61 (Full score of 5 points)

- Survey result on overall relationship; 6.61 (Full score of 10 points)
- Survey result on organization image; 4.57 (Full score of 5 points)

The safety of electric power user [103-2] [103-3]

PEA concerned about the safety of electric power user, from the power station construction to electric power system network. PEA connected with communities to create understanding, educate them about the safety, and create awareness on the dangers from electricity utilization. Moreover, PEA also planned equipment installation, maintenance, or electrical repair by regarding the safety first. For example, the Insulation Piercing Connector (IPC) installation and utilization plan in order to create installation and utilization standard for IPC equipment would stabilize low-voltage distribution system and was safer for the electric power user in the area. There were revisions and appropriate technical standard setting, as well as distinct measures and regulations for agencies and staff to follow. PEA assigned System Planning Department, Power System Research and Development Department, Safety Standard of Electrical System Division, Risk and Safety Management Department, and Engineering Department to monitor and evaluate in order to create safety and reduce the risk of dangers that might happened to electric power users and other community members around the operational area.

However, for the installation of equipment involving transmission and distribution system in both new installation case and maintenance case, PEA monitored and assessed design, quality, as well as safety standard at the rate of 100% of all products and services. This was to ensured electric power user that they would receive good quality products and services, as well as safety. [416-1]



Safety and occupational health [103-2] [103-3]

In managing the occupational health, safety and environment at work, PEA improved workplace conditions to ensure safety, sanitation and welfare, and established 214 Occupational health, safety and environment committees to cover all operational areas. These were formal joint management-worker health and safety committees, consisting of 50% representation from management and another 50% representation from worker groups. All 100% of PEA's staff and employees had the rights to participate as a representative in the committees. [403-1]

The Committees had the following key roles: deliberating and determining the occupational health, safety and environment policies, preparing safety plans, reviewing projects and training programs regarding occupational safety, and surveying occupational safety operations. Furthermore, there was a safety unit in charge of operating and monitoring the implementation of the aforementioned policies. In 2018, PEA had established key work plans and projects on occupational safety. The objective is to minimize accidents at all levels to achieve "Zero Accident" occurrence. The examples of these plans and projects were the continuous inculcation and dissemination of PEA Safety Culture in work operations, targeting management and field operations employees in all groups and levels; the Officers and Electrical Office Work Dispatcher received safety training; the occupational health and safety management system (TIS 18001); the training for safety officers at the supervisory level; the evaluation on occupational safety for all employees and workers, procuring various safety tools and equipment; and etc. It also aimed to ensure that its employees recognized the importance of safety, were able to perform their duties according to occupational health, safety and environment legal requirements, standards and regulations.

In order to respond to the occupational health, safety and environment policy at work, PEA used proactive occupational health approach by organizing a health risk assessment for its personnel, controlling risk from various establishments, as well as regularly monitoring and following up on the occupational environment to allow for appropriate prevention and mitigation measures as needed. In addition, PEA organized annual health check-ups and health screening according to risk factors, for instance the annual lead poisoning blood test for personnel involved in publishing division, and meter and power transformer division. The annual check-ups result showed that PEA personnel had a risk of being Non-Communicable Diseases (NCDs), which caused by life style habits or behavior. Hence, PEA organized trainings to provide information and encourage behavioral changes toward self-care, organized activities to improve work stations according to ergonomic principles, as well as promoted exercise in the workplace every Wednesday at 3.00 pm. to help employees nurture good health in the long term. In 2018, employees' risks of having Office Syndrome decreased by 86.11% and found that those who did adjust their work stations according to ergonomic principles reported 7.38% less work related aches. [403-3]

Employee care

PEA valued human resource development in various areas, in order to encourage capable personnel to efficiently create, and adapt digital technology to their works, as well as to be an important part in driving the organization to the target in the future. Therefore, developing its human resource so that they had knowledge, capability, and expertise at the international standard level was important for the organization in the economics and social era driven by digital technology. Moreover, PEA focused on good quality of work life, appropriate benefits and welfare, as well as occupational health, safety and environment on the basis of non-discrimination for personnel's better quality of life. [103-1]

Employment, benefits, and leaves [103-2] [103-3]

PEA had plans for recruitment, employment, placement, new employees retaining, as well as making personnel as a representative of diversity in the way of thinking, culture, and community's opinion as follows:

Recruitment employment and placement processes

PEA received annual manpower plan which included the details about positions, subordination, and additional gualification for each position required in that year. After that, PEA would define recruitment rules and methods by considering inputs from both internal and external. The job openings was publicized via various channels to reach all PEA's target groups and the recruitment was done via organization's recruiting website (http://job.pea.co.th). Applicants had to take an exam according to their required gualification, and sit for an interview. If applicants passed the exam, they should be qualified; had to report to the assigned position at PEA; and had to prepare documents for starting the job at PEA. The probation period was 3 months. After the probation period, executives from each function would consider the efficiency and capability of the applicant. Applicants who passed the final consideration would be appointed as PEA's personnel.

New employee retaining

PEA collected data such as new employee satisfaction survey, resignation statistics, attitudes, and social values of new generation, to use in revising and designing the way to keep new employees with the organization. It then was used to analyze and set strategy in retaining new employees, and to plan the projects and/or activities to improve new employee's satisfaction towards organization. These projects and methods would be communicated to various agencies to follow through. When an applicant passed the recruitment process and became PEA employee, he/she would be informed about the opportunity and career path, compensation and benefits, as well as various projects within the organization for personnel to show their capabilities and be recognized. Other processes and plans for new employee development were coaching, on the job training, as well as supervisor assignment to help new employees adjusted to the job and organization way of living.

Employee benefits and welfare

In 2018, PEA revised personnel assistant and supporting processes, updated employee benefits and welfare improvement plan, and publicized via various channels including QR code for the convenience in communication and utilization. In addition, PEA used the result of satisfaction survey on employee benefits and welfare from different groups in revising and improving benefits and welfare to respond to the diverse needs of each employee group better. The survey result showed that the average satisfaction score of employee benefits and welfare in generation Y group was less than other generation. Hence, PEA further analyzed the way to improve benefits and welfare for employee satisfaction and found out that generation Y employees were those who started to have children and used children-related benefits more than other employee groups. Therefore, PEA considered increasing child benefits, maternity allowances, as well as prepared a place for breast milk storage in the office. This resulted in higher satisfaction score of employee benefits and welfare among generation Y group.

PEA also considered that it was important for the employees to be able to take child care leave, which complied with the Children's Rights and Business Principles developed by UNICEF, The UN Global Compact, and the Save the Children organization. Both male and female employees had rights to take child care leave, which was for the safety of pregnant mother



and provided the opportunity for the child to be raised by both father and mother appropriately. In addition, PEA also allowed employees to gather and organize the Labor Unity of PEA to protect their rights in benefits and welfare. The Labor Unity of PEA also provided advice to its members who were not treated fairly. It also acted as a conduit that follows up on employment conditions, benefits and grievances, as well as considered the appropriateness of employee welfare. The total number of employees who received a wide variety of benefits and welfare stands at 100%. [102-41]



Benefits and welfares of PEA employees and workers

Employee benefits and welfare [401-2]	Personnel		Remark	
	Employees	Workers	nemark	
Severance pay or retirement funds	•		Reserved for retired employees / Based on salary rate	
Overtime and holiday pay	•		Based on salary rate	
Welfare funds	•		Reserved for membership employees	
Funeral expenses	•	•	Based on salary rate	
Medical expenses and paid sick leave	•	•		
Child benefits	•			
Paid annual leave as required by law	•			
Contributions	•		Reserved for membership employees	
Per diem for domestic and overseas travel for temporary duty assignment (TDY)	•		Reserved for approved employees	
House rental fee	•		Reserved for employees who receive house rental fee approval	
Employee uniform expenses	•		Reserved for employees in specific positions	
Pay for employees on duty during power outages	•			
Extra pay for employees on work shifts	•		Based on salary rate	
Overtime and holiday pay for employee that worked in station that distribute electricity from small plant	•		Based on salary rate	
Extra pay for hotline operators	•		Reserved for hotline operators	
Extra pay for coach or trailer drivers	•			

Employee benefits and welfare [401-2]	Personnel		Remark	
	Employees	Workers	nemark	
Extra pay for drivers	•		Reserved for drivers	
Salary Promotion	•			
Welfare for special working area	•		Reserved for approved area	
Medical expenses	•	•	Employees including parents, spouses, and children Workers including spouses and children	
Children's tuition fees	•	•		
Maternity allowance	•		Reserved for female employees	
Funds in support of ordination	•		Reserved for male employees	
Relief funds in support of fire and other disaster victims	•			
Assistance funds for employees' electricity allowance	•		Based on salary rate	
Risk allowance (The South)	•	·	Reserved for three southern most provinces	
Loans	•			
Funeral service expenses	•		Reserved for membership employees	
Shuttle bus services	•	•		
Loans for children's tuition fees	•			
Medical Care at PEA clinics	•	•		
Cellphone allowances for senior-level employees	•		Based on positions	
Company cars	•		Based on positions	
Combat pay	•		Granted to those who received combat pay before recruited into PEA	
Professional fees	•		Reserved for certain positions	
Assistance funds for criminal cases arising from the duties	•	•		
Uniform rights	•			
Rights to receive the royal decorations	•		Reserved for chief section position and the higher positions	
Rights to use PEA's Child Development Nursery	•			
Recreational activities	•	•		



Moreover, PEA had been proactively improving, developing and promoting environment, safety, benefits and welfare for employees by promoting better environment within the office through various activities, such as 5S, green office, and dust/particulate matter and lighting monitoring. In addition, PEA acquired sufficient and modern safety equipment, continually educated both employees and workers on safety issues, as well as provided CCTV and outsider verification system for the safety of personnel's life and property. PEA also promoted better preventive health care measures for personnel in all areas and all types of work by using such activities as x-ray, annual check-up, and annual lead poisoning blood test for personnel involved in risky activities.

Non-discrimination [103-2] [103-3]

PEA recognized the importance of nondiscrimination. The organization's selection, recruitment, and training processes, as well as career paths were fair, transparent, and non-discriminatory processes. PEA also established a fair procurement and selection process for its suppliers. This included disseminating full and factual information to prevent misunderstandings that lead to unfair competition between relevant suppliers. Moreover, PEA provided quality service equally to all kinds of customers, treated everyone with fairness and nondiscrimination by listening to the problems and providing support before, during, and after the service. In providing provided to customer, the organization first and foremost considered the health, hygiene and safety of consumers in its operations, as well as was equally responsive to all concerns and suspicions, treated them with attentiveness and transparency. PEA expected its personnel to treat all parties with fairness, non-discrimination, without prejudices, and provided protection to anyone lodging complaints or suspicions. In addition, PEA also specified good governance manual 2017 as an operation guideline. All PEA employees had to study the good governance concept in detail and strictly follow the guideline, which was treated as the work discipline. The violation of or omission from the good governance guideline were considered disciplinary misconduct and there would be disciplinary actions involved.

Furthermore, PEA required the committee, executive, and employees to comply with the Regulation of the Office of the Prime Minister on Giving or Accepting of Gifts by Government Officials B.E. 2544, and the morals and core professional ethics, which PEA had established. Thus, PEA personnel were not to request, accept or promise to provide any gifts, meal receptions or any benefits beyond the value that the law stipulates, and were prohibited from exhibiting any dishonest intentions that may lead to selective treatment and conflict of interest within the organization. As such, there were no complaints regarding any kind of human rights violations following PEA's operations in 2018. [406-1]

Organizational culture and commitment

In 2018, PEA set up a committee on satisfaction building and personnel commitment to the organization. High-level executives from various agencies came together to consider the directions, set strategies, plans, and activities, as well as to operate and follow up with the plan. Later on, the committee revised its direction and appointed executives from all work functions to participate in the processes of planning and activities setting in 2018 according to each work function, depending on the important factors that had impact on each work function. This new direction aimed to promote the better result for the satisfaction building and personnel commitment plan, to be more effective and responsive to the needs of personnel from each line of work.

The result of PEA's satisfaction survey tended to be higher every year, since PEA used the results from the previous satisfaction and commitment survey as an input in setting strategy and preparing the long-term and annual plans for improving personnel's satisfaction and commitment. The high-level executives also participated in setting the plan, which was supported by improving the operation system and internal environment to be in line with the opinions from PEA's personnel. There were 2-way communication via various channels in order to convey the message and listen to personnel's information, which was a way to ensure their importance to the organization. The high-level executives also acted as a good example in working and continuously participating in various organizational activities such as the "governor meets employees" activity, "value campaigning" activity, "sustainable transparency" activity, and other activities that built personnel's faith and confidence in the high-level executives. Moreover, the satisfaction building and personnel commitment plan were monitored quarterly, resulted in higher satisfaction and commitment to the organization from its personnel.

