



**CLEAN ENERGY**  
INVESTMENT  
ACCELERATOR

# **CLEAN HEAT PATHWAYS TO DECARBONIZE THE INDUSTRIAL SECTOR IN SOUTHEAST ASIA:**

Private Sector Insights and Case Studies from  
the Philippines, Vietnam, and Indonesia

**October 2023**

# About Clean Energy Investment Accelerator (CEIA)

The **CEIA** is a public-private partnership initiative that addresses barriers to clean energy deployment in the commercial and industrial sectors in emerging markets, including the Philippines, Vietnam, Indonesia, and the Philippines. The CEIA is jointly led by the **World Resources Institute (WRI)**, **Allotrope Partners**, and the **U.S. National Renewable Energy Laboratory (NREL)**.

CEIA partners with large energy purchasers to send a strong demand signal for clean energy, collaborates with governments to strengthen policy frameworks and supports the implementation of innovative procurement approaches to grow clean energy project pipelines.

CEIA acts as a bridge, translating international commitments into on-the-ground market transformation. In response to requests from private sector stakeholders seeking to implement their clean energy and net zero emissions goals, CEIA has been expanding its efforts to support the exploration and deployment of clean heat technologies in Southeast Asia. To join our future public-private dialogues, request more information on the contents of this knowledge product, or learn more about the CEIA, please visit our website at [www.cleanenergyinvest.org](http://www.cleanenergyinvest.org).

## User's Guide

This introductory knowledge product on clean heat aims to provide an overview of clean heat technologies and opportunities in the Philippines, Vietnam, and Indonesia to equip companies with a basic understanding of potential clean heat solutions and increased ability to navigate options for their facilities.

"Clean Heat Pathways to Decarbonize the Industrial Sector in Southeast Asia: Private Sector Insights and Case Studies from the Philippines, Vietnam, and Indonesia," explores the clean heat opportunities in the Southeast Asia region and showcases early-stage examples of deployment from the Philippines, Vietnam, and Indonesia.

The CEIA team aims to support industrial companies and other market stakeholders seeking to advance clean heat solutions through future knowledge products, capacity building workshops, and collaboration on pilot project opportunities. Key areas requiring in-depth country-specific analysis include heating requirements assessments, resource mapping, site-specific cost calculations, and deep dives into emerging technologies and deployment strategies to provide practical guidance for companies to decarbonize their industrial thermal processes.

# The Need for Clean Heat

During previous CEIA-led industry dialogues, companies emphasized the importance of exploring clean heat to achieve their sustainability goals. These forward-thinking companies recognize that reducing greenhouse gas emissions (GHG) and transitioning to cleaner energy sources are crucial for advancing global efforts in combating climate change.

Clean heat refers to the production of thermal energy for heating purposes using environmentally friendly and sustainable methods that minimize GHG and air pollutants. Conventional boilers, widely employed in various industries, burn fossil fuels such as natural gas, oil, or coal to generate heat for processes such as cooking, sterilization, drying, molding, and initiating chemical reactions, releasing carbon dioxide and other pollutants into the atmosphere. This reliance on conventional boilers poses a significant challenge to achieving climate goals. To transition to clean heat, industries can adopt clean heat technologies like heat pumps, solar thermal systems, and biomass boilers. These technologies utilize renewable sources like solar energy, geothermal heat, and organic materials, or even differences in media temperature, to produce heat substantially reducing carbon emissions and environmental impact.

The recent IPCC report emphasizes the crucial role of clean heat technologies in achieving the goals of the Paris Agreement, stressing the need to limit global warming to 1.5°C above pre-industrial levels. Clean heat technologies, including renewable energy (RE) sources and efficient heating systems, are deemed essential for reaching this target.<sup>1</sup>

Furthermore, the 7th ASEAN Energy Outlook acknowledges the importance of clean heat technologies in reducing emissions in Southeast Asia's industrial sector,<sup>2</sup> particularly in the Philippines, Indonesia, and Vietnam, where the industrial sector is a significant energy consumer. The deployment of clean heat technologies is vital in these countries to achieve significant emission reductions and foster sustainable development, but overall, the adoption of clean heat technologies offers numerous benefits beyond carbon emission reduction. These technologies can improve air quality, reduce dependence on fossil fuels, and enhance energy efficiency. By embracing clean heat, companies can not only contribute to climate change mitigation but also have a positive impact on local communities, foster innovation, and drive economic growth.

CEIA's role in mobilizing investment in clean energy projects aligns perfectly with the industrial sector's growing recognition of the importance of clean heat technologies. Through collaboration and collective action, CEIA and the private sector can work together to accelerate the adoption of clean heat, ultimately paving the way for a more sustainable and resilient future. By leveraging their resources, expertise, and influence, companies can champion the transition to clean heat, setting an example for others to follow and spurring positive change on a global scale.

