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Policy Brief on the Efforts to Promote Energy Saving and Energy Efficiency of Residential Buildings in Thailand

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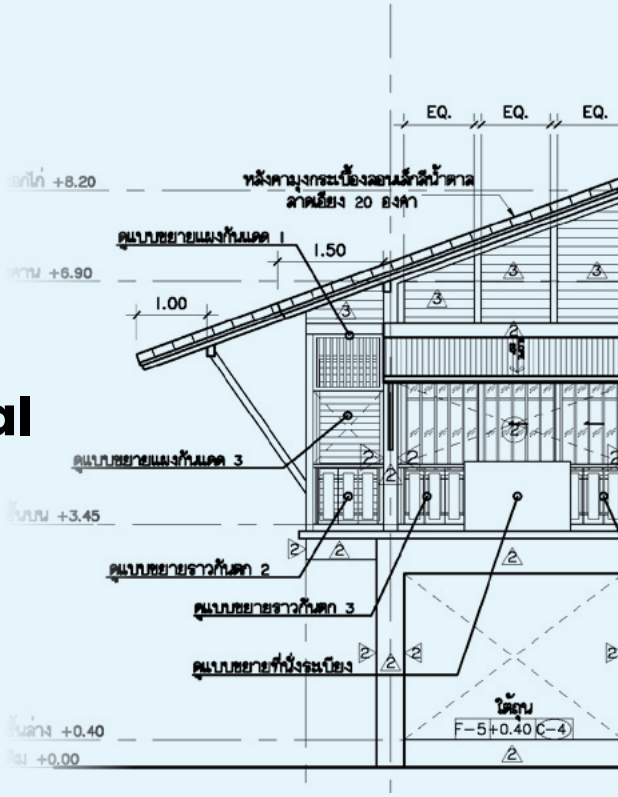
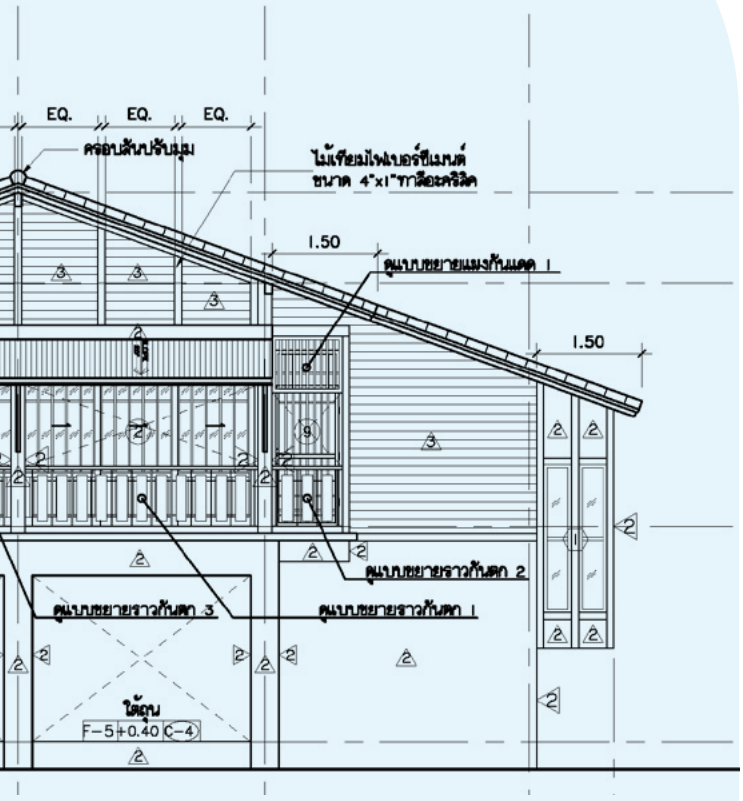


Blueprint of DEDE's Rak Nam 1, one of 12 energy-saving house models promoted by the DEDE (DEDE Energy-Saving House Designs, n.d.)

