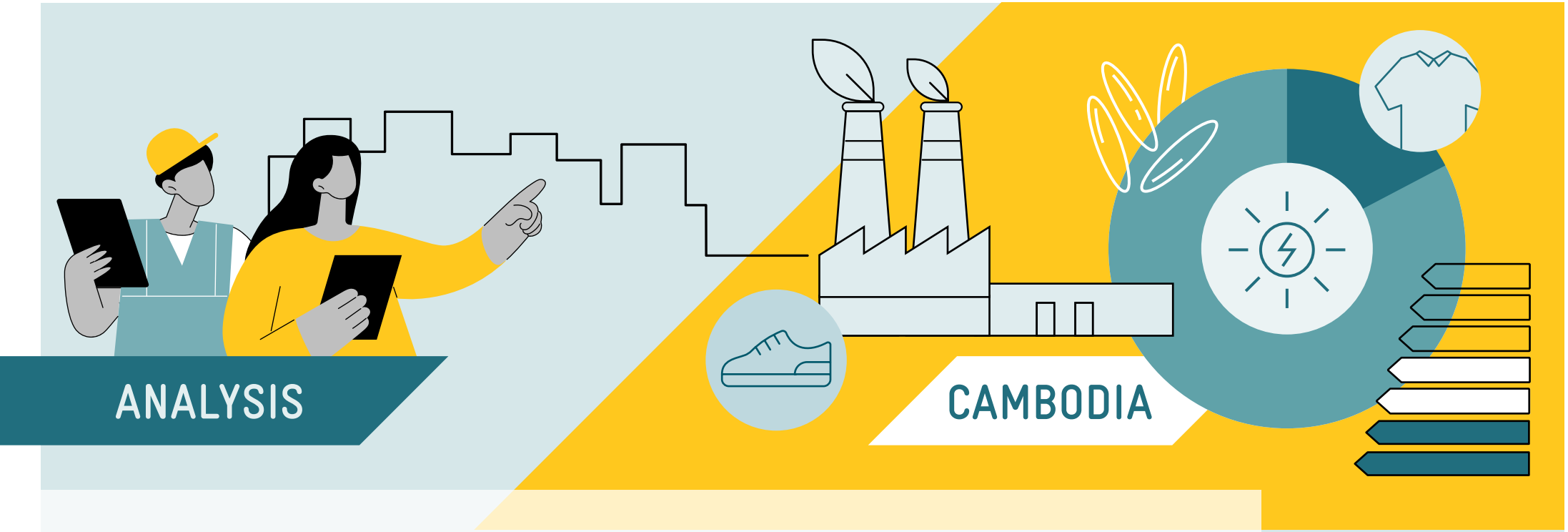

Sector Analysis Cambodia

Energy Efficiency Technologies in Commercial Buildings and Industries

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

This publication was commissioned by the German Energy Solutions Initiative of the German Federal Ministry for Economic Affairs and Climate Action (BMWK)

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Abbreviations/acronyms

ADB	Asian Development Bank
AFTA	ASEAN Free Trade Area
ASEAN	Association of Southeast Asian Nations
BEC	Building Energy Code
BELDA	Building Energy Structure and Lifestyle Database of Asia
CKFTA	Cambodia-Korea Free Trade Agreement
CPP	Cambodian People's Party
CSDG	Cambodian Sustainable Development Goals
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CCIFC	Chambre de Commerce International France Cambodge
CEPT	Common Effective Preferential Tariff
CSR	Corporate Social Responsibility
CDC	Council for the Development of Cambodia
CMT	Cut, Make and Trim
DAEDE	Department of Alternative Energy Development and Efficiency
DEC	Designated Energy Consumer
EDC	Electricité du Cambodge
EAC	Electricity Authority of Cambodia
EMC	Emerging Markets Consulting
EE	Energy Efficiency
EERF	Energy Efficiency Revolving Fund
EMS	Energy Management System
EPC	Energy Performance Contract
ESCO	Energy Service Company
ESP	Energy Service Provider
EUI	Energy Use Intensity
ESG	Environmental, Social and Governance
EBA	Everything but Arms
FFO	Federal Foreign Office
FSOG	Federal Statistical Office of Germany
FI	Financial Institution
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
GMAC	Garment Manufacturers Association in Cambodia
GTF	Garment, Textile and Footwear
GSP	Generalised System of Preferences
GBN	Global Business Network programme
GGGI	Global Green Growth Institute
GTSF	Global Trade Supplier Finance
HVAC	Heating, Ventilation and Air Conditioning
HFO	Heavy Fuel Oil
HV	High Voltage
IPP	Independent Power Producer
IEA	International Energy Agency
IFC	International Finance Corporation
ILO	International Labour Organization
ITC	International Trade Centre
JICA	Japan International Cooperation Agency
LLC	Limited Liability Company
LV	Low Voltage
LED	Low-Emitting Diode
MV	Medium Voltage
MSME	Micro, Small and Medium-sized Enterprises
MEPS	Minimum Energy Performance Standards
MoC	Ministry of Commerce
MEF	Ministry of Economy and Finance
MLMUPC	Ministry of Land Management, Urban Planning and Construction
MME	Ministry of Mines and Energy
MoE	Ministry of the Environment
MoI	Ministry of the Interior
NCSD	National Council for Sustainable Development
NEEP	National Energy Efficiency Policy
NIS	National Institute of Statistics
NDC	Nationally Determined Contribution
NIL	New Law on Investment
OEC	Observatory of Economic Complexity
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
PPSEZ	Phnom Penh Special Economic Zone