In 2018, PEA conducted an organizational satisfaction and commitment survey, with 98.27%

responses of all employees and workers (survey conducted in August 2018). It also hosted a focus group meeting with employees and workers to verify the survey results, as well as to solicit any additional insights regarding factors affecting their satisfaction, well-being and commitment toward the organization. Analysis of personnel's organizational satisfaction and commitment showed positive trend in most of the aspects when compared to results from 2017, as illustrated below.

Factors	Employee	Worker	Overall personnel (average)		
T actors	(average)	(average)	2016	2017	2018
1. Satisfaction	4.39	4.44	4.28	4.38	4.42
1.1 Job satisfaction	4.28	4.34	4.17	4.25	4.31
1.2 Organization satisfaction	4.50	4.53	4.39	4.50	4.52
2. Commitment	4.50	4.49	4.39	4.49	4.50
2.1 Well-being	4.43	4.44	4.34	4.41	4.44
2.2 Belonging	4.52	4.46	4.40	4.51	4.49
2.3 Doing the best	4.54	4.56	4.42	4.54	4.55

Employees knowledge development and management [103-2] [103-3]

PEA defined Human Resource Master Plan and Strategy for 2010-2020 (6th revision in 2016) to power the human resource development and management to become "human capital" that could adjust to the change and add value to the organization. In building the development activity framework, PEA used input from Human Resource Management Master Plan and Strategy, together with HRD Blueprint's human resource development direction. There were 5 aspects (5Ps) to this framework, as follows: (1) Professional Development (Technical Competency): develop human resource to be professional (2) People Management (Leadership & Management Competency): develop human resource to have leadership and management skill (3) Potential Enhancement (Career Development-Succession Plan-Talent Management): develop human resource competency (4) Passion Driven (Quality of Work Life):

develop human resource to balance their body, mind, and soul and (5) Planet Concern (CSR and CG): develop human resource to have responsibility to their society and good governance. The development covered all personnel in the organization and adjusted human resource development direction to focus on personnel's readiness for digital transformation and the rapidly changed innovation competition. It aimed to respond to customers' need which become much diverse than before. For the agencies that had already been revised, there would be summary about competitive capability and competency information for them, so that they could appropriately design Competency Model for personnel in each line of work, analyze and revise training courses to comply with personnel's competency according to the revised Competency Model, and improve the standard courses. The input to be considered in creating human resource development system in order to specify standard course were human resource management



master plan and strategy, as well as the survey for training needs. In addition, the plan should be publicized to all PEA agencies, who had to follow through and evaluate the training and development result. Each agency had to revise its Individual Development Plan (IDP) for personnel in all work functions according to their competency, learning system, and PEA's revised human resource development plan. This IT-assisted development had to be approved by the supervisors.

Moreover, PEA's human resource development department had adjusted the process and had improved the standard of education and human resource development system and by designing the education and human resource development system to comply with internal and external factors according to competency. All levels of personnel had to prepare Individual Development Plans (IDP), which consisted of the Core Competency (CC), Managerial Competency (MC), and Functional Competency (FC). The results of this evaluation would lead to the development planning for each employee to be equipped with knowledge, skills, and behavior according to competencies required, in order to improve both the employee's and the organization's competencies to be ready for implementing the strategy and to use IT system in assisting the operation. This connected with Learning Model 70:20:10 development plan, and followed ISO 10015 standard, which was the standard on quality guarantee for training management and human resource development. Human Resource Development Department was the main agency who was responsible for analyzing and preparing action plans, as well as operating according to the learning and development processes that comply with various relevant factors, such as the needs for training and development that was specified by the supervisors or higher levels, organization's special ability, strategic challenge, accomplishment of organization's action plan (both short-term and long-term), organization operation result improvement, change in technology and innovation, ethics and ethical way of doing business, consumer-centric approach, knowledge transfer from resigned or retired personnel, encouraging new knowledge and skills in operation, as well as creating economics value to the organization.

Overview of competency management system



Provincial Electricity Authority (PEA)



PEA reviewed the criteria for evaluation, and establishment of key performance indicators to assess the effectiveness of learning and development outcomes. In 2018, PEA categorized its employees into 5 groups, namely 1) Executive, 2) Middle Management, 3) First Line Management, 4) Operation 1, and 5) Operation 2. It then applied different evaluation criteria accordingly as follows,

1. Evaluation of the organization's overall learning and development was a survey assessing the satisfaction toward the effectiveness of learning and development system in line with the human resources development plan. The efficiency evaluation of direct learning and development system as determined by the annual human resources development plan, according the widely recognized Kirk Patrick model, was divided into the following 4 levels:

- 1) Reaction Evaluation
- 2) Learning Evaluation
- 3) Behavior Evaluation
- 4) Results Evaluation

2. Activity-based evaluation involved using designed activities to evaluate employees' capacity, to assess their knowledge and understanding in real working context. These activities included:

- 1) Competitive activities, such as annual operational skills competition
- Capacity building activities, such as outstanding employee contests, outstanding PEA, and outstanding work department
- 3) Research and innovation promotion activities, which was the event providing employees opportunities to present their achievements at academic and innovation conferences such as the PEA Conference and Innovation (PEACON) event.

3. Analysis of employee learning and development system's efficiency to inform the training evaluation result by individual level, by course level, and by various level of evaluation.



Other than the training to develop employees' knowledge and capacity, PEA also evaluated them to inform supervisors and those evaluated of their operational results, which served as key information for other considerations such as improving operational results/procedures, or tools for operational support, giving rewards, or designing appropriate compensation. Furthermore, operational evaluation results also identified any gaps between the goals established and the real operations that took place. This was an important piece of information to determine rationales, whether at the individual level such as competency and workrelated knowledge, or at the organizational level such as working procedures or tools for operational support. In 2018, all employees (100%) underwent such evaluation. [404-3]

Employee benefit obligations and retirement preparation [201-3] [404-2]

PEA comprehensively prepared its personnel before their retirement, by taking into account their physical, mental and social transition, as well as retirement benefits to ensure compliance with the State Enterprise Labour Relations Act B.E. 2543. This included severance pay upon retirement, compensation for unused leave days, retirement gifts, and leave days upon retirement, and etc. In addition, PEA established the PEA Provident Fund, according to the Provident Fund Act B.E. 2530, on October 30, 1996, as part of its welfare for retiring employees. Employee members could choose to make payment towards the fund at rates between 3-15% of their salary, while PEA contributed an additional portion of 9-11% of the employees' salary. The Net Asset Value (NAV) of the fund, as of December 31, 2018, is 36,288.12 million Baht. Payments were made to 1,094 retirees in 2018, amounting to 4,154.23 million Baht in total. The fund enabled the beneficiaries to support their living costs following their retirement.

Furthermore, PEA implemented its program for skills management and lifelong learning, and advocacy on savings and investment for happy retirement. To this end, the PEA Provident Fund committee worked together with the provident fund management division to promote financial management among its members through saving and investment, and to ensure that members had good knowledge about investing their savings in the provident fund, as well as understood the rationale for selecting appropriate investment channels according to their contexts and ensured quality of life and sufficient resources in their retirement. In 2018, PEA provided trainings to its provident fund members across the country, in all 12 PEA Areas and Head Office. In total, 6,128 provident fund members participated, 5,465 of which were from PEA Area Offices, and another 663 members from the Head Office. Members could participate through various channels such as PEA Fund network coordinator training program (692 members in total), 2017-2021 retirees training program (1,302 members in total), Q&A session with PEA Fund members program, (1,738 members in total), information session for staff with less than six years of experience (2,396 fund members in total). In addition, PEA also communicated proactively by increasing channels for members to access the information. It designated the PEA Fund coordinators and PEA Fund coordinators network across the country, and leveraged information technology to render communication channels such as the PEAFUND application, website, and Facebook. It also supported PEA Fund personnel in receiving further training to build their capacity regarding finance, investment, public relations, and information technology to equip them with the skills needed, and to advocate and disseminate knowledge efficiently.



Participating in community and social development [413-1]

To provide electricity distribution service in both electrical system construction to expand the network and efficiency improvement to be sufficient for user demand, it was necessary to operate on the basis of safety and to consider the impact that might occur to the community and surrounding areas. Hence, PEA paid attention in all the operation processes, from the construction of substation and electrical system network to the maintenance/repair of electrical system. PEA not only emphasized on its own employees on duty, but also focused on creating awareness on the safety of electric power usage to the community to promote safety and reduce risk of the dangers that might happen to the people in surrounding communities. [103-1]

PEA also emphasized on the participation with community and society, by specifying activities to connect with the communities around the areas of electrical transmission and distribution system, in order to listen to their problems, concerns, suggestions, as well as the effect on the communities in the operation area. This helped the organization to receive first-hand information and feedback, which were important for conducting analysis and evaluating social and environmental impact. Moreover, PEA could also remained vigilant about any possible problems, such as the danger from electrical transformer installed within community area, the danger from high trees with branches leaning across the electrical wire, the danger from high voltage power lines crossing over houses, the danger from electrical leakage in flooded areas, error in electricity usage record, and knowledge building about the safety from electrical usage. Furthermore, PEA also used relations-building activities as a channel in educating community about the electrical utilization knowledge and creating awareness of organization operation. PEA assigned the committee on occupational safety, health, and environment and tasked them with inspecting, monitoring, and improving operations to be more efficient, as well as dealing with problems and impact from natural disasters. The committee also needed to closely monitor other problems that might cause electricity-related dangers to the community, including various internal and external projects, to reduce the risk and loss of lives and properties to the minimum, as well as to improve safety for the electric power users in the community and PEA's own personnel. In 2018, PEA built relations with 89 other communities throughout the country via several important projects as follows: [103-2] [103-3]

Safe Community with PEA Electricity Use shared useful knowledge with public and private organizations. educational institutions, and community leaders about electricity use in order to minimize risks of accident from electricity misuse. The project also aims to educate students at the level of high vocational certificate and technical diploma in electrical power technology about inspecting and improving power systems in the community area to ensure safety in areas under PEA's responsibility. PEA first launched this project in 2013 and continued to operate this project every year. This year was the 6th year in the row. PEA selected disaster-prone communities by considering the necessity and urgency areas where floods occur frequently within 12 zones under PEA's responsibility, 1 community for each zone, as follows:

- (1) PEA Area 1 (North) Chiang Mai province,
- (2) PEA Area 2 (North) Pitsanulok province,
- (3) PEA Area 3 (North) Lopburi province,
- (4) PEA Area 1 (Northeast) Udonthani province,
- (5) PEA Area 2 (Northeast) Ubon Ratchatani province,
- (6) PEA Area 3 (Northeast) Nakhon Ratchasima province,
- (7) PEA Area 1 (Central) Ayutthaya province,
- (8) PEA Area 2 (Central) Chonburi province,
- (9) PEA Area 3 (Central) Nakhon Pathom province,
- (10) PEA Area 1 (South) Phetchaburi province,
- (11) PEA Area 2 (South) Nakhon Sri Thammarat province,
- (12) PEA Area 3 (South) Yala province.

(This amount to 0.67% of overall operation agencies that built relations with the community, which increased 0.39% comparing to 2017). In 2018, PEA allocated budget of 5,260,800 baht to the project. There were 600 university students from 15 institutions 40 students each, 360 teachers from educational institutions, and 600 junior high school students participating in this project. PEA also set up the education center as a prototype for community in learning how to safely and economically use electricity, and how to perform first aid, as well as in exchanging knowledge among 12 communities. PEA also examined community's electrical system for 5,828 households as can be seen in the table below.

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Students and households participating in the project

Project participation	2014	2015	2016	2017*	2018*
Number of participating educational institutions (Institution)	308	308	308	15	15
Number of participating students (Person)	7,725	7,765	7,700	600	600
Number of households inspected (Household)	309,000	309,750	312,150	17,935	5,828

Remark: * Safe Community with PEA Electricity Use specified the 3-year time frame (2014-2016) for project operations by collaborating with 900 institutions. Inspected and improved power systems in a total of 900,000 households. However, when the project came to a close in 2017, PEA recognized the productivity of this project and asked that it continue to proceed even with different operational goals. It identified areas with urgent needs. Therefore, the statistics from 2017 plummeted when compared to the previous year.