Saving electricity and increasing energy efficiency at residential buildings is essential for helping alleviate energy costs and reducing greenhouse gas emissions. This policy brief reviews policy instruments deployed by multi-level governance to discuss how Thailand releases the untapped potential of the household sector in cutting down energy consumption while mitigating greenhouse gas emissions. The policy brief conducted a desk review of three key policy documents. The first one is at the national level, the Energy Efficiency Plan (EEP), which has two versions- the 2015-2036 and 2018-2037. The second is at the sectoral level, the Building Energy Code (BEC); the third is at the municipality level, the Municipal ordinance on residential building construction. The paper found that the residential sector has yet to be a target of policies at three levels despite its increasing energy consumption. Thailand should implement a more effective regulatory approach for enhancing energy efficiency in the residential sector rather than relying on the market-based approach and the customers' willingness to pay for additional materials to make their houses energy efficient. It proposes three policy recommendations for the government authorities to address the policy gaps. First, National Housing Authority, a state enterprise, should invest in constructing affordable and energy-efficient houses using the Energy-Saving House Designs implemented by the Department of Alternative Energy Development and Efficiency, Ministry of Energy. The concept of Nearly Zero Energy Buildings (NZEB) can be helpful to adapt in the country. Second, a one-stop service center should be set up at the municipality office to provide free advice for house owners, including enhancing energy efficiency. Municipality offices are encouraged to partner with civil society organizations and private companies to receive in-kind service. Lastly, more options for nature-based energy-saving solutions should be provided as they are low-cost and foster a sustainable relationship between humans and nature.

บทคัดย่อ
การประหยัดพลังงานไฟฟ้าและเพิ่มประสิทธิภาพการใช้พลังงานในภาคที่อยู่อาศัยมีส่วนสำคัญในการลดต้นทุนค่าใช้จ่ายด้านพลังงานและลดการปล่อยก๊าซเรือนกระจก ร่างนโยบายนี้ใช้หลักวิธีการทบทวนเครื่องมือทางนโยบายในระดับต่างๆของภาครัฐ โดยมีจุดประสงค์เพื่อเพิ่มศักยภาพการดำเนินการเชิงนโยบาย

ในการลดการใช้พลังงานของภาคที่อยู่อาศัย ในขณะเดียวกันยังช่วย



ลดการปล่อยก๊าซเรือนกระจกอีกด้วย นโยบายในสามระดับถูกนำมาใช้ในการทบทวน ซึ่งได้แก่ (๑) นโยบายระดับชาติ : แผนอนุรักษ์พลังงาน พ.ศ.๒๕๕๘–๒๕๗๙ (EEP๒๐๑๕-๒๐๓๖) และ แผนอนุรักษ์พลังงาน พ.ศ. ๒๕๖๑ – ๒๕๘๐ (EEP๒๐๑๘-๒๐๓๗) (๒) นโยบายระดับภาคส่วน : มาตรฐานอาคารด้านพลังงาน (Building Energy Code :BEC) (๓) นโยบายระดับท้องถิ่น : การขออนุญาตก่อสร้างอาคารใหม่ตาม พ.ร.บ. ควบคุมอาคาร พ.ศ. ๒๕๒๒ จากเจ้าพนักงานท้องถิ่น จากการทบทวนนโยบายทั้งสามระดับพบว่าภาคที่อยู่อาศัยไม่ได้เป็นกลุ่มเป้าหมายหลักในการดำเนินการของนโยบาย ถึงแม้ว่าภาคที่อยู่อาศัยจะมีการใช้พลังงานเพิ่มขึ้นอย่างต่อเนื่อง ดังนั้นประเทศไทยควรวางแนวทางของนโยบายในการกำกับดูแลการอนุรักษ์พลังงานภาคที่อยู่อาศัยให้มีประสิทธิภาพ มากกว่าการอาศัยกลไกตลาดหรือการยอมจ่ายของประชาชนกับวัสดุก่อสร้างบ้านที่ช่วยประหยัดการใช้พลังงาน ร่างนโยบายฉบับนี้จึงได้จัดทำข้อเสนอแนะเชิงนโยบาย ๓ ประเด็น เพื่อให้หน่วยงานภาครัฐสามารถแก้ไขช่องว่างของนโยบายที่ได้กล่าวมา ได้แก่ ข้อเสนอแนะเชิงนโยบายที่ ๑ : การเคหะแห่งชาติซึ่งเป็นหน่วยงานรัฐวิสาหกิจควรลงทุนก่อสร้าง “โครงการบ้านอนุรักษ์พลังงานในราคาประหยัด”โดยใช้แบบบ้านประหยัดพลังงานที่ได้มีการพัฒนาจากกรมพัฒนาพลังงานทดแทนและอนุรักษ์พลังงาน กระทรวงพลังงาน แบบบ้านดังกล่าวอิงตามแนวคิดอาคารที่ใช้พลังงานใกล้เคียงเท่ากับศูนย์ (Nearly Zero Energy Buildings : NZEB) ที่สามารถนำมาปรับใช้กับการสร้างบ้านในประเทศได้ ข้อเสนอแนะเชิงนโยบายที่ ๒ : การจัดตั้งศูนย์ one stop service ของเทศบาลท้องถิ่นโดยความร่วมมือกับ ภาคประชาสังคม และบริษัทเอกชน เพื่อให้คำปรึกษาโดยไม่เสียค่าใช้จ่ายแก่เจ้าของบ้านในการสร้างบ้านประหยัดพลังงาน ข้อเสนอแนะเชิงนโยบายที่ ๓ : เพิ่มทางเลือกที่ช่วยเพิ่มประสิทธิภาพการใช้พลังงานที่อิงกับธรรมชาตินอกไปจากการใช้เทคโนโลยีอย่างเดียว โดยทางเลือกที่อิงตามธรรมชาตินั้นมีข้อดีคือต้นทุนต่ำ อีกทั้งช่วยส่งเสริมความสัมพันธ์ที่ยั่งยืนระหว่างมนุษย์กับธรรมชาติ