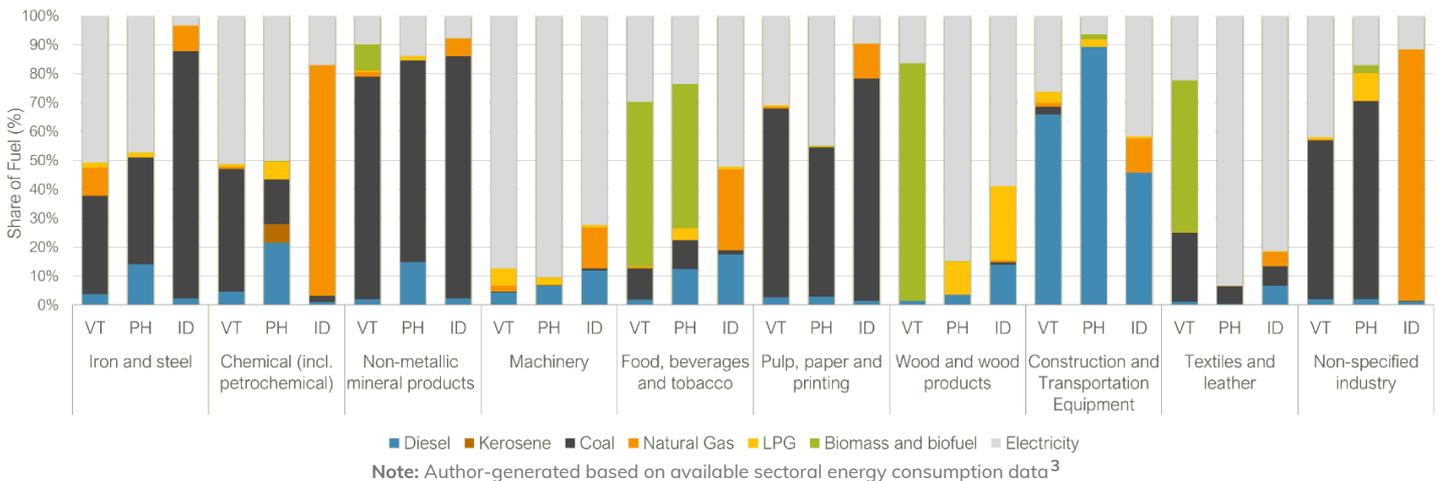
## Clean Heat Opportunities in the Region

The deployment of clean heat technologies holds immense significance in countries like the Philippines, Indonesia, and Vietnam. These nations are experiencing rapid economic growth and industrial development, leading to

1 IPCC. 2018. "Summary for Policymakers." Global Warming of 1.5°C. Special Report of the Intergovernmental Panel on Climate Change. Available at <https://www.ipcc.ch/sr15/>

2 ASEAN Centre for Energy. 2022. "The 7th ASEAN Energy Outlook." Available at <https://aseanenergy.org/the-7th-asean-energy-outlook/>

Figure 1. Fuel consumption by sector in the Philippines, Vietnam, and Indonesia



an increased demand for process heating in various sectors. However, traditional heating methods relying on fossil fuels pose significant environmental challenges, including GHG emissions, air pollution, and resource depletion.

The Philippines, Indonesia, and Vietnam have shown a commitment to sustainable development through their participation in international climate agreements like the Paris Agreement. By focusing on clean heat deployment, they can align their energy strategies with their climate commitments and contribute to the global efforts of mitigating climate change.

Moreover, these countries are home to a range of industries that heavily rely on process heating, such as manufacturing and food processing as shown above in Figure 1. Implementing clean heat technologies in these sectors can lead to substantial energy savings, cost reductions, and improved competitiveness while minimizing environmental impacts.

In the three countries, while electricity serves as the primary energy source for powering motors in machinery and equipment, fossil fuels such as coal, oil and natural gas continue to dominate in

the heating sector. This can be attributed to the specific heat requirements of certain industries.

Industries such as **iron and steel**, non-metallic mineral products which include **cement and glass production** requires high operating temperature and would need a fuel with high calorific value. Hence, it is unsurprising that these sectors predominantly rely on coal as their primary source of energy. In light industry and less energy intensive industries<sup>4</sup>, coal is still a commonly used fuel due to its abundance and affordability<sup>5</sup> in many Southeast Asian countries.

However, it is important to note the widespread use of biomass in certain sectors, particularly in the **food processing industry**. In the Philippines and Vietnam, these industries have a distinct advantage due to the abundant availability of biomass feedstock and its cost-effectiveness, facilitated by their close proximity to agricultural lands. Consequently, biomass has become a highly sought-after solution in this sector being a viable and more sustainable energy source than coal.

Another intriguing observation is that, in contrast to the Philippines and Vietnam's

3 Philippine DOE 2021 Data, Vietnam APERC 2019 Data, and Indonesia BPS, APEC and HEESI 2019 Data

4 [IPCC Working Group III Report](#)

5 The rank of coal is the stage the coal has reached during the coalification process - its degree of maturity. Lower rank coal is classified by its gross calorific value (moist, mineral-matter free). [Source: IPCC, 2018](#)

reliance on coal, Indonesia<sup>6</sup> has opted to utilize natural gas for its process heat requirements for the **chemicals** sector. Indonesia's chemicals sector has a price cap regulation from the government, which enables them to purchase natural gas at lower prices.<sup>7</sup> Moreover, natural gas has long been utilized by the sector due to its past abundance and competitive price, as well as its versatility in fulfilling the technical requirement.