Encouraging 74 Communities to Use Electricity Safety Project, PEA selected 74 nationwide communities that were within the areas under PEA's responsibility. These were disaster-prone areas or areas where disasters such as fires and floods occurred frequently. PEA allocated 150,000 baht for each community to organize trainings on safe and economical electricity use. The project also provided other services and inspected domestic electronic appliances such as fuses, protective devices, light bulbs, electrical wires, power outlets, and underground cable systems. These undertakings were carried out by expert staff members in an effort to equip communities with a better understanding of safe use of electricity.

PEA also designated methods in receiving news or consultations or submitting inquiries via PEA's channels of communications such as 1129 PEA Call Center, Facebook. PEA Mobile Application and Website. PEA designated a budget for media production through radio and television to promote safety practices including constructing, cutting tree branches, installing cables or billboards outside buildings adjacent to high voltage posts. These aforesaid activities were likely to often cause operational risks. Residents could contact PEA staff to advise the public on how to use electricity safely and to prevent risks entailed by its misuse, as well as to install conductor covers before they proceed with any kind of operation.



For operations near high voltage power systems, PEA staff will install conductor cover to prevent electrical pressure.

Digital Business

Creating a new business sustainably must meet the future need in terms of environmental friendliness, cost reduction, reduce operating time and also improving the quality of society and communities. The next step of PEA is to create an innovation leading to the stability of energy together with an organizational sustainability.

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Modern Organization with Environmental Awareness

PEA values environmental impact management, from the pre-construction phase, construction phase, to post-construction phase. As the construction of electric power systems requires large budgets and may entail significant environmental and social impacts, it is extremely necessary to analyze both the positive and negative impacts carefully to minimize the possible impacts on all groups of stakeholders. Therefore, PEA strictly follows national and international legal requirements, and engineering and safety principles on designing power stations, as well as transmission and distribution systems, for instance, the Promotion and Conservation of National Environmental Quality Act, B.E. 2535, standards of the Engineering Institute of Thailand (EIT), the International Electrotechnical Commission (IEC), and the Institute of Electrical and Electronics Engineers (IEEE), etc. [103-1]

Electric power systems construction with consideration of environmental impacts

Prior to electric power system construction, PEA conducts Feasibility Study (FS) in technical, investment, social, and environmental aspects, etc., and prepares reports to suit each type of projects, for example:

Environmental Impact Assessment (EIA) for the Electric Poles with Power Lines Crossing over Class-1 Watershed Areas Project and the Electric Poles with Power Lines Crossing over Wetlands of International and National Importance Project to predict positive and negative environmental impacts from developing important projects or businesses, determine environmental impact preventive and corrective measures, and support the consideration on project development. **Initial Environmental Examination (IEE)** for the Electric Poles with Power Lines Crossing over Additional Protected Forests Project to carry out initial examination of possible environmental impacts from the proposed projects.

Environmental Health Impact Assessment (EHIA) for electrification projects on islands (Kham Yai island, Chon Buri province, and Chik island, Chanthaburi province) to assess project-level impacts, covering process, methods, and tools used, and predict how the projects may lead to changes in health determinants and health status of affected people to be used for considering and determining preventive and corrective measures, and for supporting the consideration on project approval.

Environmental Checklist for the Electric Poles with Power Lines along the Highways Cut across Additional Protected Forests Project to assess risks of impacts on the environment and surrounding society, so that PEA will be able to determine preventive and corrective measures prior to the project construction, and the operational performance will be reported to the Office of Natural Resources and Environmental Policy and Planning (ONEP), whose duty is to monitor and examine measures, conditions, and environmental impacts based on the environmental impact assessment to ensure consistency with the guideline to strengthen the national economy, and promote sustainable development and better quality of life in accordance with environmental management in business operations [103-2][103-3].




Provincial Electricity Authority (PEA)





In addition, for every case of system expansion and maintenance, PEA will coordinate with relevant agencies and the surrounding communities in order to regularly inform them of the project's details and progress through various channels of communication, for instance, setting up a sign to notify in advance of the delivery time of large electrical appliances in the project area, as well as of the delivery route in order to mitigate traffic congestion. Moreover, PEA will proceed with trimming and pruning trees by using tree surgeons, under its "Tree Doctors" project, along power lines in distribution hotspots, such as 115 kV transmission lines, and high-voltage and low-voltage transmission lines to avoid power outages caused by trees. PEA also carries out other environmental impact assessments (for example, measurement of air quality, particulate matter, noise level, and electric and magnetic fields), and measurement of water pollution and effluents that result from its operations. PEA strives to keep these impacts within the permitted range and determines safety measures and practices for all projects concerning electrical system construction to strictly follow throughout their implementation, for example:

- Standard for constructing electrical systems of • all voltage levels
- Regulations by the Department of Civil Aviation regarding painting or installing devices for warning purposes along the power lines and buildings
- Regulations by the Department of Highways regarding electric pole installation and conductor stringing, the spacing necessary between power lines and traffic surface, and the installation of underground cables

OBJECTS

DANGER HIGH VOLTAGE

WEAR SHOES

- Other regulations on the spacing between the • underground cables and other public utilities, to determine the distance required for the design and installation of underground cables
- Regulations by the Marine Department on acquiring permission to install cables, buoys and warning signs for submarine cables
- Standard for alarm devices used in roadside operations to alert and protect passersby on the maintenance route; the use of standard warning signs such as those for high-voltage and low-voltage cables, or high-voltage electric lines, etc.



From a review of the operational performance in 2018, there were no grievances regarding environmental issues from construction of electric power systems. Based on the monitoring outcome, all the environmental impacts were within the permitted range (such as measurement of air quality, particulate matter, noise level, and electric and magnetic fields, water pollution, and effluents). There were also no monetary and non-monetary penalties resulting from environmental compliance violations. [307-1]



Management of environmental impacts in the work process

PEA has recognized the importance of environmental conservation to mitigate the current severe environmental impacts caused by sudden climate change. Therefore, PEA has determined a guideline for promoting environmental conservation through improvement of its major operations. These include sufficient and effective use of resources, strict compliance with laws and regulations on the environment, for example, the Energy Conservation Promotion Act, B.E. 2535, amended in B.E. 2550, the Promotion and Conservation of National Environmental Quality Act, B.E. 2535, and the Leadership in Energy and Environmental Design Act (LEED), etc. Furthermore, guidelines and measures for minimizing major environmental impacts are as follows: [103-1] [103-2][102-11]

- Effective use of resources and reduction of greenhouse gas emissions [103-2][103-3]

PEA has determined a policy to save its energy and designated a working group to be in charge of overseeing energy saving initiatives. Also, PEA has determined plans, measures, and targets for continual reduction of electric power and fuel consumption, with the reduction goal of 10% per year. In 2018, PEA initiated a measure to conserve energy and protect the environment by renovating four PEA offices, namely PEA Area 3 office, Nakhon Pathom province, PEA office, Chon Buri province, PEA office, Pathum Thani province, and PEA office, Nong Ya Sai District, to serve as environmentally friendly green buildings in accordance with the Leadership in Energy and Environmental Design (LEED) by the U.S. Green Building Council (USGBC). The assessment of PEA office buildings is based on the LEED for Existing Building Operations and Maintenances (LEED EBOM) standards, which consist of assessments of physical and management components of buildings, for instance, installation of fresh air distribution systems, management of lawns and areas outside buildings in order to reduce air and noise pollution, changing to water-saving sanitary ware, painting the roof with coatings that can reflect solar radiation back, management of energy for efficient energy consumption within buildings, and preparation for the performance period to assess building efficiency in terms of energy and water consumption, as well as management of buildings in various aspects. This initial assessment will be submitted to USGBC through the LEED Online system. In 2018, PEA Area 3 office, Nakhon Pathom province was certified as a green office building in accordance with the LEED standards by the U.S. Green Building Council (USGBC) and Green Business Certification, Inc. (GBCI) at a silver level, with the score of 56 points.

In 2017, PEA published its Green Office Policy and extended the Green Office program based on the standards of the Department of Environmental Quality Promotion, Ministry of Natural Resources and Environment. In addition, PEA designated a sub-committee to proceed with the Smart Green Office program to monitor and evaluate the operations to ensure consistency with the criteria, making the work more tangible, with the purpose to reduce the consumption of electricity, fuel, and water; promote reuse and recycle; reduce and eliminate the use of hazardous products and chemicals within offices, and other operations, such as cost-effective and efficient use of energy, environmentally friendly consumption, reduction of greenhouse gas emissions, and procuring materials certified as environmentally friendly. PEA has a target aimed at expanding the scope of operations under the Green Office Development Project to include all area offices in 74 provinces. In 2018, PEA upgraded its offices to be more environmentally friendly and promoted this idea to local offices with an aim towards reduction of greenhouse gas emissions in all sectors. PEA sent 30 offices to participate in the Smart Green Office program to ensure that its offices would be equipped with a good environmental management system, and its projects could be implemented sustainably. PEA established



Best Practice for the operations of the Smart Green Office program, and developed its personnel to serve as environmental management auditors. Experienced personnel from PEA offices who had participated in the program in the previous year were selected to act as speakers to give knowledge/recommendations and as auditors to audit PEA offices before undergoing a certification audit in accordance with the Green Office criteria of the Department of Environmental Quality Promotion.

PEA also developed databases on energy and resource consumption using modern information technology, such as storing data on consumption of electric power, water supply, fuel, and papers, to be used for calculating greenhouse gas emissions and analyzing eco-efficiency of PEA, and to serve as a guideline for preparing efficient energy and resource consumption measures in the future. In 2018, PEA started the

Eco-Efficiency Project, 1st stage (2018), which carried out studies and determined a guideline for measurement and assessment of eco-efficiency to facilitate sustainable development according to ISO 14045. There were 7 success factors for eco-efficiency operations, namely reducing consumption of resources or raw materials in production and services, reducing energy consumption in production and services, reducing discharge of toxic substances to the environment, enhancing reuse, promoting the use of renewable resources, increasing product lifetime, and upgrading product services and promoting service businesses, which covered the study and assessment scope of electric power generation, electric power transmission, and electric power distribution. Moreover, PEA sets a 3-year work plan (2019-2021) to continually and sustainably improve efficiency in eco-efficiency assessment.



Provincial Electricity Authority (PEA)

PEA has collected base year data to be used as a base year for comparing the outcome of eco-efficiency improvement in its operations. 2017 was set as the base year as it was the year commencing complete data collection from various PEA sectors. The collected environmental data were:

1. Amount of electricity consumption in all PEA offices nationwide

2. Amount of water supply consumption in all PEA offices nationwide

3. Amount of SF_6 (Sulphur Hexafluoride) consumption in the PEA switchgear system

4. Amount of power transformer oil consumption

5. Amount of fuel consumption of the organization and electric power generation

6. Amount of A4 and thermal papers consumption

7. Number of materials or parts used for repairing and maintaining substations and electric power systems

8. Amount of refrigerant consumption in all PEA offices nationwide

For the assessment of eco-efficiency for electric services, PEA has set greenhouse gas emissions as an environmental indicator as it is the main concern of people all over the world and in Thailand, while earnings before interest, tax, depreciation, and amortization (EBITDA) (million baht) is used as an economic indicator since it indicates the organization's business operation capacity. The calculation is based on the following formula:

Eco-Efficiency = Product or service value Environmental influence

Source : WBCSD (2000). Measuringeco-efficiency: a guide to reporting company performance. World Business Council for Sustainable Development (WBCSD)

From eco-efficiency assessment in 2018, it was found that eco-efficiency was 169,986 baht/ tCO_2e (EBITDA of 38,078.16 million baht, amount of greenhouse gas emissions excluding power losses of 224,007.62 tCO_2e). That is, EBITDA of 169,986 baht caused greenhouse gas emissions of 1 tCO_2e . This covers only greenhouse gas emissions from PEA operations (not including environmental burdens of power generation through purchases from PEA and VSPP nor power losses). However, greenhouse gas emissions from PEA operations (excluding the amount of greenhouse gas emissions from power losses) were 1,697.99 kgCO₂e per 1 MWh of power distribution. PEA also determined a plan to implement the project to promote reduction of greenhouse gas emissions both within and outside the organization according to the Greenhouse Gas Protocol (2004). A working group was set up to monitor work and report operational performance based on the plan to tangibly promote reduction of greenhouse gas emissions, and relevant agencies were designated to drive 15 projects/ activities in 2018 as follows:

 Promotion of reduction of greenhouse gas emissions (internally)

• A plan to increase efficiency in air-conditioned electric power consumption

• A project to purchase LED light bulbs and accessories and install them inside buildings.

