8. Viet Nam

8.1 Current situation of geothermal energy use and national policy

8.1.1 Current energy policy and energy mix

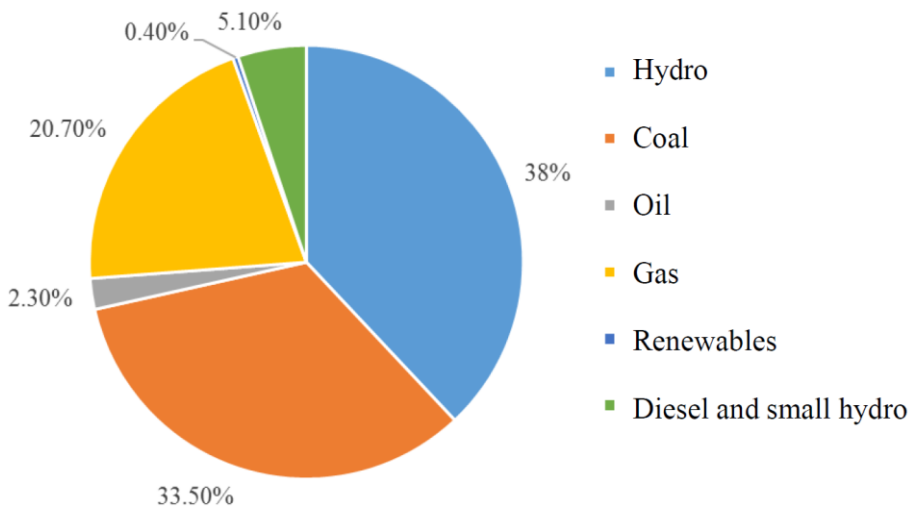
The total installed capacity of domestic and imported electricity in Viet Nam as of 31 December 2015 is shown in Table 3.8.1-1 and Figure 3.8.1-1 (Vietnam Electricity, 2016).

Table 3.8.1-1. Capacity of Viet Nam's Power Sources in 2016

Power Source	Capacity (MW)	Share (%)
Hydropower	14,636	38%
Coal	12,903	33.50%
Oil	875	2.30%
Gas	7,998	20.70%
Renewables	135	0.40%
Diesel and small hydropower	2,006	5.10%
Total	38,553	100%

Source: Vietnam Electricity, 2016.

Fig. 3.8.1-1. Power Capacity Mix of Viet Nam in 2016



Source: Vietnam Electricity, 2016.

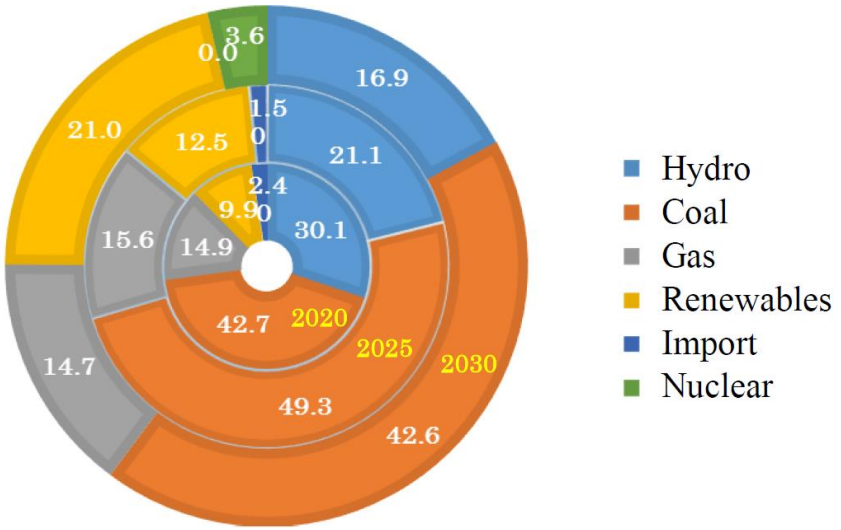
Taking into consideration the 7% annual economic growth of Viet Nam, the National Power Development Master Energy Plan (Electric Plan No. 7) was adjusted by Decision No. 428/QD-TTg in 2016 to signify the electric generation target for all kinds of energy sources (Table 3.8.1-2).