The Philippines uses diesel and liquefied petroleum gas (LPG) for **wood and wood product processing**, but Vietnam has been leveraging its proximity to feedstock with its dominant use of biomass. Due to unavailable data on biomass consumption for the Indonesian wood and wood products sector, LPG and diesel are depicted as the most preferred options for heating purposes. However, some sources indicate that wood waste is directly utilized by the wood and wood products sector.<sup>8</sup>

In comparison to Indonesia, the **textile and apparel industry** in the Philippines and Vietnam exhibits a higher degree of electrification which the majority classified in Tier 1.<sup>9</sup> In general, the need for heat is heavily dominant in Tier 2 and Tier 3, compared to electricity. Most of the heat consumed in the industry is low-medium or under 500°C, only the ironing process demands heat lower than 100°C. In Indonesia, the most common use cases to replace coal is through fuel switching using agricultural waste due to the current price of electric boilers.

The availability of RE sources, such as solar radiation and biomass resources provides a strong foundation for clean heat deployment in these countries. By harnessing these indigenous energy sources and adopting

innovative technologies, they can unlock the potential for sustainable and clean heating solutions.

Global and local companies operating in the Philippines, Vietnam, and Indonesia are increasingly embracing science-based targets to reduce GHG emissions and showcase their commitment to sustainability. These targets encompass ambitious goals such as achieving 100% RE and reaching net-zero emissions goals. By focusing on science-based targets, companies are motivated to decarbonize their operations and establish a clear trajectory for emission reductions.

## Clean Heat Technologies

Clean heat technologies refer to a range of energy systems and practices that prioritize efficient and low-carbon heating solutions. These technologies aim to minimize environmental impact and reduce GHG emissions associated with heat generation. Some of these technologies include biomass boilers, solar heaters, heat pumps, and waste heat recovery units.

### Biomass Boilers

Biomass boilers utilize biomass materials, such as wood pellets, agricultural residues, or dedicated energy crops, as fuel for combustion. These boilers can operate either solely on biomass or in combination with traditional fossil fuels, such as coal, to produce steam for process heating in various industrial applications. Biomass is considered an RE because it can be replenished through sustainable forestry practices or agricultural

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6 Indonesia's industrial data excludes the Mining sector.

7 The Decree of Minister of Energy and Mineral Resources 91 Year 2023 regulates the plant gate at a price lower than the market.

8 Among others, 2016 Energy Input Output Data compiled by the Statistical Bureau.

9 There are four tiers of textile and apparel industry:  
Tier 1: finished product assembly,  
Tier 2: material production including knitting, weaving, wet processing, finishing,  
Tier 3: raw material processing including yarn making,  
Tier 4: material extraction including agriculture cotton growing to gin, etc.  
(Source: [SBTi Apparel & Footwear Guideline](#))

waste management. This makes it a viable alternative to finite fossil fuels that contribute to GHG emissions and climate change. By utilizing biomass as a fuel source, biomass boilers help reduce dependence on fossil fuels and promote a more sustainable energy mix.

However, it is crucial to carefully consider the sustainability aspects of biomass fuel sources. Sustainable sourcing practices ensure that biomass feedstocks are obtained from responsibly managed forests or agricultural systems. This ensures that the

biomass used does not contribute to deforestation or land-use change, which can have negative ecological impacts and undermine the carbon benefits of biomass energy. Therefore, a commonly recognized, and nationally contextualized biomass feedstock sustainable indicator is urgently needed. In the region, CEIA Indonesia, in collaboration with other non-governmental organizations, are working on a policy brief to inform the government about this matter. The findings will be shared in future knowledge products and capacity building events.



40 MW Boiler Turbine Generator (BTG) supplying steam and power to the sugar and refinery factory  
Source: [Thermax Global](#)



Universal Robina Corporation's biomass-fired cogeneration plant in Kabankalan, Negros Occidental.  
Source: [JG Summit Holdings, Inc.](#)

## Case Study: Biomass Boiler in Philippines Sugar Mills

The Philippine Sugar Millers Association (PSMA), representing Binalbagan-Isabela Sugar Company, Bogu-Medellin Milling Company, Busco Sugar Milling Company, Capiz Sugar Central, and others, embraced the shift towards utilizing more efficient bagasse-fired cogeneration systems. This transition involved 27 sugar mills, with capacities ranging from 500 to 18,000 tons of sugar produced per day. The primary driving force behind this change was the increasing cost of supplementary fuel (mostly bunker oil and coal) leaving bagasse, a by-product of sugar production, which emerged as a more cost-effective and reliable fuel source. By using bagasse more efficiently, the need to purchase supplemental fuels was eliminated, and excess waste that was previously incinerated now added value to the process. Given the energy-intensive nature of sugar production, where processes like juice extraction and evaporation require substantial heat, optimizing heat generation through more efficient biomass boilers significantly improved energy usage within the facilities.

Another driver of the adoption of biomass boilers was the Philippines' Renewable Portfolio Standards (RPS) mandate, which enabled sugar mills to sell surplus cogenerated power to the grid. This new revenue stream made investments in biomass boilers more economically viable.

However, this transition faced implementation and operational challenges. The grid has been ill-equipped to handle the quantity of surplus electricity generated by the sugar mills, which forced the mills to curtail excess power generation. Additionally, sugar mills located in isolated provinces encountered difficulties in transmitting electricity due to the lack of large facilities capable of absorbing their surplus generation.