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• A project to improve diesel power plants efficiency

• Meetings in the form of VDO conferences

 Promotion of reduction of greenhouse gas emissions (externally)

• A project of "PEA Plant Trees, Save the Forest Campaign"

• A project to improve and increase efficiency of energy consumption at Rajamangala University of Technology Lanna

• A project to improve and increase efficiency of energy consumption at Ramkhamhaeng University

• A project on energy management advisory support for the commercial and industrial sector

• A project to improve and enhance the energy efficiency of lighting systems at Bueng Kan Hospital

• A project to improve and enhance energy efficiency of air-conditioning systems at Rajabhat University, Nakhon Si Thammarat

• A project on management for energy conservation at the Thai Customs Department

• Support for buying electricity from very small power producers (VSPP)

• Buying electricity from rooftop solar photovoltaic systems on residential buildings

• PEA LED Project for cultural-based tourism in Thailand

• A PEA project to alleviate droughts through renewable energy

• Reduction of amount of paper consumption

PEA had a measure to enhance its process capacity using digital technology based on 5 strategic aspects, namely **Grid** to increase the capacity in data analysis, with an aim to effectively manage property and grids; **Customer** to create an image of modern services by integrating data from various channels and analyzing such data for providing proactive services; **Enterprise** to support management's decisions by installing large data management systems, analyzing in-depth data,

and increasing operation agility and efficiency with an emphasis on connection of systems and information; Human Resource to apply technology for continual learning to enhance creativity and innovations, as well as to create awareness, knowledge and understanding, and skills in using digital technology among employees; ICT to build a PEA digital platform to support its operations throughout the organization, with an emphasis on integration, connection of systems and data, and strengthening ICT infrastructure towards international standards and system stability and security. Apart from enhancing operation efficiency, large data management, and in-depth data analysis, these 5 strategic aspects also played a major role in reducing the amount of paper consumption in the organization. In 2018, PEA developed major work systems as follows:

• Paperless Meeting System (PLMS): Meetings were managed by using a QR code for attendee registration, checking and summarizing the number of attendees in a real time manner, and downloading documents on Smart Device instead of using papers. Through Smart Device, meeting attendees could check and follow up on meeting minutes online and study meeting details and agendas before or after meetings, resulting in more convenient and faster work and processes.

• **e-Slip System:** The e-Slip system was used instead of printouts. Employees could access e-slips via the organization's e-mail account.

• Electronic Letter of Guarantee (e-LG): It is a work system that helps improve services and solve problems in the Letter of Guarantee (LG) process. Moreover, it reduces the service steps and time, document losses and damage, data errors, and document falsification, and facilitates fast search for Letter of Guarantee.

• Application of the M-Vara System: Electronic documents were used in PEA meetings to reduce paper consumption.

• Communication with personnel through video conferences: This method could conveniently reach personnel in all areas.

All of the above practices aimed to reduce paper consumption and respond to the MOU on State Enterprise Performance Appraisal (SubPAC), which required PEA to reduce the use of papers and encourage state enterprises to use electronic innovations or information systems and to make its information systems available for use. In 2018, PEA used 514.85 tons/year of papers, with a decrease of 159.06 tons/year compared to that of the previous year.

- Assessment of cost-effective resource consumption and environmental conservation

PEA had a performance assessment guideline in accordance with ISO 26000 in Processes Self-Assessment Manual or ISPA Manual. This manual has determined environmental topics for relevant agencies both centrally and regionally to apply in assessment and improving the work system to be more efficient in accordance with State Enterprise Performance Appraisal, using the ADLI principle, which consists of Approach (A), Deployment (D), Learning (L) and Integration (I) as a cycle. This helps to tangibly upgrade social responsibility operations based on ISO 26000 under the CSR in Process of PEA towards sustainability. The environmental topics required establishment of measures and management plans to reduce the consumption of electric power, fuel, papers, and other important resources, and dissemination of ideas for various organizations to implement systematically, having Corporate Social Responsibility Function in charge of setting up such process.

Management of effluents and hazardous waste

PEA has placed great importance on management of effluents and hazardous waste both in power transmission and distribution systems and infectious wastes from medical clinics within office buildings as most of the effluents and hazardous waste come from these sources, which might lead to leakage or improper disposition and affect health and safety of those in communities surrounding PEA's operation areas. Therefore, PEA has determined a guideline for management of power transmission and distribution system equipment and effluents within office buildings in accordance with the Promotion and Conservation of National Environmental Quality Act, B.E. 2535 as follows: [103-1]

- Management of effluents and hazardous waste in the power transmission and distribution systems [103-2][103-3]

PEA will assess, check, and select the devices whose conditions meet the standard criteria stipulated by relevant agencies. Those criteria are divided into the following:

• Repairable materials and devices such as electricity meters and transformers will be repaired and restored back to the condition where they are readily available for reuse.

• Unrepairable materials and devices such as transformers' iron cores, copper windings, and leftover parts of electrical wires from distribution systems will be sold or provided to external agencies so that they can dispose of them properly.

• Separated materials and devices available for use in other areas such as high-voltage bushings and low-voltage transformers will be used as substitute spare parts and concrete products. For instance, electric poles that have not expired will be reused. Expired/defective poles will be sold to the others to use in farming, bridge construction, and low-voltage power line communication. Moreover, these poles can be used to generate benefits for communities, society, and environment; for example, building weirs and making artificial coral reefs.

In addition, there are routine maintenance checks on these materials and devices in accordance with work plans, so as to prolong their lifetime.



These checks include cleaning electrical devices such as insulators in areas adjacent to the sea, or in areas where salt is concentrated, or in areas where dust is dense in the air. This is done to prolong their lifetime and create the health index database of electrical devices such as reclosers, in an effort to replace equipment before they become defective, which can reduce effluents from defective devices. Moreover, in 2018, there was a policy to reuse power transformer oil from the process of maintaining power transformers with deteriorating dielectric breakdown voltage. Deteriorating transformer oil had to undergo the purifying process using heat and moisture absorption repeatedly until the transformer dielectric breakdown voltage reached the standard value, and it would be installed in power transformers. For damaged power transformers whose dielectric breakdown voltage consisted of soot, was out of order, and could not be reused, PEA would gather and send them to the Concrete Product Division for concrete pole molding to be used for producing electric poles.

- Management of effluents and hazardous waste within office buildings

In 2018, PEA developed an information storage system based on the MOU on State Enterprise Performance Appraisal (SubPAC), which focuses on encouraging state enterprises to use electronic innovations or information systems so as to reduce the organization's paper consumption. Furthermore, campaigns were organized to encourage the use of papers on both sides. Later, these papers would be dispatched to schools for the blind so that they could use them as embossed braille documents (third side). With regard to general waste, PEA rallied a campaign to sort it by type: wet waste, general waste, recycled waste, and hazardous waste. The disease-ridden waste from medical clinics at the head and district offices would be separated from general waste in the hope that they would be lawfully disposed of by responsible private agencies.

PEA also designated the Transformer Division to be in charge of analyzing and planning the management and maintenance of distribution system transformers to be sufficient for use, testing those transformers, issuing test result certificates, creating a guideline for reusing the oil from old transformers in order to promote natural resource and environmental conservation, reducing imports of raw materials used in the process which might cause pollution, and controlling discharge of hazardous effluents externally which might cause harm to persons, animals, plants, and PEA's surrounding environment by doing as follows:

1. For agencies with transformer oil-related operations, upon requisitioning transformer oil from the material stores for maintenance, filling, or changing, they need to gather the old transformer oil to be returned to the designated agency which will then send it to undergo the purifying process for reuse.

2. Transformer oil must carefully be transported and transferred. The oil tanks should be prevented from denting and should be tightened, as well as inspected for lid condition and leakage before delivery.

3. To open transformer oil tank lids and use transformer oil, the operators should follow the Material Safety Data Sheet of PTT Hivolt Plus products.

4. Transformer oil operators should wear personal protective equipment, such as PVC or nitrite gloves, safety glasses with side shields, and clothes to protect arms, legs, and body.

5. Transformer oil operators must be careful not to allow leakage of transformer oil on land and in water sources. In case of leakage, they must follow Clause 6 of the safety recommendations on leak measures in the material safety data sheet.

6. A container must be provided for transformer oil transferred from transformers or electrical appliances so as to prevent leakage on land and in water sources. The container should be clean and dry and made of carbon steel, stainless steel, polyethylene, polyester, or teflon. In case the container surface is covered with oil, make sure it is the same type of oil. 7. In returning old transformer oil, it must be contained in a prepared transformer oil tank or a new oil tank whose oil is used up. The operator needs to be careful with cleanliness and prevention from leakage, and the oil must not be spilled as old transformer oil is regarded as a hazardous substance which needs to be controlled as prescribed by law.

8. The designated agency must be responsible for gathering old transformer oil, controlling the number of tanks and amount of oil in the tanks in liters by keeping record, and specifying the color of each tank. The oil sender should be the same as the requisitioning person, and the sender must specify his/her name and position clearly for collecting oil to undergo the purifying process for reuse.

9. The old transformer oil for reuse should be stored in a cool place at the atmospheric temperature with good ventilation and separated from other chemicals, placed away from fire, sunlight, heat, and ignition sources.

10. The designated agency to receive old transformer oil to undergo the purifying process for reuse must prepare personal protective equipment and foam or dry chemical fire extinguishers at the operation site.

11. Upon collecting about 10-20 tanks or about 2,000 - 4,000 liters of old transformer oil, the receiving agency should collect a sample of approximately 20 ml from each tank to be tested for PCB, which must not exceed 50 ml/kg according to the notification of the Ministry of Industry, using the field test kit for PCB screening.

12. Upon collecting about 25 tanks or about 5,000 liters of old transformer oil, the agency designated to keep old transformer oil for undergoing the purifying process for reuse should start purifying the oil based on the following 3 options:

1) Purifying transformer oil using PEA's existing transformer oil purifiers

2) Hiring workers with expertise in transformer oil purification to perform the work

3) Informing the Transformer Division to perform the work

13. Before purifying transformer oil, a sample must be collected to test properties as follows:

1) Testing breakdown voltage according to the ASTMD1816 and IEC156 standards

2) Testing water content in transformer oil

3) Testing the dissipation power factor in transformer oil as there are many contaminants such as copper and peroxide content.

After transformer oil purification, oil sampling must be carried out to test the above three properties for comparison purposes, and the value must meet the standard.

 For breakdown voltage according to the ASTMD1816 and IEC156 standards, the value should not be lower than 30 kV.

2) For water content, the value should not exceed 35 ppm.

3) For the dissipation power factor caused by contaminants such as copper and peroxide, the value must be in accordance with the ASTM D924-99e1 standard.

14. Deteriorating transformer oil, which is not cost-effective to purify for reuse is regarded as hazardous waste which needs to be controlled under relevant laws. It needs to be attached with a clear sign and separated from regular oil. As it can be transformed and utilized for other benefits, it should be collected for sales to buyers of old oil with a license from the Ministry of Industry.

From its operations in 2018, it was found that PEA could collect 34,000 liters of old transformer oil to be reused based on the above concept, which accounted for 170% of the set target.



Involvement in community environmental conservation

PEA highly values mitigation of environmental impacts on communities. In 2018, important projects were as follows:

- A PEA project to encourage community enterprise to use renewable energy

It was implemented by developing a model community in using the renewable energy generation system based on the Philosophy of Sufficiency Economy to support community occupations, increase community income, and serve as a model for renewable energy consumption. In 2018, the project was implemented in 3 areas, namely Nong Sano Village Community Enterprise in Nakhon Phanom province, Doi Pha Som Community Enterprise in Chiang Mai province, and Phai Si Thong Housewife Group Community Enterprise in Chon Buri province.

- PEA's communities revived the marine environment of Thailand project

PEA had a plan to efficiently make use of damaged and deteriorating materials and equipment from the electric power system maintenance process, such as insulators, electric poles, spacers, and truck wreck, etc. by bringing these materials and equipment to make artificial coral reefs. These materials and equipment were collected and put in gabions, and placed on designated locations in Laem Ta Chi (Pattani Bay) in Yaring District, Pattani province 6 miles off the coast with the target of 1,050 tons. As the artificial coral reefs created channels and layers, it served as home to fish and aquatic animals. This, as a result, led to an increase in the number of aquatic animals and productivity of fisheries and coastal ecosystems, good living condition of local fishermen, and an increase in household income which would lead to sustainable self-reliance.