Table 3.8.1-2. Capacity Shares of Energy Generation as Adjusted by Plan No. 7

Year	Total Capacity (MW_e)	Energy Source	Share (%)
2020	60,000	Hydro	30.1
		Coal	42.7
		Gas	14.9
		Renewables	9.9
		Import	2.4
		Nuclear	0
2025	96,500	Hydro	21.1
		Coal	49.3
		Gas	15.6
		Renewables	12.5
		Import	1.5
		Nuclear	0
2030	129,500	Hydro	16.9
		Coal	42.6
		Gas	14.7
		Renewable	21
		Import	0
		Nuclear	3.6

MW_e = megawatt electric.
Source: Decision No. 428/QD-TTg, 2016.

Fig.3.8.1-2. Capacity Mix in 2020, 2025, and 2030 According to Plan No. 7



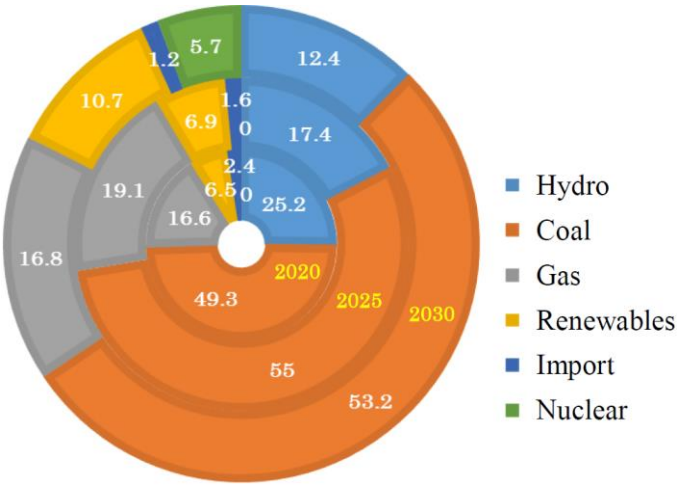
Source: Decision No. 428/QD-TTg, 2016.

Table 3.8.1-3. Energy Production Mix According to Adjusted Plan No.7

Year	Total Production (billion kWh)	Energy Source	Share (%)
2020	265	Hydro	25.2
		Coal	49.3
		Gas	16.6
		Renewables	6.5
		Import	2.4
		Nuclear	0
2025	400	Hydro	17.4
		Coal	55
		Gas	19.1
		Renewables	6.9
		Import	1.6
		Nuclear	0
2030	572	Hydro	12.4
		Coal	53.2
		Gas	16.8
		Renewables	10.7
		Import	1.2
		Nuclear	5.7

kWh = kilowatt-hour.
Source: Decision No. 428/QD-TTg, 2016.

Fig. 3.8.1-3. Energy Production Mix in 2020, 2025, and 2030 According to Plan No. 7



Source: Decision No. 428/QD-TTg, 2016.

Renewable energy is targeted with the capacity share of 9.9% in 2020, 12.5% in 2025, and 21% in 2030. Accordingly, the targeted share of electricity production is 6.5% in 2020, 6.9% in 2025, and 10.7% in 2030.

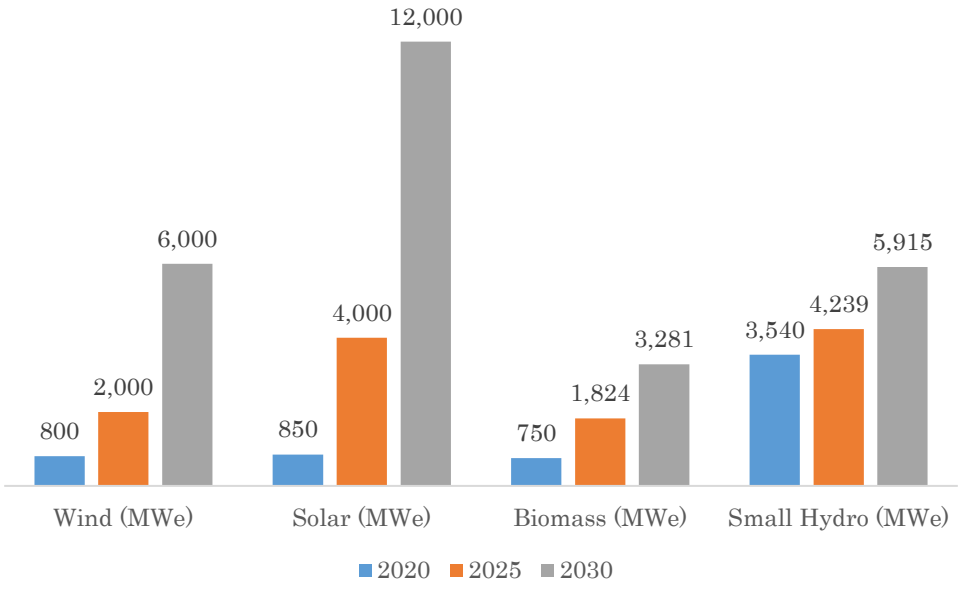
Although Decision No. 428/QD-TTg in 2016 set the targets for the development of renewable energy by the years mentioned, it did not include geothermal power (Table 3.8.1-4 and Figure 3.8.1-4).