Despite these challenges, the socio-economic impacts of biomass boiler deployment have been remarkable. Utilizing biomass waste resulted in significant cost savings, reducing the industry's dependency on imported fossil fuels. Moreover, the sale of surplus electricity to the grid contributed to increased revenue for sugar millers. The adoption of biomass boilers has created job opportunities for farmers and mill workers, particularly in regions where sugar cane production plays a vital role in the local economy.

However, even a mature sector like sugar milling faced challenges related to feedstock availability. The Comprehensive Agrarian Reform Program (CARP) implemented in the 1990s fragmented sugar plantations into smaller areas, leading to reduced productivity and support for farmers. Over the last decade, there has been a gradual decline of 0.56% in farm area, and this decrease in cane production can be linked to several factors, including climate conditions, the conversion of sugar farms into subdivisions and solar farms, and a reduction in the number of cane cutters. To ensure a sustainable and year-round supply of feedstock, empowering farmers and establishing efficient collection frameworks for biomass waste from smaller farms is crucial. Moreover, enhancing the transmission system is also necessary to enable more economical adoption of biomass boilers and ensure their continuous operation.

The successful deployment of more efficient biomass boilers in Philippine sugar mills highlights the importance of leveraging local and renewable resources to achieve cost savings, reduce emissions, and stimulate economic growth. The experiences of the sugar milling industry also underscore the significance of addressing feedstock availability challenges through farmer empowerment and efficient collection mechanisms. By considering these valuable lessons, similar industries can overcome barriers and harness biomass utilization to drive sustainability in their operations.

## Solar Heaters

Solar heaters are technology that harnesses the power of the sun to provide heat for various applications. The system typically consists of a solar collector, which is made up of a dark-colored, heat-absorbing material. This collector absorbs solar radiation, converting it into heat energy. The heat is then transferred to a fluid, such as water or a heat transfer medium, which circulates through the system. The heated fluid can be utilized for process heating in industrial settings, providing a clean and sustainable alternative to traditional fossil fuel-based heating methods.

Solar heaters offer numerous benefits, including reduced reliance on non-RE sources, lower GHG emissions, and potential cost savings in the long run.



Source: SolarBK and CADE Engineered Technologies

## Case Study: Solar Heaters in Vietnam

SolarBK, a local provider of clean heat solutions in Vietnam, conducted multiple case studies in the food processing industry. These studies involved the utilization of solar water heaters to replace less efficient water heating systems with high and uncontrollable electricity as well as fuel costs. Through their calculations, SolarBK demonstrated that employing solar water heaters can result in a reduction of up to 90% in total heating costs when compared to conventional methods. These conventional methods include the use of resistors, diesel, fuel oil, and gas for heating 1000L of water from 27°C to 60°C. This heated water is used for tasks such as cleaning tools, equipment, and hands.

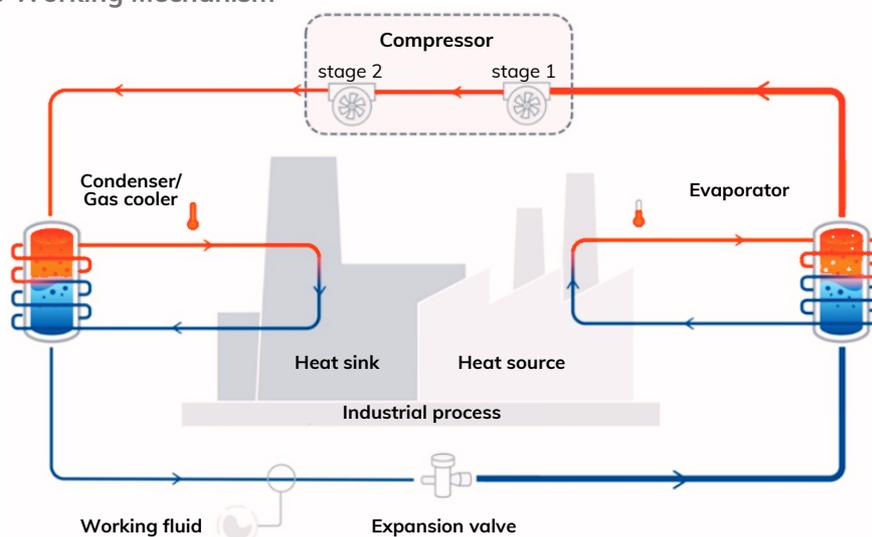
The adoption of solar water heaters not only has the potential to yield substantial cost savings but also leads to a significant decrease (ranging from 80% to 90%) in CO<sub>2</sub> emissions when contrasted with water heater resistors. Despite the potential overall reductions in costs and CO<sub>2</sub> emissions, outlined in the SolarBK case study, this solution has not yet garnered the complete attention of energy buyers. This is due in part to the relatively low absolute cost savings when weighed against the initial investment costs. Furthermore, energy users often show reluctance to adopt changes in their facilities, hindering the widespread adoption of solar thermal solutions.