- PEA save water, build weirs project

In PEA's process of electrification and electric power system maintenance, there was a huge number of damaged or deteriorating materials from concrete products, such as electric prestressed concrete poles. Therefore, PEA used these materials for constructing check dams to store water for community consumption and agriculture, as well as for alleviating droughts and preventing flash floods in communities adjacent to water sources.



Awards of Pride

International level

• Received 5 International Invention Awards for 4 invention projects at the 46th International Exhibition of Invention in Geneva, Switzerland.

• Received the Asset Treasury, Trade, Supply Chain and Risk Management Awards 2018 for Cash Management Solution Thailand, organized by the Asset Magazine in Hong Kong Special Administrative Region of the People's Republic of China.



• Received 7 outstanding State Enterprise Awards 2018 from the State Enterprise Policy Office (SEPO). Those awards include the following:

- State Enterprise Award for Outstanding Organization Leader

- State Enterprise Award for Excellent State Enterprise Performance

- State Enterprise Award for Outstanding CSR Operations

- State Enterprise Award for Honorable Development Cooperation in Strategic Alliances.

- State Enterprise Award (Honorable Mention) for Outstanding Innovation in Creativity.

- State Enterprise Award (Honorable Mention) for Outstanding Innovation

- State Enterprise Award for Outstanding Disclosure and Transparency

• Received first-place 38th "Suriyasasithon Awards" for Outstanding Calendar Design 2018 for supporting the nation's identity and arts & culture at the Government Public Relations Department, organized by the Public Relations Association of Thailand.

• Received Outstanding Sustainability Report Award 2018 from the Thai Listed Companies Association, the Securities and Exchange Commission, and the Thaipat Institute.

• Received Honorable Mention Award from the Innovation Management and Human Resource Development Competition 2018 - hosted by the Personnel Management Association of Thailand, Thailand Productivity Institute, and NIDA's Graduate School of Human Resource Development - for developing processes designed to foster specialists operating in power distribution systems by not suspending both international and domestic electricity.

• Received Government Easy Contact Center: GECC Award 2018 as State Enterprise Agency for 166 PEA offices from the Office of Public Sector Development Commission (OPDC).

• Received Public Sector Excellence Award 2018 for Service Development from the Office of Public Sector Development Commission (OPDC).

• Received 39 Honor Plaques for Zero Accident Campaign 2018 (Platinum, Silver, and Bronze Level) from the Safety and Health at Work Promotion Association of Thailand.

• Received 7 Honor Plaques for Official Information Center 2018 from the Office of the Official Information Commission (OIC).





PEA Performance Summary

Organizational profile

Transmission and distribution systems

Transmission system	2016 (circuit-kilometer)	2017 (circuit-kilometer)	2018 (circuit-kilometer)
Transmission system	11,776.37	12,257.68	12,764.57
115 kV	11,758.73 12,240.04		12,746.93
69 kV	17.64 17.65		17.65
High-voltage distribution system	304,450.31	308,988.09	313,424.44
33 kV	27,816.51	28,640.83	29,066.25
22 kV	257,947.12	261,659.07	265,678.70
19 kV	18,686.68	18,688.19	18,679.49
Low-voltage distribution system	453,835.62	462,786.40	472,464.45
Total	770,062.29	784,032.17	798,653.47

Electric power users

Highest amount of electricity distributed	2016 (million units)	2017 (million units)	2018 (million units)
Highest amount of electricity distributed	129,673	132,401	134,661.55
Electric power users [102-6]	2016 (person)	2017 (person)	2018 (person)
Residential sector	16,739,341	17,101,498	17,450,080
Commercial sector	1,595,770	1,667,814	1,699,324
Industrial sector	34,808	35,699	37,370
Others sector	524,000	555,768	579,256
Total	18,893,919	19,360,779	19,766,030



Number of personnel [102-8]

Employees and workers	2016		2017		2018	
Employees (by gender)	Number (person)	%	Number (person)	%	Number (person)	%
Male	22,309	74.10	22,002	73.75	21,862	73.71
Female	7,799	25.90	7,833	26.25	7,797	26.29
Total	30,108	100	29,835	100	29,659	100
Workers (by gender)	Number (person)	%	Number (person)	%	Number (person)	%
Male	3,809	66.06	3,881	66.62	3,915	66.66
Female	1,957	33.94	1,945	33.38	1,958	33,.34
Total	5,766	100	5,826	100	5,873	100
Net total	35,874		35,661		35,532	

Remark : Employees refer to (1) Groups of Directors such as PEA Deputy Governor, Assistant Governor/ Executive Director of PEA Area / Executive Director of Internal Audit Burea/Executive Director of Legal Office/ Executive Director of Office of The Governor, Director of Department / Senior Manager Attached to PEA Area / Manager of PEA Grade 1, Deputy Director of Department, Manager of Division, / Director of Centre, Manager of Electric Vocational School, Manager of PEA Grade 2,3 or those in equivalent positions, Deputy/Assistant Manager of Division, Deputy/Assistant Director of Centre, Deputy/Assistant to Technician School Directors, PEA Deputy Managers Level 1-2, Manager of PEA Branch, Assistant Manager of PEA Grade 3, Chief of Section, Manager of PEA Subbranch, Assistant Chief of Section, (2) Groups of Specialists such as Expert Level 12-13, Professional Officer Level 9-11, Specialists Level 9, Specialists Level, Professional Officer Level 7-8, Specialists Level 8, Technical Officer Level 7, and (3) Operational Staff including Professional Officer/ Technical Officer Level 4-6, Technical Officer Level 2-3

Workers refer to monthly workers, or those contracted to work for employers in order to receive monthly salaries. Their recruitment is based on manpower plans, covering those hired to work for the offices of Governor, Deputy Governor, and Assistant to Governor. They include drivers and maids.



Number of personnel by area [102-8]

		Employees		Workers			
Area	2016 (person)	2017 (person)	2018 (person)	2016 (person)	2017 (person)	2018 (person)	
Head Office	4,137	4,105	4,128	248	249	167	
North	6,099	6,023	5,926	1,211	1,169	1,233	
Northeast	6,980	6,912	6,944	1,350	1,440	1,421	
Central	7,268	7,196	7,103	1,723	1,704	1,752	
South	5,624	5,599	5,558	1,234	1,264	1,300	

Grievance mechanism [103-2]

Customer complaints	2016	2017	2018
Total number of customer complaints	1,966	3,689	4,246
Number of responses to customer complaints within 30 days	1,800	3,666	4,236
Percentage of customer complaints that received responses within 30 days	91.56	99.38	99.76

Performance in the economic dimension

Direct economic value generated and distributed [102-7] [201-1]	2016 (million baht)	2017 (million baht)	2018 (million baht)			
(1) Direct economic value generated						
Revenues	456,707.78	463,747.42	499,253.86			
(2) Direct economic value distributed						
Operating costs	403,130.90	408,119.81	451,684.60			
Employee wages and benefits	24,361.62	24,662.89	23,849.55			
Payments to providers of capital	3,087.61	3,056.45	2,903.44			
Payments to government	13,039.00	13,857.00	13,350.00			
Community investment	234.79	294.54	262.09			
(1) - (2) Economic value retained	12,853.86	13,756.72	7,204.18			



Employee statistics

New employee hire and turnover rates [401-1]

New employee hires				Employee turnovers									
Emp	oloyee criteria and components	20	16	20	17	20	18	20	16	20	17	20	18
		Number (person)	%										
	Numeric changes	2,007	6.67	954	3.20	1,097	3.70	1,051	3.49	1,234	4.14	1,466	4.94
der	Male	1,430	4.75	671	2.25	797	2.69	851	2.83	253	0.85	1,131	3.81
Gen	Female	577	1.92	283	0.95	300	1.01	200	0.66	981	3.29	335	1.13
	Age < 30 years	1,908	6.34	872	2.92	966	3.26	37	0.12	30	0.10	30	0.10
Age	Age 30 - 50 years	99	0.33	82	0.27	131	0.44	56	0.19	50	0.17	51	0.17
	Age > 50 years	0	0.00	0	0.00	0	0.00	958	3.18	1,154	3.87	1,385	4.67
su	Head Office	358	1.20	228	0.76	306	1.03	208	0.69	196	0.66	219	0.74
eratio	North	346	1.19	189	0.63	172	0.58	241	0.80	287	0.96	339	1.14
of ope	Northeast	459	1.52	165	0.55	259	0.87	198	0.66	253	0.85	321	1.08
eas c	Central	458	1.52	188	0.63	198	0.67	214	0.71	266	0.89	326	1.10
Ar	South	386	1.28	184	0.62	162	0.55	190	0.63	232	0.78	261	0.88

Remark : The percentage outlined in the table was calculated in comparison to the total number of employees in each year (total number of employees in 2016, 2017, and 2018 were 30,108 persons, 29,835 persons, and 29,659 persons, respectively.)

Number of employee turnovers by causes of turnovers

Causes of employee turnover	Number of employees (person)
Retirement before 60 years of age	216
Retirement at 60 years of age	1,096
Death	79
Dismissal	6
Resignation	63
Lay-off	4
Discharge or forced resignation	1
Termination of employment	1
Total	1,466

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		Number of employees (person)								
Reasons for taking leave	20	16	20	17	2018					
	Men	Women	Men	Women	Men	Women				
Total number of employees who were entitled to parental leave	22,309	7,799	22,002	7,833	21,862	7,797				
Total number of employees who took parental leave	268	155	355	194	394	202				
Total number of employees who returned to work after parental leave ended	268	155	355	190	373	166				
Total number of employees who returned to work after parental leave ended and who were still employed 12 months after their return to work	208	135	268	155	355	190				
The Return to Work Rate ⁽¹⁾ for employees who returned to work after parental leave ended (%)	100	100	100	98	95	82				
The Retention Rate ⁽²⁾ for employees who returned to work after parental leave ended (%)	99.52	87.66	100	100	100	100				

Return to work and retention rates after parental leave [401-3]

Remark : ⁽¹⁾ Return to Work Rate = (number of employees returning to work after parental leave ended/number of employees, by gender, that used their entitlement for parental leave) × 100

⁽²⁾ Retention Rate = (number of employees who returned to work after parental leave ended and were still employed 12 months after their return to work/number of employees who returned to work after parental leave ended in the previous reporting cycle) × 100

Average hours of employees training [404-1]

Information on employee training	2016	2017	2018	
Average hours of employees training (hrs./person/year)	36.16	40.89	20.28	
Number of employees who received training, by gender (hrs./person/year)				
Male	n/a	n/a	23.06	
Female	n/a	n/a	11.74	



Number of employees who received training per year

Information on employee training	2016	2017	2018		
Number of employees who received training, by gender (person/year)					
Male	n/a	18,048	35,312		
Female	n/a	4,782	10,637		
Number of employees who received training, by position level (pers	son/year)				
Management level	n/a	4,835	2,142		
Expert level	n/a	3,163	7,143		
Operation level	n/a	14,832	38,742		

Employees training and education courses for 2018 [404-2]

PEA employees training and education courses						
Executive management development courses	Managerial courses	Engineering courses				
 Executive education program Smart manager Pre-management course 	 Logistics & supply chain Corporate governance for PEA sustainability Negotiation techniques 	 Electrical engineering Electric power systems planning Unmanned substation management Cyber security for SCADA system and network Connecting high-voltage power lines (22-33 kV) using hot stick technique 				
Foreign language courses	Other courses	Special training courses				
 English camp for ASEAN Economic Community (AEC) Burmese/Chinese languages 	 Safety officers at the supervisory level for Hotline operations 					

Occupational health and safety

Rates of injury, occupational diseases, and lost days and work-related fatalities due to employee operations [403-2]

Type of injury, occupational disease, lost days and work-related fatalities		Number of reported case (person)	Number of lost day (day)
Injuries			
• Injury	Head Office	-	-
	North	2	244
	Northeast	2	116
	Central	9	933
	South	2	163
• Disability	Head Office	-	-
	North	-	-
	Northeast	-	-
	Central	-	-
	South	-	-
Fatalities			
• Work-related fatalities	Head Office	-	-
	North	-	-
	Northeast	-	-
	Central	1	6,000
	South	2	12,000

Remark : - Injury refers to damages to body parts resulting from force or external factors whether physical or chemical, and can be intentional or unintentional, but do not ultimately cause disabilities.