Table 3.8.1-4. Summary of Renewable Energy Development Plan by 2030

Year	Wind (MW_e)	Solar (MW_e)	Biomass (MW_e)	Small Hydro (MW_e)
2020	800	850	750	3,540
2025	2,000	4,000	1,824	4,239
2030	6,000	12,000	3,281	5,915

MW_e = megawatt electric.
Source: Decision No. 428/QD-TTg, 2016.

Figure 3.8.1-4. Development Plan for Renewable Energy in Viet Nam



MW_e = megawatt electric.
Source: Decision 428/QĐ-TTg, 2016.

Even with the exclusion of geothermal energy in Power Plan No. 7, the Vietnamese government expects to attain the target for developing individual power sources of renewable energy by 2030. The vision for 2050, however, already includes geothermal energy (Table 3.8.1-5 and Figure 3.8.1-5).

Although the Energy Administration under the Ministry of Industry and Trade of Viet Nam is expecting geothermal energy capacity of 680 MW_e (EEP Mekong and Vietnam General Directorate of Energy, 2013), it has no timeline for this source of energy, unlike the rest of the mentioned renewable energy sources in Decision No. 428/QD-TTg.

With the goal set for the development of renewable energy in general, the government of Viet Nam has put in place policies to encourage the development of renewable energy sources. Policy for geothermal energy, however, has yet to be specified (Table 3.8.1-6).

Table 3.8.1-5. Installed and Potential Renewable Energy Capacity in Viet Nam

Type of Renewable Energy	Expected Potential (MW)	Current and Development Trend	
		Installed and under construction in 2016 (MW)	Potential could be exploited and invested in (MW)
Biomass/biogas	Approx.	375	8,125
Wind	Approx.	160	26,840
Solar	Approx.	5.6	129,944
Small hydro	Approx.	2,143	> 4,857
Municipal solid waste	Approx.	2.4	400
Geothermal	Approx.	0	680

Mw = megawatt.
Source: Decision No. 428/QD-TTg, 2016.

Table 3.8.1-6. Key Renewable Energy Policies

Year	Policy	Main Field Covered	Status
2007	• Financial mechanism for CDM projects	Financing, tariff	Effective
2008	• Regulations on electricity selling tariff and Small Power Purchase Agreement for small renewable energy-based power projects	Tariff (ACT)	Effective
2011	• Supporting mechanism for wind power projects	Tariff (FiT); taxes (income, import); land rent and use	Effective (under redesign)
2014	• Supporting mechanism for biomass co-generation projects	Tariff (FiT and ACT); land rent and use	Effective
	• Supporting mechanism for solid waste-based power projects	Tariff (FiT); taxes (income, import); land rent and use	Effective
2015	• Small Power Purchase Agreement for solid waste-based power projects	Tariff (FiT)	Effective
	• Small Power Purchase Agreement for biomass co-generation projects		
	• Viet Nam renewable energy development strategy.	Renewable energy targets; renewable energy development fund	
2016	• Price list of electricity selling tariff for 2016 for biomass-based power generation	Tariff (ACT)	Effective
	• The adjusted power development master plan No. 7.	Renewable energy targets	
	• Drafted: Supporting mechanism for solar PV (roof tops and ground mounted)	Tariff (FiT); taxes (income, import); land rent and use	Submitted Government

ACT = avoided cost tariff, CDM = clean development mechanism, FiT = feed-in tariff, PV = photovoltaics.
Sources: Danish Ministry of Energy; Ministry of Industry and Trade, Vietnam, 2017.