### Heat Pumps

Heat pumps operate in a similar manner to a refrigerator but in reverse. Heat pumps extract heat from a heat source such as ambient air, ground, or water. This is achieved by evaporating a special fluid with a low boiling point, which absorbs the heat from the source. The vaporized fluid is then compressed, which increases its temperature and pressure. As the compressed fluid passes through a condenser, it releases the absorbed heat to the process heating system,

condenses back into a liquid state, and is sent back to the heat pump to begin the cycle again. This continuous process of extracting heat from the source, transferring it, and releasing it for process heating provides a highly efficient and sustainable solution for meeting heating needs while reducing energy consumption and environmental impact. Heat pumps offer versatility, as they can provide heating and cooling functions and are particularly suitable for areas with moderate climates.

Figure 2. Heat Pump Working Mechanism

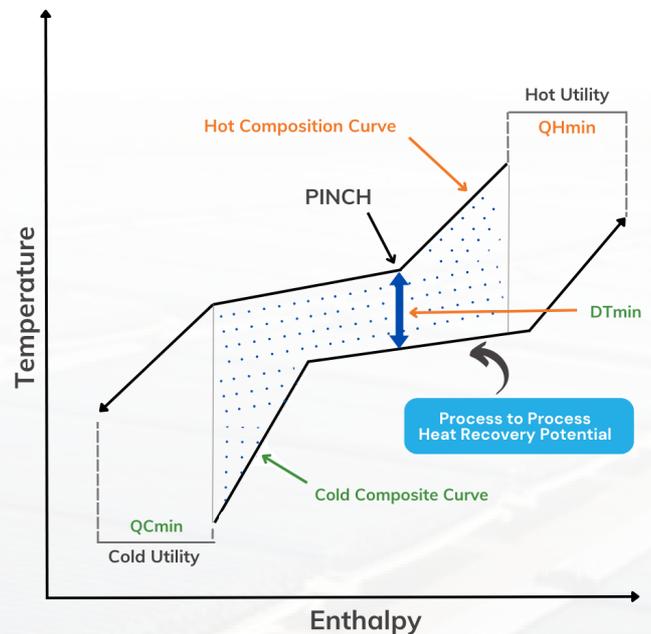


## Waste Heat Recovery

Waste heat recovery is a process that involves capturing and utilizing the heat energy that is generated as a byproduct of various industrial processes. In many industrial operations, a significant amount of heat is produced and discharged into the environment without being utilized effectively. Waste heat recovery systems aim to harness this otherwise wasted heat by employing heat exchangers. Heat exchangers transfer the captured heat from the process streams to a separate fluid or system, such as water or air, which can then be utilized for heating, power generation, or other industrial processes. By capturing and re-utilizing this heat energy, waste heat recovery systems reduce the overall energy consumption and carbon emissions of industrial processes, provide cost savings, and improve overall energy efficiency. Waste heat recovery is a valuable and sustainable approach to optimize resource utilization and mitigate environmental impacts in industrial sectors.

Examples of this technology include ultra-low pressure vapour absorption chillers, one-degree chillers, evaporative condensers, closed loop cooling towers, and adiabatic coolers.

Figure 3. Industrial Process Waste Heat Recovery



## Case Study: Waste heat recovery in Indonesia's food processing industry

In Indonesia, the rising energy costs, stricter regulations, and the need to reduce carbon footprints are all driving the industry towards more sustainable solutions. Energy conservation and decarbonization practices have great potential to combat the rising energy and environmental demands. Absorption chillers utilize a waste heat recovery concept that maximizes energy efficiency and reduces costs in industrial operations. In Indonesia, one of the industrial examples that uses an absorption chiller is potato chip processing.

Potatoes contain 60-70% moisture that is vented out to the atmosphere during the frying process. The moisture leaves in the form of vapor at 100-115°C and atmospheric pressure through a chimney connected to the fryer. Additionally, the packing area needs to be air-conditioned and conventionally uses electric chillers (i.e., an HVAC system) for this purpose. By using an absorption chiller, the water vapor from the fryer can be trapped and used to cool down the packing room area, which leads to a reduction of almost 80% of the load on the grid system.



Electric boilers are available in a wide range of pressures and capacities  
Source: [Power Mechanical](#)

These technologies differ in how the electricity is converted into heat. Resistive heating is the simplest method of heating, which has been in the market before natural gas-fired furnaces entered the market. Through this method, the electricity is passed through a resistive (heating) element which generates heat at a relatively high efficiency level. Widely available equipment that employ resistive heating are electric boilers, furnaces, and ovens. Some of these equipment can reach up to 2,000°C with considerable volume, even though, the heating rates are fairly limited as compared to electromagnetic heating.

## Electric Boilers

Electricity is a versatile form of secondary energy product, which can be utilized for industrial process heat. In general, the electric heating possesses unparalleled advantages compared to other heating technologies, such as compact size due to absence of handling units and fuel storages, high efficiency, low capital & maintenance cost, and low emissions at the plant site. The electric-driven heating can be achieved through different technologies, including but not limited to: resistive heating and electromagnetic heating.<sup>10</sup>

Electromagnetic (EM) heating involves electromagnetic field radiation, including, induction (through coils), dielectric (radiofrequency and microwave), infrared, and ultraviolet. The technologies depend on the EM waves with different lengths and yield different heating characteristics (Table 1). Compared to resistive heating, electromagnetic (EM) heating can heat up to 3,000°C with varied heating flux per area. Furthermore, these technologies can ramp up in short periods of time, making it suitable for industrial process that require greater control.