- Disability refers to losses of organs or the capacity of organs or body, or even mental balance resulting in an inability to work.

				Area			
Information	Unit	Head Office	North	Northeast	Central	South	Total
Injury Rate (IR)	Number of people per 200,000 working hours	0.00	0.04	0.03	0.15	0.04	0.06

Remark : The figure was calculated by referring to the International Labour Organization (ILO)'s standard, ILO-OSH 2001, whereby "day" refers to calendar days, and lost days are counted starting from the day after the accident onwards.



Rates of injury,	occupational	diseases, lo	ost days and	work-related	fatalities d	lue to worker	operations	[403-2]
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Type of injury, occupational disease, lost days and work-related fatalities		Number of reported case (person)	Number of lost day (day)			
Injuries						
• Injury	Head Office	-	-			
	North	2	192			
	Northeast	1	25			
	Central	6	3,056			
	South	3	303			
• Disability	Head Office	-	-			
	North	-	-			
	Northeast	-	-			
	Central	-	-			
	South	-	-			
Fatalities						
• Work-related fatalities	Head Office	-	-			
	North	-	-			
	Northeast	-	-			
	Central	-	-			
	South	1	6,000			

Remark : - Injury refers to damages to body parts resulting from force or external factors whether physical or chemical, and can be intentional or unintentional, but do not ultimately cause disabilities.

⁻ **Disability** refers to losses of organs or the capacity of organs or body, or even mental balance resulting in an inability to work.

				Area			
Information	Unit	Head Office	North	Northeast	Central	South	Total
Injury Rate: IR	Number of people per 200,000 working hours	0.00	0.18	0.00	0.00	0.25	0.10

Remark : The figure was calculated by referring to the International Labour Organization (ILO)'s standard, ILO-OSH 2001, whereby "day" refers to calendar days, and lost days are counted starting from the day after the accident onwards.

Amount of electricity and fuel consumption within the organization [302-1]

In 2018, PEA consumed 119,246,722 kWh/year of electricity (429,288.20 GJ/year), and 20,442,645 liters of fuel (744,521.13 GJ/year), which accounted for a total of 1,173,809.33 GJ/year of electricity and fuel consumption within the organization.

Information		2016	2017	2018	
Amount of electricity consumption		Unit (Kilowatt-hour : kWh)			
Head Office	Target	-	12,756,314	13,199,219	
	Result	13,746,028	13,893,915	13,754,825	
North	Target	-	23,364,437	22,838,491	
	Result	25,177,195	24,040,517	24,275,287	
Northeast	Target	-	23,890,330	23,731,286	
	Result	25,743,890	24,980,302	24,725,354	
Central	Target	-	32,804,829	32,783,698	
	Result	35,350,031	34,509,155	34,696,352	
South	Target	-	21,646,531	20,914,779	
	Result	23,326,003	22,015,557	21,800,903	
Total	Target	-	114,462,441	113,467,473	
Total	Result	123,343,148	119,439,445	119,246,722	
Amount of fuel consumption		Unit (Liter)			
Head Office	Target	-	1,235,541	1,255,077	
	Result	1,287,022	1,321,134	1,264,998	
North	Target	-	4,226,295	4,209,499	
	Result	4,402,368	4,431,051	4,564,309	
Northeast	Target	-	5,056,503	4,758,316	
	Result	5,267,476	5,008,753	4,719,016	
Central	Target	-	4,763,732	4,848,414	
	Result	4,962,221	5,103,593	5,171,361	
South	Target	_	4,494,902	4,514,903	
	Result	4,682,191	4,752,530	4,722,961	
Total	Target	-	19,776,973	19,586,209	
, otat	Result	20,601,280	20,617,062	20,442,645	

Remark : - 1 kilowatt-hour (kWh) is equivalent to 0.00360 gigajoule (GJ) and 1 liter of fuel is equivalent to 0.03642 GJ. The information is obtained from the Department of Alternative Energy Development and Efficiency, Ministry of Energy.

- The amount of fuel outlined in the table is the total combined amount of benzene fuel and diesel fuel. The data have not been divided into category; however, they reveal the proportion in which diesel fuel was used more than benzene fuel with significant implications. Therefore, a diesel fuel converter was used to calculate the amount of energy used.



Amount of electricity consumption conserved by changing to LED bulbs [302-4]

Building opted for LED bulbs	Amount of electricity consumption conserved (kWh/year)						
	2013	2014	2015	2016	2017	2018	
LED Building	230,000	230,000	230,000	230,000	230,000	230,000	
Buildings 1, 2, 3 and others	_	802,148	802,148	802,148	802,148	802,148	
12 area offices service buildings	_	3,864,000	3,864,000	3,864,000	3,864,000	3,864,000	
Rangsit warehouse	_	_	-	48,162	48,162	48,162	
Buildings under 12 area offices	-	_	-	4,427,270	4,427,270	4,427,270	
Total	230,000	4,896,148	4,896,148	9,371,580	9,371,580	9,371,580	

Remark : The amount of electricity conserved (kilowatt-hour per year : kWh/year) = The number of LED bulbs installed × the amount of electricity conserved per bulb (kilowatt : kW) × 8 hours used × 250 days per year

PEA's amount of greenhouse gas emissions By activity

Type of activity	Unit	2018 total
(Scope 1) Direct greenhouse gas emissions [305-1]		
PEA stationary fuel combustion	tCO ₂ e/year	32,515.52
PEA mobile fuel combustion source	tCO ₂ e/year	51,937.45
Spill of SF ₆	tCO ₂ e/year	23,388.48
Spill of HFCs and PFCs	tCO ₂ e/year	84.27
Total amount of scope 1 greenhouse gas emissions	tCO ₂ e/year	107,925.72
(Scope 2) Indirect greenhouse gas emissions [305-2]		
PEA's electricity consumption	tCO ₂ e/year	68,917.00
PEA's electricity transmission and distribution losses	tCO ₂ e/year	4,382,393.12
Total amount of Scope 2 greenhouse gas emissions	tCO ₂ e/year	4,451,310.12
Total greenhouse gas emissions in all scopes	tCO ₂ e/year	4,559,235.84

By gas type [305-1] [305-2]

Type of gas	Unit	2018 total
CO ₂	tCO ₂ e/year	4,313,389.94
CH ₄	tCH₄/year	3.55
N ₂ O	tN ₂ O/year	0.71
SF ₆	tSF ₆ /year	0.00
HFCs	tCO ₂ e/year	84.27
PFCs	tCO ₂ e/year	0.00
Total amount of greenhouse gas	tCO ₂ e/year	4,559,235.84

- Remark : 2017 is set as a base year as it was the start of complete data collection from different PEA sectors. The amount of greenhouse gas emissions of Scope 1 and Scope 2 accounted for 98,586.42 tCO_e/year and 4,229,812.08 tCO_e/year, respectively.
 - Global Warming Potential (GWP) is calculated based on a 100-year timeframe by referring to IPCC Fourth Assessment Report -Climate Change 2007.
 - The presented values of greenhouse gas emissions exclude those of PEA's affiliates.

By area [305-1] [305-2]

Area	Unit	Yearly total
North		
PEA Area 1, Chiang Mai province	tCO ₂ e/year	293,043.83
PEA Area 2, Phitsanulok province	tCO ₂ e/year	275,472.34
PEA Area 3, Lop Buri province	tCO ₂ e/year	313,896.40
Northeast		
PEA Area 1, Udon Thani province	tCO ₂ e/year	322,782.75
PEA Area 2, Ubon Ratchathani province	tCO ₂ e/year	288,715.48
PEA Area 3, Nakhon Ratchasima province	tCO ₂ e/year	325,228.01



Area	Unit	Yearly total
Central		
PEA Area 1, Phra Nakhon Si Ayutthaya province	tCO ₂ e/year	565,517.28
PEA Area 2, Chon Buri province	tCO ₂ e/year	635,967.40
PEA Area 3, Nakhon Pathom province	tCO ₂ e/year	510,434.23
South		
PEA Area 1, Phetchaburi province	tCO ₂ e/year	329,507.23
PEA Area 2, Nakhon Si Thammarat province	tCO ₂ e/year	441,983.69
PEA Area 3, Yala province	tCO ₂ e/year	245,255.79
PEA Head Office	tCO ₂ e/year	11,431.41
Total amount of greenhouse gas	tCO ₂ e/year	4,559,235.84

PEA's amount of greenhouse gas reduction [305-5]

Type of activity	Unit	2018 total
Power generation from renewable energy	tCO ₂ e/year	29,759.35
Consumption of diesel fuel mixed with biodiesel	tCO ₂ e/year	3,404.84
The projects to promote greenhouse gas emission reduction	tCO ₂ e/year	10,180,051.36
Total amount of greenhouse gas reduction	tCO ₂ e/year	10,213,215.55

- Remark : 2017 is set as a base year as it was the start of complete data collection from different PEA sectors. The total reduction amount of greenhouse gas emissions accounted for 5,164,417.52 tCO₂e/year compared with the base year, 2017.
 - Global Warming Potential (GWP) is calculated based on a 100-year timeframe by referring to IPCC Fourth Assessment Report -Climate Change 2007.
 - The presented values of greenhouse gas emissions exclude those of PEA's affiliates.

Power generation from renewable energy PEA has determined the responsibility of the Production System Division to cover production planning and electric generator running operations to ensure efficiency, quality, safety standards, and eco-friendliness. The Division is also in charge of studying and appropriately adopting modern technologies and technical knowledge to develop power generation systems, and operations and innovations management continuously. PEA generated electric power from hydro power, solar energy, and wind energy at the amount of 52,541,226 kWh, 450 kWh, and 63,825,810 kWh, respectively, resulting in greenhouse gas reduction of 29,759.35 tCO₂e/year. <u>Consumption of diesel fuel mixed with biodiesel</u> such consumption was derived from a total diesel fuel of 20,618,395.95 liters/year according to the Government Gazette and the Notification of the Department of Energy Business on Prescription of Properties and Quality of Diesel Fuel (No. 11), B.E. 2561, which stated that fuel must have a combination of biodiesel of not less than 6.6% and not over 7%. Thus, the amount of greenhouse gas reduction from biodiesel components accounted for 3,404.84 tCO₂e/year.

<u>The projects to promote greenhouse gas emission reduction</u> They are projects or activities supported by PEA in order to reduce emissions of greenhouse gas. Among them, reduction supported within the organization and outside the organization accounted for 1,113.59 tCO₂e/year and 10,178,937.77 tCO₂e/year, respectively.

Amount of effluents and hazardous waste generated by electric power systems and office buildings [306-2]

Disposal method	Deteriorating meters	Unit	Deteriorating transformers	Unit	Infectious waste from medical clinics	Unit
Recycle	-		-		-	
Reuse	3,686	Meters	34,000	Liters	-	
Landfill	-		-		-	
Other	39,810	Kilograms	-		1,325	Kilograms

Remark : Other disposal methods refer to sending effluents to external agencies or recipients who can dispose of waste properly in accordance with the law.

In 2018, PEA's electricity consumption rate/person was 3,362.59 units/person/year, with an increase of 0.40% from 2017, and its fuel consumption rate/person was 575.33 liters/person/year, with a decrease of 0.49% from 2017 as PEA adopted the video conferencing system for organizing meetings so as to reduce executives' and employees' time spent and expenses on traveling to the Head Office to attend meetings.

Information	2017	2018
Amount of electricity consumption per person (kWh/person/year)	3,349.30	3,362.59
Amount of fuel consumption per person (liter/person/year)	578.14	575.33

Remark : The number of PEA personnel in 2017 and 2018 were 35,661 persons and 35,532 persons, respectively.