Regarding renewable energy pricing policy, there are pricing policies for renewables except for geothermal energy (Table 3.8.1-7).

Table 3.8.1-7. Price Tariffs of Electricity for Different Types of Renewable Power Projects

Generation Source	Technology	Capacity Limit	Tariff	Electricity Sale Price
Small hydro	Power generation	≤ 30 MW	Avoided cost tariff published annually	• D598 – 663/kWh for electricity sales (depending on time of use, season, and region) • D302 – 320/kWh for surplus electricity • D2 – 158/kWh for capacity sales (for whole country)
Wind	Power generation	No limit	FiT for 20 years	• US$0.78/kWh (on-shore) • US$0.98/kWh (near-shore) – not yet informed
Biomass	Co-generation	No limit	FiT for 20 years	• US$0.58/kWh for excess electricity
	Power generation	No limit	FiT for 20 years	• US$0.76/kWh for North region • US$0.74/kWh for Central region • US$0.75/kWh for South region
Municipal solid waste	Incineration	No limit	FiT for 20 years	• US$0.10/kWh
	Landfill gas	No limit	FiT for 20 years	• US$0.73/kWh
Solar power	Power generation	No limit	FiT for 20 years	• US$0.94/kWh

D = dong, FiT = feed-in tariff, MW = megawatt.
Source: Danish Ministry of Energy; Ministry of Industry and Trade, Vietnam, 2017.

8.2 Target capacity estimation for geothermal power in Viet Nam

In 1995, the American company ORMAT Inc. set up a pre-feasibility project to generate 50 MW of electricity from geothermal prospects in Bang (Quang Binh), Mo Duc and Nghia Thang (Quang Ngai), Hoi Van (Binh Dinh), Tu Bong, and Danh Thanh (Khanh Hoa), all in the central region. However, these projects have been unsuccessful due to various barriers.

In 2013, the Vietnamese government granted licence to LiOA Geothermal Joint Stock Company to explore Hoi Van geothermal prospect in South Central Viet Nam and develop a geothermal power plant with 10 MW–15 MW capacity. The project is still in the thermal gradient drilling stage.

Currently, Viet Nam's geothermal energy, with a total estimated capacity of 30 MW_t, is only used for drying iodine mixing salt, fish farming, bathing and swimming (including balneology), and animal farming (Nguyen et al., 2005).

According to 'Geothermal Potential for Power Generation for Viet Nam' in ERIA 2016 report (ERIA, 2016), a preliminary assessment indicates that the 11 most prospective geothermal potential sites in Viet Nam can be developed for 155 MW_e capacity by 2025, and 680 MW_e capacity can be attained in 2050 if all barriers are removed.

8.3 Barriers to geothermal energy use, and necessary innovations

Questionnaires were sent out to 11 geologists and 8 renewable energy engineers (Table 3.8.3-1) as inquiry survey on geothermal power generation and GSHP.

Table 3.8.3-1. Institutions and Number of Domestic Experts Respondents to the Survey

	Institution and Specialisation	Number	Sub-	Total
Geology Group	Exploration company engineer	2	11	19
	Research institution researcher	6		
	University researcher or teacher	3		
Energy Group	Renewable energy institute	4	8	
	Renewable energy company	4		

Source: Authors.

1) Geothermal power generation

Table 3.8.2-2 and Figure 3.8.2-1 show the results of interviews, indicating that the biggest category of barriers to geothermal energy development is technical (25%), followed by policy (24%). Social issues are also major barriers (20%), while financial and legal barriers represent 18% and 13%, respectively.