Table 1. Comparison between different types of electric heating

Technologies	Induction	Radio	Microwave	Infrared	Ultraviolet	Resistive
Heating method	EM	EM	EM	EM	EM	Resistive
Max temp	3,000	2,000	2,000	2,200	N/A	1,800
Heating flux (kW/m <sup>2</sup> )	50,000	100	500	300	100	high
Efficiency	50-90%	80%	80%	60-90%	-	~100%

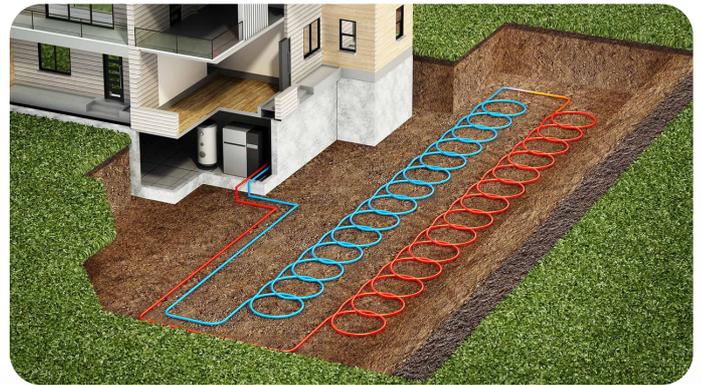
<sup>10</sup> Australian Renewable Energy Agency (2019). Renewable energy options for industrial process heat. Available at: <https://arena.gov.au/assets/2019/11/renewable-energy-options-for-industrial-process-heat.pdf>

When electricity consumption is a concern, two aspects are essential to consider for electric boilers: emission factors and electricity tariffs. Currently, national grids in the Southeast Asia region have high emission factors that make electric boilers powered by grid electricity a less attractive option for many companies. In this regard, to be able to benefit from the low carbon solutions, the company would need to accompany the utilization of electric boilers with on-site power generation to reduce the overall emission factor of power consumption. Among the three countries, Indonesia has the highest emission factor with 0.778 tCO<sub>2</sub>e per Megawatt-hour<sup>11</sup>, whereas the Philippines is lower by 8.1%<sup>12</sup> and Vietnam by 7.2%<sup>13</sup>. Moreover, the electricity tariff is vital in determining the feasibility of transitioning to electric heating. At current fossil and alternative fuel prices, the marginal cost of producing heat from electricity is not yet competitive, even if the tariff is as low as USD 7.4 cents per kilowatt-hour, such as the one in Indonesia.

Electrification of heat will continue to be the key consideration for the clean energy transition. Sustainably sourced bio-based energy products are limited; therefore, it could only be near-to-medium-term solutions. In the long run, the opportunity to electrify heat with electricity generated from abundant renewable energy sources, such as solar or wind, would solve many problems and many companies would likely take quick action to build the business case, including total system costs, lack of volatile commodity prices, and reduced complexity within the plant, for conversions to electric boilers.

## Other Technologies

**Geothermal heating** harnesses the natural heat stored in the Earth's crust for heating purposes. This technology utilizes heat pumps to extract heat from underground sources, such as geothermal wells or ground loops and transfers it to a heating system.



Geothermal heat pumps  
Source: [RMI](#)

Geothermal heating systems are highly efficient, environmentally friendly, and can provide consistent heating throughout the year. They are particularly suitable for regions with stable ground temperatures and can significantly reduce energy consumption and GHG emissions.

Geothermal heat applications in agricultural food production have gained significance in Southeast Asia, driven by the abundant availability of geothermal resources. Some areas in the Philippines harness geothermal heat for coconut meat drying, while Vietnam employs it for salt extraction. However, one particularly remarkable application of geothermal heat stands out in Indonesia, where it plays a pivotal role in mushroom cultivation. In the Kamojang geothermal field situated in West Java, geothermal energy has demonstrated exceptional effectiveness in facilitating the sterilization process essential for mushroom cultivation. This innovative approach has effectively supplanted the reliance on conventional oil fuels, yielding significant cost savings and noteworthy reductions in harmful emissions.<sup>14</sup>

**Waste-to-heat (WtE) boilers and pyrolyzers** are innovative technologies that convert various types of waste materials into valuable heat energy. Waste-to-heat boilers utilize combustion processes to burn waste materials, such as municipal solid waste or industrial waste, to generate heat that can be

11 Institute for Global Environmental Strategies (2023). List of Grid Emission Factors, version 11.1. Available at: <https://pub.iges.or.jp/pub/iges-list-grid-emission-factors>

12 Department of Energy (2023). 2015-2017 National Grid Emission Factor (NGEF). Available at: <https://www.doe.gov.ph/electric-power/2015-2017-national-grid-emission-factor-ngef>

13 Based on OL 1278/BDKH-TTBVTOD), dated 12/2022

14 IRENA (2022), Powering agri-food value chains with geothermal heat: A guidebook for policy makers, International Renewable Energy Agency, Abu Dhabi.

used for process heating or electricity generation. These boilers are designed to ensure efficient combustion and minimize harmful emissions.