Background Information on Thailand’s Electricity Demand and Energy Saving Targets by Each Economic Sector

On 15 August 2022, the Energy Regulatory Commission (ERC) approved the change in electricity price as 4.72 baht (€ 0.13[1]) per kilowatt hour (unit), the highest price ever recorded in Thailand (Bangkok Post, 2022). The new charge is 18% higher than the present figure at 4.00 baht (€ 0.11[1]) per unit and will take effect in September 2022. Among those sectors struck by a higher energy cost, households would be severely impacted as they have a continued rise in demand for electricity. Figure 1 presents electricity demand by sector from 2011-2020. It is found that while other sectors have reduced electricity consumption in past decades, only households’ demand has increased. In contrast, the industrial sector has been reducing electricity consumption, especially during 2019-2020, due to the economic downturn during the COVID-19 pandemic. Electricity prices per unit rise, as do the electricity expenses of households per month, as shown in Figure 2.

A significant source of Thailand's greenhouse gas emissions is grid-connected electricity and heat production at around 108,238.6 GgCO2eq[2] or 42.84% of total emissions according to the mid-century, long-term Low Greenhouse gas emission Development Strategy 2021 (Thailand, 2021). Households or the residential sector are critical in mitigating greenhouse gas (GHG) emissions via energy saving and efficiency. The Energy Efficiency Plan (EEP) 2018-2037 set a goal to reduce energy intensity (EI) by 30% from 2010 levels in 2037. Five main economic sectors, including residential

1 Bank of Thailand exchange rate as of 15 August 2022: 36.66 THB = 1 Euro
2 Total greenhouse gas emissions measured in the unit of *gigagrams of a carbon dioxide equivalent*

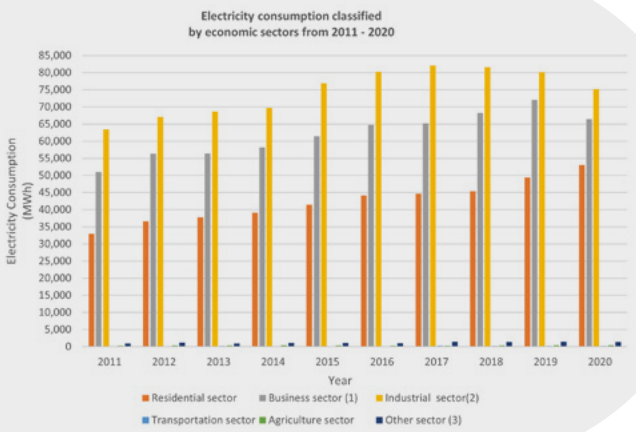


Figure 1: Electricity consumption by sectors from 2011-2020 (National Statistical Office Ministry of Digital Economy and Society, 2021b)