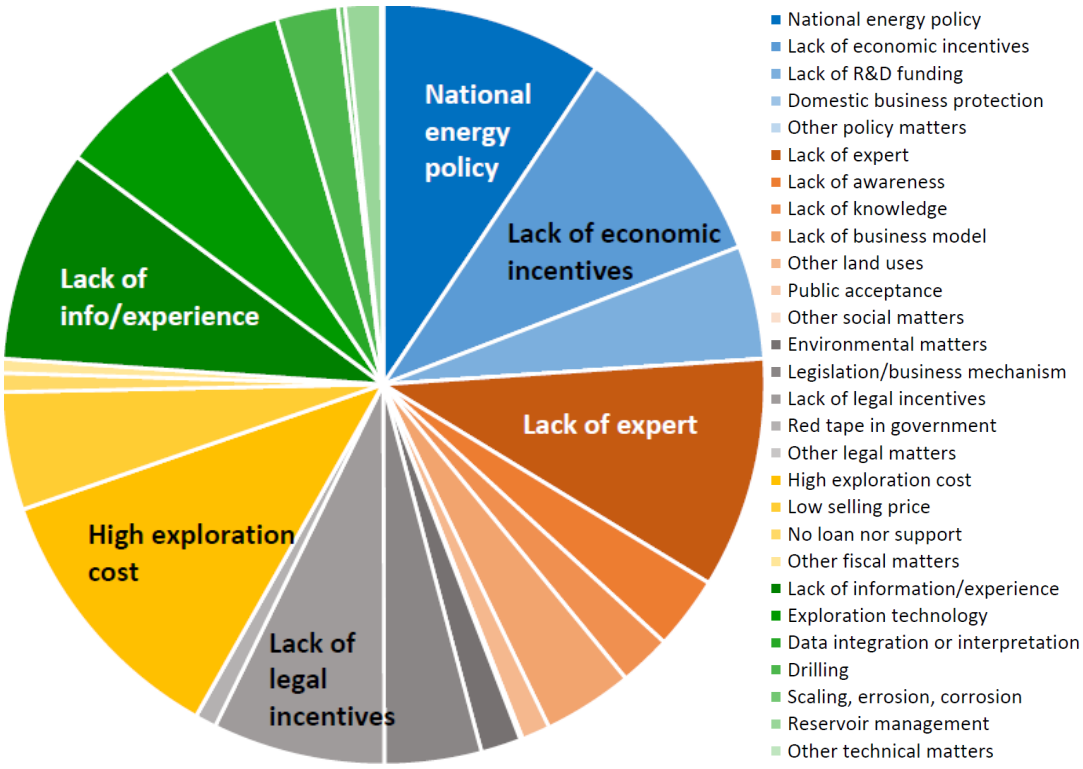
Considering specific barriers, the biggest is exploration costs (11.5%), followed by lack of expertise (9.8%) and economic incentives (9.7%). The fourth is the government's energy policy (see Section 3.8.1.1). There are small barriers that also contribute in diminishing the development of geothermal energy in Viet Nam.

Table 3.8.3-2. Degrees of Barriers Hindering Geothermal Power Generation Development in Viet Nam

CategoryBarriers	%	Barrier	%
Policy	**24**	National energy policy	9.4
		Lack of economic incentives	**9.7**
		Lack of R&D funding	4.8
		Domestic business protection	0.0
		Other policy matters	0.0
Social	**20**	Lack of experts	**9.8**
		Lack of awareness	3.1
		Lack of knowledge	2.2
		Lack of business models	3.8
		Other land uses	1.2
		Public acceptance	0.1
		Other social matters	0.0
Legal	**13**	Environmental matters	1.7
		Legislation/Business mechanism	4.1
		Lack of legal incentives	**7.3**
		Red tape in government	0.9
		Other legal matters	0.0
Fiscal	**18**	High exploration cost	**11.5**
		Low selling price	5.0
		No loan nor support	0.8
		Other fiscal matters	0.6
Technical	**25**	Lack of information/experience	**9.1**
		Exploration technology	5.3
		Data integration or interpretation	5.0
		Drilling	2.6
		Scaling, erosion, corrosion	0.3
		Reservoir management	1.5
		Other technical matters	0.1
TOTAL (%)	**100**		**100**

R&D = research and development.
Source: Authors.

Figure 3.8.3-1. Barriers to Geothermal Power Generation Development in Viet Nam



Source: Authors.

2) GSHP

Since there is no GSHP application in Viet Nam, technical barriers form the largest of barriers (27%), of which 12% corresponds to lack of installation experience. Although fiscal barriers are only 18% of the total, installation cost (14.7%) is the highest amongst all barriers in this category. Policy issues form the second largest category where national energy policy is the highest (10.6%).