Pyrolyzers employ a thermal decomposition process called pyrolysis to convert waste materials, such as biomass or plastic, into a mixture of combustible gases, liquid bio-oils, and solid char. The combustible gases and bio-oils can be utilized as heat sources, either directly or through combustion, while the solid char can have applications as a fuel or as a raw material for other processes. Both waste-to-heat boilers and pyrolyzers offer

promising solutions for waste management, energy recovery, and reducing the environmental impact of waste disposal.

Although it is suggested that the decision to implement the waste-to-heat solution needs to consider whether the facilities involved allow for the conversion process to take place onsite. Certain companies do not permit onsite waste-to-heat conversion, the solution might need to be applied offsite instead. Where onsite waste-to-heat conversion is allowed, the emission is inventoried as company's scope 1 emission reduction if the waste is otherwise incinerated or landfilled within company's boundary.<sup>15</sup>

Figure 4. Clean heat technology selection framework



## Which Technology Fits My Facility?

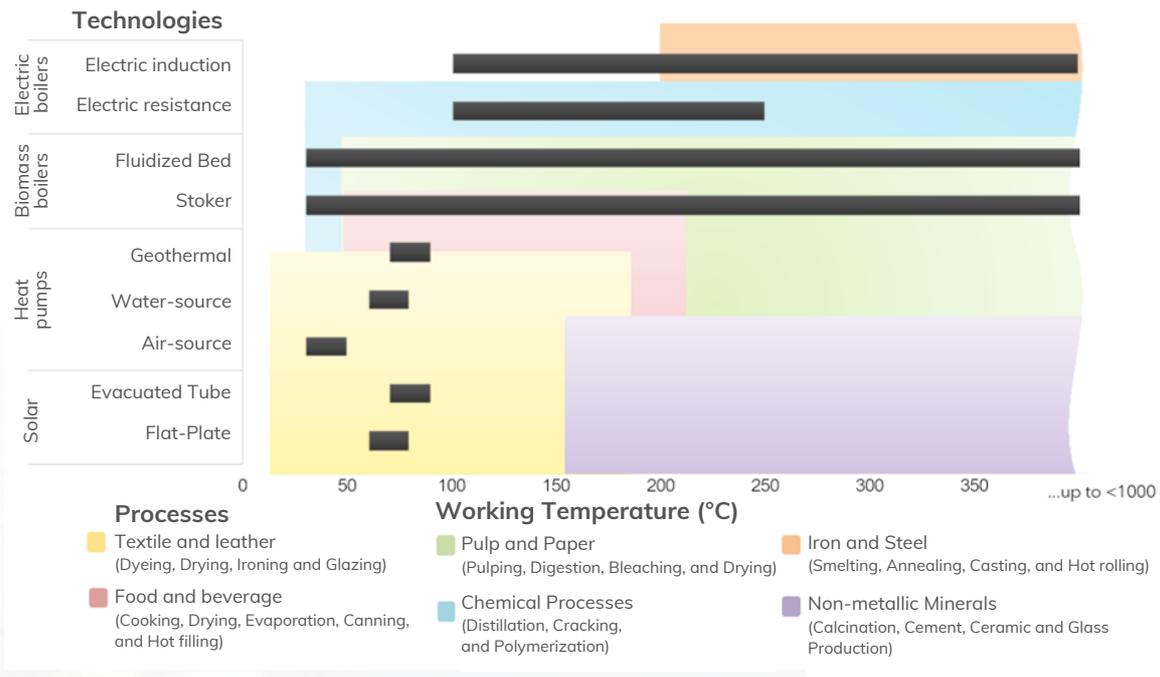
Choosing the appropriate clean heat technology for your facility is crucial in promoting sustainability and reducing the environmental impact of your operations. Assessing your heating requirements is the first step in this process. This involves understanding the specific needs of your facility, such as the required heat output, temperature ranges, and heating duration. By conducting a thorough assessment of your heating requirements, you can effectively filter out the technologies that are incapable of meeting your specific needs.

Next, it is important to map out the available energy resources. This includes evaluating the availability of renewable energy sources like solar or biomass, and even electricity in your location. Gaining a comprehensive understanding of the energy resources available to your facility is instrumental in identifying a clean heat technology that can provide a cost-effective and dependable feedstock for heat production.

Once you have assessed your heating requirements and mapped out the energy resources, the next step is to evaluate the performance of different clean heat technologies. Evaluating the clean energy sources that can be harnessed for heating purposes is crucial. For example, if a facility receives ample solar radiation with minimal shading, solar thermal systems could be a viable option. Similarly, if there is access to

<sup>15</sup> If the organic waste is handled by third party and accounted as scope 3 emission, own WtE contribute to the reduction of its scope 3 emission

Figure 5. Working temperature of selected processes and technologies



biomass or geothermal energy, corresponding technologies can be considered.

However, when considering biomass, it is necessary to address the sustainability aspects of the biomass fuel sources. It is imperative to ensure that biomass is obtained from responsibly managed forests or agricultural systems to avoid any contribution to deforestation or adverse land-use change.

Technology performance is another important consideration. It encompasses factors such as efficiency, reliability, maintenance requirements, and environmental impact. Evaluating the performance of different technologies allows for a comparison of their effectiveness in meeting the facility's heating needs. It is vital to consider not only the initial cost but also the long-term performance and operational costs associated.