buildings, are prioritized by the EEP 2018-2037 to conserve a certain amount of electricity and heat, as shown in Table 1. Targets set by Energy Efficiency Plan, together with the other four national policies, namely Power Development Plan, Oil Plan, Gas Plan, and Alternative Energy Development Plan (AEDP) are vital for Thailand to achieve its pledge announced at the COP26 to become carbon neutral by 2050 and to be an economy with net-zero GHG emissions by 2065 (Bangkok Post, 25 November 2021). Given the importance of residential buildings for Thailand's energy conservation and climate change mitigation, the policy brief investigates vital policy documents to reveal how the government authorities attempt to reduce electricity consumption in this sector. The following section is the key findings from the policy review.

Key Findings from the Policy Documents Review: Some key results from the analysis of key policy documents are as follows;

1. Thailand has Implemented the Most Compulsory Policy Instruments in Other Economic Sectors (Industrial, Transportation, and Commercial Buildings) while Only Implementing a Few Voluntary Measures in the Residential Sector with Few Incentives to Comply with Them.

Thailand's Energy Efficiency Policy has two versions, the EEP 2015-2036 and the EEP 2018-2037. Both EEP versions had set the same energy intensity target of 30%. However, at the time this policy brief was written in August 2022, the government was drafting the EEP 2022-2037, which will have a more ambitious Energy Intensity (EI) target than the previous versions, meaning the EI will be 36% by 2037 and 40% by 2050 for Thailand to reach its carbon neutrality (Green network, 2023)[3]. As the EEP 2022 has not been announced yet, the paper will review only the EEP 2015-2036 and the EEP 2018-2037.

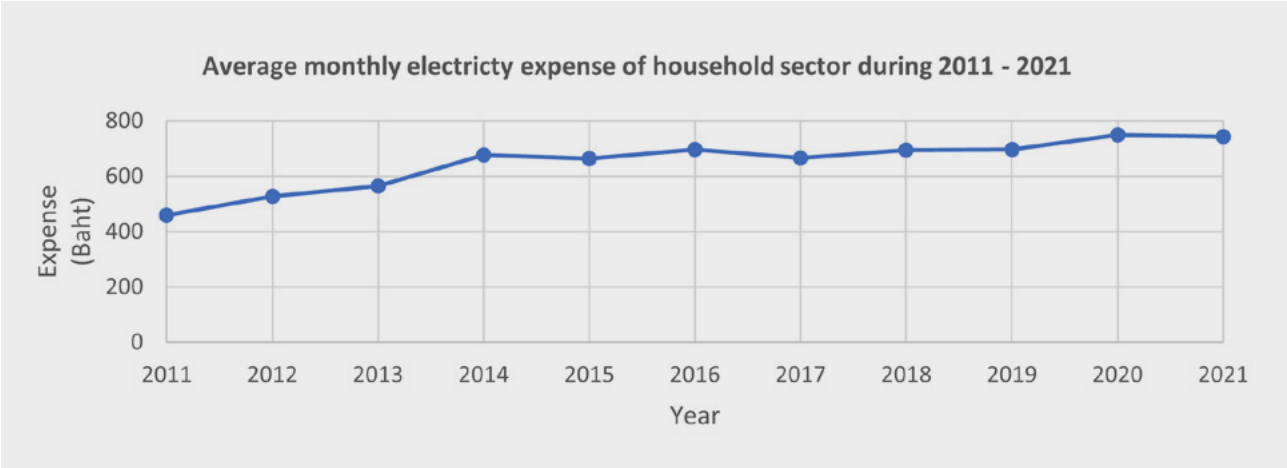


Figure 2: Average monthly electricity expenses of the household sector during 2011-2021 (National Statistical Office Ministry of Digital Economy and Society, 2021a)

3 https://www.greennetworkthailand.com/energy-efficiency-plan_eep2022/ accessed on 22 February 2023

Economic sector	Electricity (ktoe)	Heat (ktoe)	Total (ktoe)
Industry	6,777	14,360	21,137
Commercial	5,532	886	6,418
Residential	2,923	377	3,300
Agriculture	147	380	527
Transport	0	17,682	17,682
Total	15,379	33,685	49,064

Table 1: Energy saving targets by sectors (Thailand, 2021)

It is found that despite several policy instruments comprising three categories: compulsory, voluntary, and complementary programs, as illustrated in Table 2, there are only two voluntary measures for the owners of residential buildings to take action themselves. The first one is a voluntary measure to change light bulbs in the household into LED (light emitting diode), which was introduced by the EEP 2015-2036[4] (add reference), and the second one is the measure to enforce Energy Efficiency Standards (Energy Code) in the residential sector stated by the EEP 2018-2037.