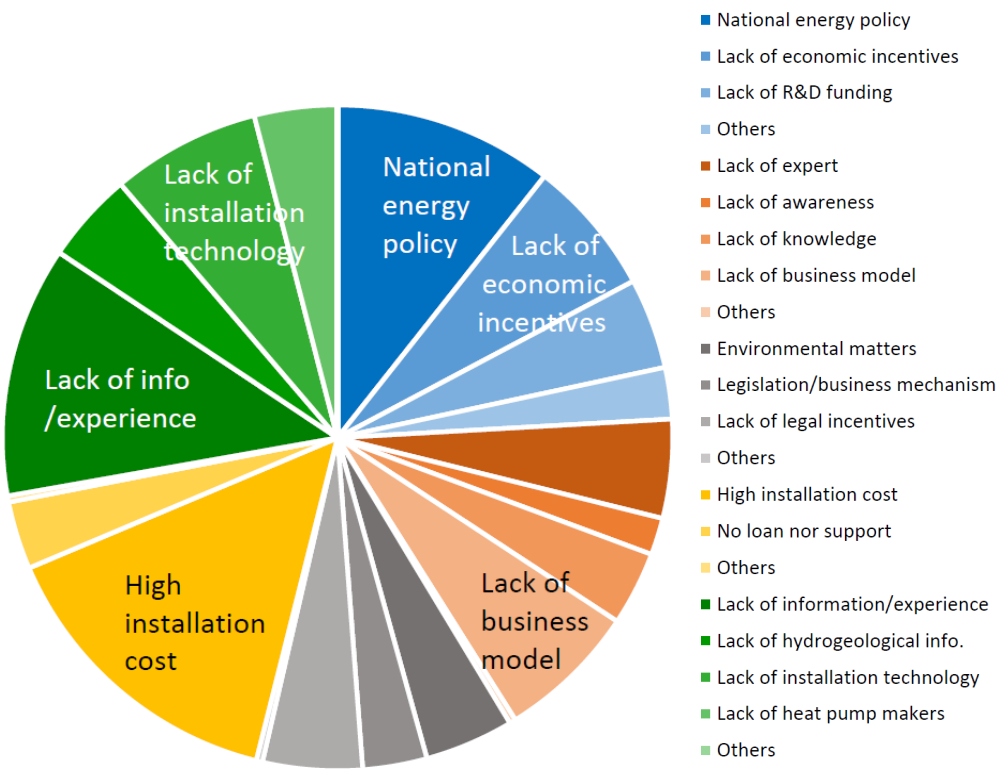
Table 3.8.3-3. Degrees of Barriers Hindering the Ground Source Heat Pump Installation in Viet Nam

Category	%	Barriers	%
Policy	**24%**	National energy policy	10.6%
		Lack of economic incentives	6.6%
		Lack of R&D funding	4.4%
		Others	2.5%
Social	**17%**	Lack of experts	4.8%
		Lack of awareness	1.8%
		Lack of knowledge	3.6%
		Lack of business models	6.8%
		Others	0.3%
Legal	**13%**	Environmental matters	4.3%
		Legislation/Business mechanism	3.1%
		Lack of legal incentives	4.8%
		Others	0.3%
Fiscal	**18%**	High installation cost	14.7%
		No loan nor support	3.3%
		Others	0.3%
Technical	**27%**	Lack of information/experience	12.2%
		Lack of hydrogeological information	4.4%
		Lack of installation technology	7.2%
		Lack of heat pump makers	4.0%
		Others	0.0%
TOTAL (%)	**100**		100

R&D = research and development.

Source: The study team.

Figure 3.8.3-2. Barriers to Ground Source Heat Pump Installation in Viet Nam



Source: The study team.

8.4 Benefits of geothermal energy use in Viet Nam

Viet Nam is expecting to generate 680 MW_e total geothermal power, 155 MW_e of which is expected to be available by 2025 (ERIA, 2016).