Table 2. Common Pros and Cons of selected clean heat solutions

Technologies	Pros	Cons
<b>Biomass boilers</b>	<ul style="list-style-type: none"> <li>• Maturity</li> <li>• Wide heating range</li> <li>• Utilization of existing infrastructure</li> <li>• Waste reduction</li> </ul>	<ul style="list-style-type: none"> <li>• Localized and limited feedstock availability</li> <li>• Fuel and transportation cost</li> <li>• Emission and air quality concern</li> <li>• Fuel compatibility and handling challenges</li> </ul>
<b>Heat pumps</b>	<ul style="list-style-type: none"> <li>• Ubiquitous resource</li> <li>• Energy efficiency</li> <li>• Versatility</li> <li>• Low environmental impact</li> <li>• Scalability and modularity</li> </ul>	<ul style="list-style-type: none"> <li>• Space requirements</li> <li>• Temperature limitations</li> <li>• Retrofitting challenges</li> <li>• Maintenance and technical complexities</li> </ul>

	Pros	Cons
<b>Solar heaters</b>	<ul style="list-style-type: none"> <li>• Ubiquitous resource</li> <li>• Fuel cost savings</li> <li>• Scalability and modularity</li> <li>• Long lifespan and low maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Weather dependent</li> <li>• Moderate temperature range</li> <li>• Space and energy storage requirements</li> <li>• Limited heat generation capacity</li> </ul>
<b>Waste heat recovery</b>	<ul style="list-style-type: none"> <li>• Efficient resource utilization</li> <li>• Cost savings</li> <li>• Versatility and flexibility</li> </ul>	<ul style="list-style-type: none"> <li>• Limited heat recovery potential, Technical complexity</li> <li>• System integration challenges heat quality and temperature limitations</li> </ul>
<b>Electric boilers</b>	<ul style="list-style-type: none"> <li>• Energy efficiency</li> <li>• Operational safety</li> <li>• Quiet operation</li> <li>• Ease of installation</li> </ul>	<ul style="list-style-type: none"> <li>• Electricity cost and power supply reliability</li> <li>• Heat output limitations</li> <li>• Heating speed</li> </ul>

Among the technologies discussed, heat pumps, waste heat recovery systems and electric boilers are energy efficient. Solar heaters have a longer lifespan and require low maintenance, making them a reliable option. On the other hand, biomass may emit unwanted emissions during its transport to facilities and thus optimizing transportation routes, utilizing cleaner modes of transport, investing in efficient handling and storage infrastructure, and promoting the use of locally available biomass resources would be necessary. Electricity cost and power supply reliability would remain as a huge consideration in adopting electric boilers in industrial facilities.

Additionally, estimating the initial investment, operating costs, payback period, and potential savings over time is crucial to determining the financial viability of adopting clean heat

technologies and in making informed decisions.

Environmental impact evaluations are also essential. Take into consideration the GHG emissions, air quality implications, and overall environmental footprint associated with each clean heat technology and prioritize options that have lower emissions and align with your sustainability goals.

Seeking expert advice is highly recommended during this process. Engaging with professionals, consultants, or technology providers who specialize in clean heat technologies can provide valuable insights and guidance. They can help you assess your options and provide detailed information on the technical aspects, performance metrics, and potential benefits of each technology.

# Takeaways

Summarized below are the **key insights** from this knowledge product:

## 1. Clean heat solutions present opportunities for economic growth.



The Philippines, Vietnam, and Indonesia are experiencing rapid economic growth and industrial development, leading to increased energy demand, especially for process heating in various sectors. Embracing clean heat technologies in these countries presents an opportunity to address environmental challenges, align energy strategies with climate commitments, and achieve substantial energy savings and cost reductions.

## 2. Successful deployments exist, yet challenges remain for widespread adoption.



Case studies in the region offer valuable insights into the opportunities for clean heat deployment, such as the potential for reducing GHG emissions, enhancing energy efficiency, and promoting sustainable development, but challenges such as the availability and sustainability of biomass feedstock, the initial investment costs of technology adoption, and the need for supportive policy frameworks still require careful consideration. Combining financial incentives, technological support, and regulatory mechanisms to create an environment where facilities can reduce their emissions with support from relevant tools, training, and guidance to achieve these goals effectively could address these barriers and unlock the full potential of clean heat technologies in the industrial sector.

## 3. The first step is raising awareness and understanding of clean heat technologies.



Clean heat encompasses a broad range of technologies and approaches. The initial step towards integrating clean heat into corporate decarbonization strategies is to raise awareness and foster a deeper understanding of the technologies and their deployments. By focusing on increasing knowledge about clean heat solutions and their potential benefits, businesses can better grasp the relevance and significance of adopting these technologies, as well as build the business case for conversions to clean heat technologies.

## Next Steps

This introductory knowledge product is intended to provide an overview of clean heat technologies and emerging opportunities in the Philippines, Vietnam, and Indonesia, but this is just the first step in a journey for companies seeking to decarbonize their industrial thermal processes. In future knowledge products and capacity building events, the CEIA team aims to delve into specific areas, offering additional insights on the technology selection process, country-specific cost considerations, and practical guidance tailored to companies' needs. CEIA aims to provide a clear roadmap for companies to assess their clean heat options in Southeast Asia, navigate the procurement process, and effectively implement clean heat solutions across their supply chains, driving positive environmental impact and supporting global climate action.

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