Performance in the electric utilities dimension

Demand side management plan [EU7]

DSM workplan	Type of project	Project	Project duration	Operating results
PEA	Measurement & verification of energy conservation	1. Building Energy Management System (BEMS)	2017-2020	It is under operation plan and expected to be completed within the set timeframe.
		2. Unmanned substation energy management project	2017-2018	It was completed as planned and within the set timeframe.
	Chiller	3. Centrifugal chiller optimization project in PEA offices and SCADA buildings	2017-2020	It was completed as planned before the set timeframe.
		4. Centrifugal chiller optimization project at PEA Headquarters	2017-2019	It was completed as planned before the set timeframe.
	Solar rooftop	5. Project to install the solar rooftop system at PEA offices	2017-2020	 For PEA Head office, the project was completed before the set timeframe. For PEA area offices, the project is under operations according to the plan and expected to be completed within the set timeframe.
	Green building	6. Project to renovate Building 1, Building 2 and PEA Head office building connecting corridor to achieve LEED Gold certification	2017-2020	It is under operation plan and expected to be completed within the set timeframe.
	CSR	7. PEA LED project for cultural tourism destinations	2017-2019	It is under operation plan and expected to be completed within the set timeframe.
	Financing research	8. PEA Electric Vehicle (EV) Charging Station and EV Charging network management (Suvarnabhumi - Pattaya route) pilot project	2017	It was completed as planned and within the set timeframe.

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DSM workplan	Type of project	Project	Project duration	Operating results
	Small-scale electricity consumers (residential users and small businesses)	9. Project on energy management advisory support for commercial buildings	2017-2020	There was MOU signing with PTT Public Company Limited and it is expected to be completed within the set timeframe.
		10. Pilot project to promote energy conservation among residential users	2017-2019	It has been financed by JYURI, Japan, and is expected to be completed within the set timeframe.
PEA customers	Large-scale electricity consumers (industrial users)	11. Project on energy management advisory support for the industrial sector	2017-2020	It is under operation plan and expected to be completed within the set timeframe.
	Government offices	12. Project on management for energy conservation in universities and government offices	2017-2020	It is under operation plan and expected to be completed within the set timeframe, with the participating entities as follows: - Ramkhamhaeng University - Provincial Waterworks Authority - Walailak University - Mae Fah Luang University
Street and public lighting	Replacing parts and equipment	13. Integrated high-efficiency street lights energy conservation system	2017-2018	It is under operation plan and is delayed from the set timeframe due to the update of the government procurement process, which undered the Comptroller General's Department, Ministry of Finance.



Forecast of demands for electric power [EU10]

Year	Peak demand (MW)	Purchased/ generated unit (million unit)	Sold unit (million unit)	Number of electric power users (person)
2018	20,677.00	142,700.00	131,935.00	19,525,475
2022	23,808.00	163,818.00	151,347.00	21,152,162
Margin	3,131.00	21,118.00	19,412.00	1,626,687
Average increase rate per year	4.60	3.32	3.12	2.04

Forecast of number of electric power users categorized by user type

Data	Existing values		Forecasted values (user)			
Data	2018	2019	2020	2021	2022	
Residences	17,450,482	17,787,213	18,123,517	18,455,936	18,797,466	
Increase/(Decrease) percentage	2.04	1.93	1.89	1.83	1.85	
Small businesses	1,639,386	1,675,591	1,720,955	1,781,319	1,834,684	
Increase/(Decrease) percentage	1.82	2.21	2.71	3.51	3.00	
Medium businesses	77,285	80,844	84,276	87,973	90,860	
Increase/(Decrease) percentage	4.06	4.61	4.25	4.39	3.28	
Large businesses	6,898	7,136	7,435	7,704	7,984	
Increase/(Decrease) percentage	3.08	3.45	4.19	3.62	3.63	
Specific businesses	12,896	13,261	13,726	14,108	14,485	
Increase/(Decrease) percentage	2.92	2.83	3.51	2.78	2.67	
Non-profit organizations	1,131	1,155	1,181	1,205	1,231	
Increase/(Decrease) percentage	-13.33	2.12	2.25	2.03	2.16	
Water pumps for agriculture	5,484	5,784	6,005	6,265	6,527	
Increase/(Decrease) percentage	8.68	5.47	3.82	4.33	4.18	
Temporary electric power	331,913	347,666	368,419	383,372	398,925	
Increase/(Decrease) percentage	6.14	4.75	5.97	4.06	4.06	
Total	19,525,475	19,918,650	20,325,514	20,737,882	21,152,162	
Increase/(Decrease) percentage	2.10	2.01	2.04	2.03	2.00	

Remark : The forecast of all electric power users does not include free user types such as street and public lights.

Forecast of power units sold categorized by user type [EU10]

Data	Existing values	visting values Forecasted values (Gigawatt-hour: GWh)			
Data	2018	2019	2020	2021	2022
Residences	32,078	33,658	35,086	36,499	37,908
Increase/(Decrease) percentage	2.38	4.93	4.24	4.03	3.86
Small businesses	13,347	14,023	14,711	15,432	16,175
Increase/(Decrease) percentage	2.40	5.06	4.91	4.90	4.82
Medium businesses	21,756	22,752	23,804	24,918	26,050
Increase/(Decrease) percentage	2.83	4.58	4.63	4.68	4.54
Large businesses	59,067	60,550	61,765	63,019	64,380
Increase/(Decrease) percentage	0.57	2.51	2.01	2.03	2.16
Specific businesses	4,309	4,415	4,597	4,780	4,922
Increase/(Decrease) percentage	3.01	2.46	4.12	3.98	2.97
Non-profit organizations	71	74	83	92	102
Increase/(Decrease) percentage	6.43	4.75	12.02	11.10	10.32
Water pumps for agriculture	365	355	371	388	404
Increase/(Decrease) percentage	22.39	-2.69	4.55	4.36	4.18
Temporary electric power	942	1,073	1,187	1,294	1,406
Increase/(Decrease) percentage	-3.57	13.94	10.59	9.00	8.69
Total (Excluding free electric power)	131,935	136,900	141,604	146,421	151,347
Increase/(Decrease) percentage	1.66	3.76	3.44	3.40	3.36
Free electric power	2,739	2,907	3,128	3,365	3,621
Increase/(Decrease) percentage	4.63	6.13	7.59	7.59	7.59





Forecast of power units purchased [EU10]

Data	Existing values	values Forecasted values			
Dala	2018	2019	2020	2021	2022
Purchased quantities from EGAT					
Electric energy (GWh)	132,387	136,822	142,027	147,370	152,846
Maximum electric power (MW)	n/a	20,651	21,426	22,217	23,025
Purchased quantities from the					
Department of Alternative Energy					
Department and Efficiency					
Electric energy (GWh)	112	112	112	112	112
Maximum electric power (MW)	n/a	7	7	7	7
Quantities generated by PEA					
Electric energy (GWh)	105	105	105	105	105
Maximum electric power (MW)	n/a	7	7	7	7
Purchased quantities from VSPPs					
Electric energy (GWh)	10,096	10,755	10,755	10,755	10,755
Maximum electric power (MW)	n/a	1,963	1,963	1,963	1,963
Total					
Electric energy (GWh)	142,700	147,794	152,999	158,342	163,818
Increase/(Decrease) percentage	2.27	3.86	3.52	3.49	3.46
Maximum (MW)	20,677	21,434	22,209	23,000	23,808
Increase/(Decrease) percentage	2.24	10.06	3.62	3.56	3.51





PEA power losses between 2016-2018 [EU12]

Power loss	Percentage of power losses in the transmission and distribution systems				
	2016	2017	2018		
Total target loss	5.36	5.40	5.18		
Total loss	5.40	5.12	5.36		

Remark : - Most technical losses are caused by high-voltage distribution lines, power distribution transformers, low-voltage distribution lines, and connectors.

- Non-technical losses are calculated by the total units lost in the distribution system, minus the technical losses. These usually result from inaccuracy of electricity measurement tools, incomplete installation of electric meters, as well as incomplete utility billing or illegal uses of electricity.
- Loss refers to power losses that occur in the transmission and distribution of electricity. It is the difference between the net energy which the transmission system receives from power producers, and the electricity load that the distribution system delivers to the users.

Business continuity management

Organizations with the BCMS system in accordance with the ISO 22301 standards [EU21]	2016 (organization)	2017 (organization)	2018 (organization)
Practice of Incident Management Plan (IMP)	199	199	202
Preparation of Business Continuity Plan (BCP)	199	199	202

Operation duration	Time spent (minute)
Time spent on practicing IMP/BCP in case of natural disasters, terrorism/terrorist attacks/ and chemical spill	180
Time spent on practicing IMP/BCP in case of riots and office blockade, epidemics, employees' inability to provide services, and office building fires	120
Recovery Time Objective (RTO) of the information technology system	45
Recovery Point Objective (RPO) of the information technology system	0



Access to electricity [EU23]

Details	2017* Number (household)	2018** Number (household)
Total households in Thailand	21,513,363	21,885,053
Households with access to electricity	21,464,395	21,834,757
- Access by pole installation and conductor stringing	21,400,658	21,772,856
- Access by solar cell systems installation	62,244	59,925
 Others (Electric power from other organizations, such as military areas, Petroleum Authority of Thailand, Department of Alternative Energy Development and Efficiency, Royal Irrigation Department, private power, project cancellation due to population migration) 	1,493	1,976
Households without access to electricity	48,968	50,296
- Households in regular areas waiting to join the project	22,296	23,559
- Households in restricted areas, but with entry permission from the agencies governing the areas	771	436
- Households in restricted areas, such as areas with protected forests, national parks, military areas, which need permission from relevant agencies.	25,453	25,794
- The electrification project not carried out due to failure to meet the PEA criteria.	448	507

Remark : * Data from the Technology Administration and Development on Registration Division, Bureau of Registration Administration, Department of Provincial Administration as of December 2017

** Data from the Technology Administration and Development on Registration Division, Bureau of Registration Administration, Department of Provincial Administration as of December 2018

Index of electrical system stability (SAIFI & SAIDI) [EU28] [EU29]

Data	SAIFI*(times/household/year)			SAIDI**(minutes/household/year)			
Duta	2016	2017	2018	2016	2017	2018	
Nationwide	5.17	4.50	3.81	153.13	118.70	89.82	
12 major cities: Chiang Mai, Phitsanulok, Lop Buri, Khon Kaen, Ubon Ratchathani, Nakhon Ratchasima, Rangsit, Pattaya City, Samut Sakhon, Hua Hin, Phuket, and Hat Yai	1.568	1.232	1.174	21.182	16.528	14.853	

Remark : *SAIFI (System Average Interruption Frequency Index) (times/household/year) is the rate of how many times electrical service was interrupted.

**SAIDI (System Average Interruption Duration Index) (minutes/household/year) is the rate of how long electricity interruptions lasted.

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GRI Content Index [102-55]





Service

"For the SDG Mapping Service, GRI Services reviewed that the disclosures included in the content index are appropriately mapped against the SDGs"

		Page number(s) And/or URL(s)	Omission			SDG
GRI Standard	Disclosure		Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
GRI 101: Foundation	2016					
General Disclosures						
GRI 102:	102-1 Name of the organization	6				
General	102-2 Activities, brands, products,	6				
Disclosures 2016	and services					
	102-3 Location of headquarters	7				
	102-4 Location of operations	6, 7				
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	102-18 Governance structure	8				
	102-19 Delegating authority	42				
	102-26 Role of highest governance	42				
	body in setting purpose,					
	values, and strategy					

EU - Specific Information Disclosure of Electric Utilities Sector according to GRI (G4)



				SDG				
GRI Standard	Disclosure	Page number(s) And/or URL(s) O	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure		
	102-40 List of stakeholder groups	10						
	102-41 Collective bargaining	95				SDG 8		
	agreements							
	102-42 Identifying and selecting	10						
	stakeholders							
	102-43 Approach to stakeholder	10-15, 92						
	engagement							
	102-44 Key topics and concerns raised	10-15						
	102-45 Entities included in the	6, 17						
	consolidated financial							
	statements							
	102-46 Defining report content and	18, 20						
	topic boundaries							
	102-47 List of material topics	16, 18, 20						
	102-48 Restatements of information	17						
	102-49 Changes in reporting	16						
	102-50 Reporting period	17						
	102-51 Date of most recent report	17						
	102-52 Reporting cycle	17						
	102-53 Contact point for questions	17						
	regarding the report							
	102-54 Claims of reporting in	17						
	accordance with the GRI							
	Standards							
	102-55 GRI content index	140-152						
	102-56 External assurance	17						
Material Topics								
Economic Performar	nce							
GRI 103:	103-1 Explanation of the material	18						
Management	topic and its boundary							
Approach	103-2 The management approach	43, 45-47, 49-51						
2016	and its components	90-91, 122						
	103-3 Evaluation of the management	45-48, 51, 90-91			1			
	approach							

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				Omission			SDG
GRI Standard	Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure	
GRI 201:	201-1	Direct economic value	122				SDG 2, SDG 5,
Economic		generated and distributed					SDG 7, SDG 8,
Performance							SDG 9
2016							
	201-3	Defined benefit plan obligations	101				
		and other retirement plans					
Energy							
GRI 103:	103-1	Explanation of the material	20, 110				
Management		topic and its boundary					
Approach	103-2	The management approach	45-46, 90-91,				
2016		and its components	110-112, 114, 122				
	103-3	Evaluation of the management	45-46, 90-91,				
		approach	110-112, 114				
GRI 302:	302-1	Energy consumption within	128				SDG 7, SDG 8,
Energy		the organization					SDG 12,
2016							SDG 13
	302-4	Reduction of energy	129				SDG 7, SDG 8,
		consumption					SDG 12,
							SDG 13
Emissions							
GRI 103:	103-1	Explanation of the material	20, 106, 110				
Management		topic and its boundary					
Approach	103-2	The management approach	45-46, 90-91,				
2016		and its components	106-108, 110-113,				
			122				
	103-3	Evaluation of the management	45-46, 90-91,				
		approach	106-108, 110-113				
GRI 305:	305-1	Direct (Scope 1) GHG emissions	129-130	Gases	Information	Improving	SDG 3,
Emissions 2016				included	unavailable	the data	SDG 12,
				in the		collection	SDG 13,
				calculation;		The complete	SDG 14,
				CH NO		disclosure of	SDG 15,
				HFCs. PFCs.		information	
				SF, NF, or		will report	
				6′3′- all.		on the next	
						reporting	
						period.	