However, because of many barriers, the geothermal power generation target by 2025 is deemed to be not feasible. But assuming that by 2025, Viet Nam would have developed 155 MW_e with a capacity factor of 70%, the selling price would be US$0.09/kW-h, with electricity sales tax of 8%. The benefits drawn from it, shown in Table 3.8.3-1, are as follows:

- CO_2 reduction of 410,284 tonnes-CO_2/year
- New employment of 493.
- New business profit of US$277,214/year
- New business sales tax of 22,177 US$/year
- New business economic effects of 346,580 US$/year

In addition are direct benefits to local people, such as food provision for those directly involved in the exploration, construction, and operation of geothermal power plants. Restaurants, hotels, and recreation facilities will also be developed in areas with geothermal power plants. The larger

the plant capacity is, the more will these services be available, thus enhancing the livelihood of local population.

The number of services that utilise surplus heat from power plants will also be significant. Large amount of water with temperature of 90°C can be extracted from the geothermal power plants, which local people can use for bathing, physiotherapy, recreation, etc. Roads, schools, and clinics will also be built in communities around power plants.

Table 3.8.4-1. Benefits if 155-MWe Geothermal Power Capacity is Developed in 2025

Item		Unit	Policy	Social	Legal	Fiscal	Technical	Total	Remark
Barrier		**%**	**24**	**20**	**13**	**18**	**25**	**100**	
Target capacity		MW	37.2	31	20.15	27.9	38.75	155	x
Target power		MWh/ye	277,1	230,9	150,1	207,8	288,7	1,154,	capacity factor
Electricity		US$/year	24,94	20,78	13,51	18,70	25,98	103,94	US$0.9/kW-h
Electricity		US$/year	1,995,	1,663,	1,081,	1,496,	2,078,	8,315,	8%
Saving oil		boe/yr	335,6	279,7	181,8	251,7	349,6	1,398,	1
CO_2 mitigation		(tonnes-	119,5	99,64	64,76	89,67	124,5	498,20	
Saving energy cost	Fac	US$/MW	7.200	6.000	3.900	5.400	7.500	30	
	Tot	US$	8,315,	6,929,	4,504,	6,236,	8,661,	34,647	
Saving CO_2 reduction	Fac	US$/ton	18.01	15.01	9.760	13.51	18.76	75.08	
	Tot	US$	8,976,	7,480,	4,862,	6,732,	9,351,	37,404	
Benefits to local									
New employment		Employe	118	99	64	89	123	493	2.71x+73
New business profit		US$	66,53	55,44	36,03	49,89	69,30	277,21	1788.47x
New business sales		US$	5,323	4,435	2,883	3,992	5,544	22,177	8%
New business		US$	83,17	69,31	45,05	62,38	86,64	346,58	2236x

boe = barrel of oil equivalent, CO_2 = carbon dioxide, J = joule, MW = megawatt, MWh = megawatt hour, PV = photovoltaics.
Source: Authors.

8.5 Summary of barriers to and benefits of geothermal energy use, and policy recommendations

8.5.1 Summary of barriers

Although the development of geothermal energy in Viet Nam has many barriers, the most important thing is for the country to first have a geothermal power plant. With this plant, investors can truly understand the technological and exploration processes involved, the advantages and disadvantages in developing geothermal energy as well as the necessary government policies needed for developing geothermal projects. As in the case of other forms of renewable energy, appropriate policies and legal frameworks are necessary for geothermal energy development as it has its own characteristics.

8.5.2 Summary of benefits

Developing geothermal energy in Viet Nam means creating a new renewable energy source with many benefits to be gained. In addition to creating new jobs, contributing to a stable electricity supply, and reducing CO_2 emission, geothermal power plants also occupy very small land areas. Given Viet Nam's large population, saving natural land areas is very important.

8.5.2 Recommendation to policymakers

Include geothermal energy in the national energy development plan as soon as possible.

As a new type of resource, geothermal energy should be added to the current mineral law so geothermal developers can be licenced for exploration and development. Like other types of minerals, geothermal resource also requires geological exploration area that is greater than the area of exploration for hot mineral water, which is only 2 km^2.

Exempt from import tax equipment for exploration and exploitation of geothermal resource and construction of geothermal power plants.

Appropriately reduce electricity tax.

Encourage research cooperation between geothermal scientists and experts of Viet Nam and scientists and experts from countries with geothermal development experience.

Set training subjects related to geology and energy as well as technology in universities such as Hanoi University of Mining and Geology, Vietnam National University, Hanoi University of Science and Technology, and Electric Power University.

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