The review of policy documents clearly shows that all existing compulsory programs regulate all other economic sectors except the residential buildings sector. To give some examples, the Energy Conservation Promotion Act Amended B.E. 2550 seeks to increase energy saving in factories that installed high voltage adapters over 1,000 kW or installed the heating system from thermal over 20 MJ, the Building Energy Code applies only to the newly constructed government and business buildings which have a total usable area of more than 2,000 m2, and the Energy Efficiency Resource Standard (EERS) is imposed only on electricity suppliers. With various compulsory measures, the government expects higher energy-saving targets in those main economic sectors. In contrast, the residential sector is expected to reduce energy usage by only 3,300 ktoe out of the national target of 49,064 ktoe (Table 1).

Such limited policy instruments provided to the residential sector resulted in the house owners not fully participating in the energy-saving paths as they needed to realize what else they could do at their house or with their houses. The Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, conducted a study on "Research and Development in the field of Energy Conservation and Renewable Energy in Thailand," published in 2012 (DEDE, 2012). The report presented various energy conservation technologies in main economic sectors, including commercial buildings and households. However, many potential technologies are not considered policy instruments in the EEP 2018-2037. According to the report, energy conservation should commence from the design process. The study found that if the buildings are designed since the beginning with energy-saving principles and built with high energy-efficient technology and equipment, energy consumption can be decreased to 25-50 kWh/m2/year, which is very nearly net-zero energy.

The building envelope should aim to reduce air-conditioning usage but must be designed to suit the tropical weather. It is noted that the building sector's energy conservation does not depend upon

4 The EEP 2015-2036 was the first version of the country. The EEP 2018-2037 was a revised version of most of the content and the targets were the same as the EEP 2015-2036.

Compulsory program	Voluntary program	Complementary program
1. Measures to Enforce Energy Conservation Standards	1. Measures for setting benchmarks and labeling energy efficiency for equipment, machinery, and materials.	1. Measures to promote personnel development in energy conservation
2. Measure to enforce energy efficiency standards (Energy Code) in factories/control buildings.	2. Measure to enforce Energy Efficiency Standards (Energy Code) in the residential sector	2. Public relations and educational measures on energy efficiency with the general public
3. Measure to Enforce Energy Efficiency Standards (EERS) for energy producers and distributors.	3. Measures to change equipment and promote high-efficiency technology	3. Measure for research and development (R&D) of energy efficiency technologies and innovations
4. Measures for the use of practical equipment/machinery benchmarks	4. Measures to support investment in implementing energy-saving measures	
5. Tax measures in the transport sector	5. Measures to promote innovation	
	6. Energy efficiency measures in the transport sector	
	7. Energy efficiency measures in the agricultural sector	

Table 2: Policy Instruments (EEP, 2018)

only technologies and innovation. However, it is highly influenced by the geographical areas where the buildings are located. Environmental factors, i.e., sun radiation, daylight, wind flow, temperatures, humidity, precipitation, and even environmental problems such as PM2.5 air pollution, are precisely local contexts. Thus the energy conservation effort for the buildings needs to be customized to specific geographical locations. Table 3 presents the energy conservation technologies in commercial and small residential buildings, adapted from the report by DEDE (2012).

2. Building Energy Code (BEC) has Targeted Only Large Buildings, while all Residential Buildings have not been Regulated for Energy Performance.
This lack of a Building Energy Code (BEC) for small residential buildings is concerning given the fact that the residential buildings in Thailand will increase to 36,419,247 buildings (i.e., detached houses, townhouses, and apartments, etc.) in 2036 according to the forecast of Department of Administrative Affairs, Ministry of Interior. Among those, 8,003,250 buildings will be located in Bangkok and the metropolitan, while 28,415,997 will be in other provinces nationwide (DEDE, 2018). The existing Building Energy Code (BEC) endorsed by the EEP 2018-2037 is a measure to enforce energy conservation standards for factories and new construction with a usable area of more than 2,000 m^2. They are, for example, hospitals, university facilities, offices, hotels, theatres, department stores, conventional halls, condominiums, etc. The EEP 2018-2037 selected several commonly-used standards to be implemented by large-area buildings and factories in Thailand, such as the LEED standard (Leadership in Energy and Environmental Design) and the TREES standard invented by the Thai Green Building Institute.