EU - Specific Information Disclosure of Electric Utilities Sector according to GRI (G4)


				Omission		SDG
GRI Standard	Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
	305-2 Energy indirect (Scope 2)	129-130	Gross	Information	Improving	SDG 3,
	GHG emissions		location-	unavailable	the data	SDG 12,
			based energy		collection	SDG 13,
			indirect		process.	SDG 14,
			(Scope 2)		The complete	SDG 15,
			GHG		disclosure of	
			emissions		information	
			in metric		will report	
			tons of $\rm CO_{_2}$		on the next	
			equivalent		reporting	
					period.	
			gross market-			
			based energy			
			indirect			
			(Scope2)			
			GHG			
			emissions			
			in metric			
			tons of CO ₂			
			equivalent			
			Gases			
			included			
			in the			
			calculation;			
			whether CO ₂ ,			
			CH ₄ , N ₂ O,			
			HFCs, PFCs,			
			SF ₆ , NF ₃ , or			
			all.			
	305-5 Reduction of GHG emissions	131	Gases	Information	Improving	SDG 13,
			included	unavailable	the data	SDG 14,
			in the		collection	SDG 15,
			calculation;		process.	
			whether $CO_{_2}$,		The complete	
			CH ₄ , N ₂ O,		disclosure of	
			HFCs, PFCs,		information	
			$SF_{6}^{}, NF_{3}^{}, or$		will report	
			all.		on the next	
					reporting	
					period.	



					Omission		SDG
GRI Standard		Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
Effluents and Waste							
GRI 103:	103-1	Explanation of the material	20, 106, 114				
Management		topic and its boundary					
Approach	103-2	The management approach	45-46, 90-91,				
2016		and its components	106-108, 110-112,				
			114-116, 122				
	103-3	Evaluation of the management	45-46, 90-91,				
		approach	106-108, 110-112,				
			114-116				
GRI 306:	306-2	Waste by type and disposal	132	Total weight	Information	Improving	SDG 3, SDG 6,
Effluents and		method		of non-	unavailable	the data	SDG 12,
Waste 2016				hazardous		collection	
				waste, with a		process.	
				breakdown by		The	
				the following		complete	
				disposal		disclosure of	
				methods		information	
						will report	
						on the next	
						reporting	
						period.	
Environmental Com	pliance	2					
GRI 103:	103-1	Explanation of the material	20, 106				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	45-46, 90-91,				
		and its components	106-109, 122				
	103-3	Evaluation of the management	45-46, 90-91,				
		approach	106-109				
GRI 307:	307-1	Non-compliance with	109				SDG 16
Environmental		environmental laws and					
Compliance 2016		regulations					



					Omission		SDG
GRI Standard		Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
Employment							
GRI 103:	103-1	Explanation of the material	18, 93				
Management		topic and its boundary					
Approach 2016	103-2	The management approach and	45-46, 48-50,				
		its components	90-91, 94-96,				
			122				
	103-3	Evaluation of the management	45-46, 48-50,				
		approach	90-91, 94-96				
GRI 401:	401-1	New employee hires and	123				SDG 5, SDG 8
Employment 2016		employee turnover					
	401-2	Benefits provided to	95-96				SDG 8
	full-time employees that are						
		not provided to temporary or					
		part-time employees					
	401-3	Parental leave	124				SDG 5, SDG 8
Occupational Health	n and S	afety	4.0		ľ	1	
GRI 103:	103-1	Explanation of the material	18				
Management	102.0		45 46 00 01 02				
Approach 2016	103-2	The management approach	45-46, 90-91, 93				
	100.0	and its components	122				
	103-3	Evaluation of the management	45-46, 90-91, 93				
	100.4	approach	00	1			
GRI 403:	403-1	Workers representation in	93				SDG 8
Occupational		rormal joint management-					
Health and Safety		worker health and safety					
2016		committees					



			Omission			SDG	
GRI Standard		Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
	403-2	Type of injury and rates of	126-127	Injury rate	Information	Improving	SDG 3, SDG 8
		injury, occupational diseases,		(IR), for all	unavailable	the data	
		lost days, and absenteeism,		employees		collection	
		and number of work-related		and workers,		process.	
		fatalities		with a break		The	
				down by		complete	
				gender		disclosure of	
						information	
				Occupational		will report	
				diseases		on the next	
				rate (ODR),		reporting	
				lost day rate		period.	
				(LDR) and			
				absentee			
				rate (AR),			
				for all			
				employees,			
				with a break			
				down by			
				region and			
				gender			
	403-3	Workers with high incidence or	93				SDG 3, SDG 8
		high risk of diseases related to					
		their occupation					
Training and Educat	ion		1	1			
GRI 103:	103-1	Explanation of the material	18				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	45-46, 48-50,				
		and its components	90-91, 98-101,				
			122				
	103-3	Evaluation of the management	48-50, 90-91,				
		approach	98-101				



					Omission		SDG
GRI Standard		Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
GRI 404:	404-1	Average hours of training per	124	Average	information	Improving	SDG 4, SDG 5,
Training and		year per employee		hours of	unavailable	the data	SDG 8
Education 2016				training		collection	
				that the		process.	1
				organization's		The	
				employees		complete	
				have		disclosure of	
				undertaken		information	
				during the		will report	
				reporting		on the next	
				period, by		reporting	
				employee		period.	
				category.			
	404-2	Programs for upgrading	101, 125				SDG 8
		employee skills and transition					
		assistance programs					
	404-3	Percentage of employees	101				SDG 5, SDG 8
		receiving regular performance					
		and career development					
		reviews					
Non-discrimination							-
GRI 103:	103-1	Explanation of the material	18				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	45-46, 90-91, 97,				
		and its components	122				
			www.pea.co.th/				
			เกี่ยวกับเรา/				
			การกำกับดูแล				
			กิจการที่ดี				
	103-3	Evaluation of the management	45-46, 90-91, 97				
		approach					

					Omission		SDG
GRI Standard		Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
GRI 406:	406-1	Incident of discrimination and	97				SDG 5, SDG 8,
Non-discrimination		corrective actions taken					SDG 16
2016							
Local Communities							
GRI 103:	103-1	Explanation of the material	18, 102				
Management		topic and its boundary					
Approach 2016	103-2	The management approach and	45-46, 90-91,				
		its components	102, 122				
	103-3	Evaluation of the management	45-46, 90-91,				
		approach	102				
GRI 413:	413-1	Operations with local	102-103				
Local Communities		community engagement, impact					
2016	assessments, and development						
		programs					
Customer Health an	d Safe	ty					
GRI 103:	103-1	Explanation of the material	18				
Management		topic and its boundary					
Approach 2016	103-2	The management approach and	45-46, 90-92,				
		its components	122				
	103-3	Evaluation of the management	45-46, 90-92				
		approach					
GRI 416:	416-1	Assessment of the health and	92				
Customer Health		safety impacts of product and					
and Safety 2016		service categories					
Customer Privacy	1						
GRI 103:	103-1	Explanation of the material	18, 88				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	44, 89-91,122				
		and its components					
	103-3	Evaluation of the management	44, 89-91				
		approach					



					Omission		SDG
GRI Standard		Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
GRI 418:	418-1	Substantiated complaints	89				SDG 16
Customer Privacy		concerning breaches of					
2016		customer privacy and losses					
		of customer data					
Availability and Reli	ability		1	l		1	
GRI 103:	103-1	Explanation of the material	20				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	46-47, 54-55,				
		and its components	90-91, 122				
	103-3	Evaluation of the management	46-47, 54-55,				
		approach	90-91				
Electric Utilities	EU6	Management approach to	54				
		ensure short and long-term					
		electricity availability and					
		reliability					
	EU10	Planned capacity against	66-67, 135-137				SDG 7
		projected electricity demand					
		over the long term, broken					
		down by energy source and					
		regulatory regime					
Demand-Side Manag	gement	t	1				
GRI 103:	103-1	Explanation of the material	20				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	46-47, 64-66,				
		and its components	90-91, 122				
	103-3	Evaluation of the management	46-47, 64-66,				
		approach	90-91			,	
Electric Utilities	EU7	Demand-side management	64, 133				
		programs including residential,					
		commercial, institutional and					
		industrial programs					

					Omission		SDG
GRI Standard		Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
Research and Devel	.opmen	t					
GRI 103:	103-1	Explanation of the material	20				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	48-50, 68-72,				
		and its components	74-75, 90-91, 122				
	103-3	Evaluation of the management	48-50, 68-72,				
		approach	74-75, 90-91				
Electric Utilities	EU8 Research and development		68				
		activity and expenditure aimed					
		at providing reliable electricity					
		and promoting sustainable					
		development					
System Efficiency							
GRI 103:	103-1	Explanation of the material	20				
Management		topic and its boundary					
Approach 2016	103-2	The management approach	46-47, 68,				
		and its components	90-91, 122				
	103-3	Evaluation of the management	46-47, 68,				
		approach	90-91				
Electric Utilities	EU12	Transmission and distribution	68, 138				SDG 7, SDG 8
		losses as a percentage of total					SDG 12,
		energy					SDG 13,
							SDG 14



				Omission		SDG
GRI Standard	Disclosure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
Disaster/Emergency	Planning and Response	_				
GRI 103:	103-1 Explanation of the material	20, 37				
Management	topic and its boundary					
Approach 2016	103-2 The management approach ar	d 37-39, 90-91,				
	its components	122				
	103-3 Evaluation of the management approach	37-39, 90-91				
Electric Utilities	EU21 Contingency planning	37, 138				
	measures, disaster/emergency					
	management plan and training	https://				
	programs, and recovery/	www.pea.co.th/				
	restoration plans	en/About-PEA/				
		Business-				
		Continuity-				
		Management				
Access						
GRI 103:	103-1 Explanation of the material	20				
Management	topic and its boundary					
Approach 2016	103-2 The management approach	46-47, 64,				
	and its components	90-91, 122				
	103-3 Evaluation of the management	46-47, 64,				
	approach	90-91				
Electric Utilities	EU23 Programs, including those in	64, 139				
	partnership with government,					
	to improve or maintain access					
	to electricity and customer					
	support services					
	EU28 Power outage frequency	139				SDG 1,
						SDG 7
	EU29 Average power outage duration	139				SDG 1,
						SDG 7

GRI Standard				Omission	SDG		
	Disc	losure	Page number(s) And/or URL(s)	Identified for Omission(s)	Reason(s) for Omission(s)	Explanation for Omission(s)	linkage to Disclosure
Provision of Informa	ion						
GRI 103:	103-1 Explanation	of the material	18				
Management	topic and its	s boundary					1
Approach 2016	103-2 The manage	ement approach	44, 90-92, 122				
	and its com	ponents					
	103-3 Evaluation of the management		44, 90-92				
	approach						







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Sustainability Report 2018 Provincial Electricity Authority



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200 Ngam Wong Wan Road, Ladyao, Chatuchak, Bangkok 10900 Tel. (66) 2590 9916 Fax. (66) 2590 9919 www.pea.co.th, 1129 PEA Call Center