Despite the lack of a Building Energy Code (BEC) for small residential buildings, several pilot projects are

Energy conservation technologies	Areas for energy conservation
1. Building envelope and design	• Wall materials and glass • Insulated envelope- can optimize natural light and make thermal comfort in the building. • Envelope design to make use of daylight
2. Air-conditioning and ventilation and thermal comfort	• High-efficient air-conditioner • Options for cooling, i.e. solar cooling, passive cooling, and hybrid system for thermal comfort
3. Use of daylight and light innovation	• High-efficient lamps (and their component), i.e. LED
4. Equipment and appliances in the building	• Refrigerator and cooling retention • Air-condition • Cooking stove • General electric appliances, i.e. fan, water pump • Electric appliance using low interrupt power supply
5. Controlling system and building management	• Methods and procedures to follow up and control energy use for activities in a particular area, such as tasked lighting • Methods and procedures for energy management with building automation system (BAS)
6. Cogeneration (CHP) and district cooling	• Combined heat and power system by using clean energy i.e. natural gas, including district cooling • Absorption cooling using waste heat

Table 3: Energy conservation technologies in commercial buildings and small residential buildings (Adopted from DEDE, 2012)

done by both the government department and the business sector to enhance household energy performance and energy conservation. To name a few, Sena Development Public Company Limited, a leading real estate entrepreneur in Thailand, initiated the design of house models using renewable energy and energy saving under the solar smart village concept in 2011 (Mongkolrangsarit, 2019). The company developed two pilot projects, Sena Park Ville and Sena Park Grand located in Raminthra-Wongwaen district in Bangkok. The Department of Alternative Energy Development and Efficiency (DEDe), the Ministry of Energy, attempting to promote better energy performance of Thailand's residential buildings voluntarily, has promoted 12 energy-saving house models. The blueprints of architectural structure, electricity systems, and sanitary work are available for free download from the website https://www.aad.kmitl.ac.th/dede/. The 12 houses-models are the outcome of the study on energy performance standards of Thai residential buildings and on creating pilot energy-saving house models in which the DEDE collaborated with the Faculty of Architect, King Mongkut's Institute of Technology Ladkrabang (DEDE Energy-Saving House Designs, n.d.).

3. The Energy Efficiency Concept has not been Mainstreamed into Municipal Ordinances on Residential Building Construction.

The Building Control Act, B.E. 2522 has authorized Local Administrative Offices (LAO) to approve a permit for construction, modification, demolition, or change of the use of a building in their administrative areas (Department of Local Administration Ministry of Interior, 2006). The process to apply for a construction permit of new residential buildings comprised of the owner of the houses or authorized people by the owners submitted the permission requests, the LAO officers checked the required documents, examined the city plan and public condition, and reviewed the

drawing by the technician or the engineer, and finally the major of LAO decided whether to approve the permit. According to Article 21 of the Building Control Act B.E. 2522, a permit must be obtained prior to the commencement of construction and should be granted within 25 working days. However, the Ministry of Interior's Directive มท 0892.2/ว 1582 issued on 11 May 2004 stated that if the design of the buildings is from a house model created by the Local Administrative Office or by the Department of Public Works and Town &Country Planning, all process could be shortened to 10 working days to facilitate and ease administrative burdens of the petitioners (Department of Local Administration Ministry of Interior,2006).

The process to obtain a permit for construction is shortened to give the green light for the construction. Furthermore, the required documents to be submitted for a permit application mainly focus on the house's physical characteristics and structure, i.e., area plan, floor plan, wastewater treatment, and land ownership declaration. The construction permit application is a regulatory approach that, if used correctly, can be an effective policy instrument to enhance energy saving and energy efficiency of residential buildings. However, the energy performance of the houses needs to be included in the consideration for a permit application process by the Local Administrative Offices. Energy-saving in households in Thailand has been an individual choice of the house owners if they would like to invest more in this issue. Some materials for thermal insulation, for example, Aluminium Foil, Polyethylene Foam-PE, Air Bubble or Bubble Foil, and Fiberglass (SCG, 2022), are all available for consumers who are willing to pay more for their houses to use less electricity for cooling. Therefore, energy-saving in households in Thailand has so far depended upon a market-based approach and individual choice. That means once the prices of the materials are costly, they could be the first thing to be deleted from the list.

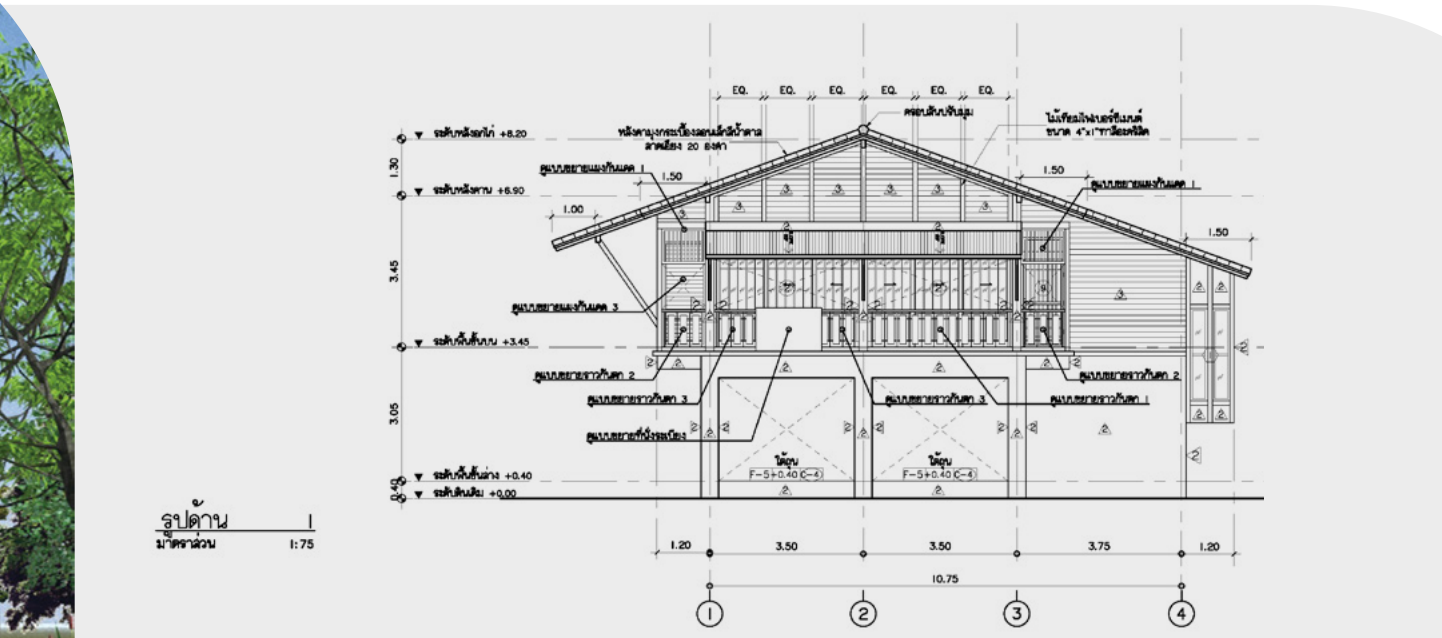
Discussions

The residential sector has a high potential to contribute to greenhouse gas emission reduction by enhancing energy efficiency. However, the

current policy instruments must be revised to include house owners' actions. Also, because some of them are based on a market-based approach, it will likely stimulate only some Thai people to purchase additional materials for thermal insulation. The research proposes some policy responses as follows.

First, government departments such as National Housing Authority (NHA) should invest in constructing affordable and energy-efficient houses using the DEDE Energy-Saving House Designs. Such government investment promotes the house's new design to a broader public. Moreover, National Housing Authority is a state enterprise under the supervision of the Ministry of Social Development and Human Security. It aims to provide housing for low and moderate-income earners to enhance their well-being and develop strong and resilient communities and environmentally friendly cities. Considering its missions, NHA is a perfect state authority that would take on such pioneer construction work of the energy-efficient house in the country. Furthermore, it could be beneficial for NHA to apply the concept of Nearly Zero-Energy Buildings (NZEB), which is implemented in many countries. For instance, the European Union has promoted the NZEB via the Energy Performance of Buildings Directive, which required new buildings built as Nearly Zero-Energy by the end of 2020, and to have all new public buildings be nearly zero-energy after 31 December 2018 (European Commission, n.d.). The European Union has recently set a new ambitious target to go beyond the current NZEB to Zero-Emission Building (ZEB) by revising the directive in December 2021. The revised directive set the goal that ZEB, which is defined "as a building with a very high energy performance, with the very low amount of energy still required fully covered by energy from renewable sources and without on-site carbon emissions from fossil fuels," will be applied to all new buildings by 1 January 2030, and to all new buildings occupied or owned by public authorities by 1 January 2027 (ibid).

Second, municipality offices are critical in giving construction permits to build new houses and



Blueprint of DEDE's Rak Nam 1, one of 12 energy-saving house models promoted by the DEDE (DEDE Energy-Saving House Designs, n.d.)

directly contacting the house owners. The research suggests that there should be one stop-service center at municipality offices around the country to provide comprehensive advice related to house construction, including how to enhance the house's energy efficiency. Such an idea can be done with little budget should the municipality offices establish a Memorandum of Agreement (MOA) with stakeholders who share similar missions and can provide in-kind support. They are, for example, the Association of Siamese Architects under the Royal Patronage, the Thai Contractors Association Under H.M. The King's Patronage, and the Home Builders Association. Moreover, some private companies have conducted Corporate Social Responsibility (CSR) in their social engagement and business promotion. Thus, they may be interested in providing free advice on construction materials at a one-stop service center at the municipality offices.

Third, solutions for enhancing energy saving and energy efficiency can be nature-based and thus low-cost. Table 3 presents energy conservation technologies and innovations in commercial and small residential buildings proposed by the study of DEDE. However, the task can be accomplished with nature-based solutions. Fernandes and Guiomar (2018) pointed out that nature-based solutions that integrate natural processes and functions in the built environment, such as residential, industrial, and infrastructures, would reconnect nature and humans and foster a sustainable relationship between the two actors. Some examples of nature-based solutions which enhance thermal comfort for people are green roofs, green walls, vertical structures with vegetation to shade holes, plant selection in an outdoor garden, and free-cooling ventilation (Gómez et al., 2021).

Conclusions

Thailand's residential buildings consume increasing electricity and face economic difficulty due to rising electricity prices. The paper reviewed four key policy documents; the EEP 2015-2036, the EEP 2018-2037, the Building Energy Code, and the Municipality ordinance (based on Article 21 of Building Control Act B.E. 2522) and investigated policy instruments that the Thai authorities implement to enhance energy saving and energy efficiency at the household level. The results reveal critical gaps in government policies, including residential buildings for cutting down energy and reducing greenhouse gas emissions. A permit for construction approved by the Local Administrative Offices is a practical regulatory approach to enhance household energy saving. However, there is no requirement to examine the energy performance of the buildings before granting the construction permit. The choice of energy saving in Thailand is, therefore, on the hand on market mechanism and on the willingness to pay additional costs of the house owners. This policy brief argues that there is great potential for saving energy.

The paper suggests that the government utilize the existing knowledge of the DEDE and private sectors and Building Energy Code (BEC) on the more prominent buildings to apply for the small residential buildings sector. Furthermore, it is advised that the investment should be made by National Housing Authority to build pilot energy-efficient and affordable houses for low and middle-income families. The municipality office should play an active role in seeking collaboration with other stakeholders to set up a one-stop service center to provide free comprehensive advice for house owners, including how to enhance energy efficiency. The concept of Nearly Zero Energy Buildings (NZEB) and even Zero-Emission Buildings (ZEB), which the European countries have been pioneers in, are helpful for Thai authorities to follow and adopt. Finally, it is essential to offer nature-based solutions as options for house owners apart from technology-based ones because the former is low-cost and could reconnect humans and nature for a sustainable relationship.