PPP	Public-Private Partnership
QIP	Qualified Investment Project
RCEP	Regional Comprehensive Economic Partnership
RGC	Royal Government of Cambodia
REE	Rural Electrification Enterprise
SME	Small and Medium-sized Enterprises
SEZ	Special Economic Zone
SEC	Specific Energy Consumption
SOP	Standard Operating Procedures
ToU	Time of Use
TFEC	Total Final Energy Consumption
TPES	Total Primary Energy Supply
USAID	U.S. Agency for International Development
USDOS	U.S. Department of State
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value-Added Tax
VFD	Variable Frequency Drive
VRF	Variable Refrigerant Flow
VSD	Variable Speed Drive

Currency units

KHR	Khmer Riel
EUR	Euro
USD	United States Dollar

Conversion rate as of 21.09.2023

EUR 1 = KHR 4,389
USD 1 = KHR 4,117
USD 1 = EUR 0.94

Technical units

kW	Kilowatt
MW	Megawatt
GW	Gigawatt
kWh	Kilowatt hour
MWh	Megawatt hour
GWh	Gigawatt hour
kVA	Kilovolt-ampere
kWp	Kilowatt peak
GWp	Gigawatt peak
TPES	Total Primary Energy Supply
TJ	Terajoules
TR	Tonnes of Refrigeration
GJ	Gigajoules
hp	Horsepower

ENERGY SOLUTIONS – MADE IN GERMANY

The German Energy Solutions Initiative

The German Energy Solutions Initiative, coordinated and financed by the German Federal Ministry for Economic Affairs and Climate Action (BMWK), aims to globalise German and European technologies and expertise in climate-friendly energy solutions.

Years of promoting smart and sustainable energy solutions in Germany have led to a thriving industry known for world-class technologies. Thousands of specialised small and medium-sized enterprises (SMEs) focus on developing renewable energy systems, energy efficiency solutions, smart grids and storage technologies. Cutting-edge energy solutions are also built on emerging technologies like Power-to-Gas, fuel cells and green hydrogen. The initiative's strategy is shaped around ongoing collaboration with the German business community.

THE PROJECT DEVELOPMENT PROGRAMME (PDP)

Implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the Project Development Programme (PDP) is an integral part of the German Energy Solutions Initiative. The PDP combines development cooperation with private-sector engagement to promote climate-friendly energy solutions and facilitate market access for German and European small businesses in selected developing and emerging countries. This fosters economic growth and international cooperation, and contributes to climate change mitigation. The PDP works closely with the German Chambers of Commerce Abroad (AHK) to implement tailor made local solutions.

The PDP team keeps a constant eye on key market sectors in the target countries for providers of climate-friendly energy solutions. Using these insights, they generate sector analyses for areas where renewable energies or energy efficiency measures can compete effectively without extra subsidies.

PROJECT OPPORTUNITIES IN DEVELOPING AND EMERGING COUNTRIES

The markets in developing countries and emerging economies are promising, but also pose challenges for international business partners. The PDP team provides free and impartial advice to local companies, in particular, and puts them in contact with German or European business partners.

The team collects data from the energy consumer and evaluates it from a technical and economic perspective, thus developing financially viable projects focused on renewable energies and energy efficiency with local companies. It also offers business initiation opportunities with German or European small and mid-sized companies.

At the same time, the project provides training courses, analyses and studies on the risks and potential of renewable energies to help support market development. Visiting reference projects within the countries also promotes the creation of private-sector business partnerships.

In addition to commerce and industry, operators of refugee camps are a further target group for the transition to renewable energies as many still use diesel generators to supply energy or water.

The focus of activities currently lies in 15 countries across Southeast Asia, South Asia, Sub-Saharan Africa, and the Middle East.

Executive summary

As per the local energy service providers and experts, Cambodia has a massive demand for energy efficiency services and equipment. By improving energy efficiency in the industrial, commercial and building sectors, Cambodia can save up to 40% in electrical and thermal energy.

The sector analysis provides information on energy efficiency applications, the current state of the energy efficiency market, incentive regulations and identifies areas with significant potential for energy savings, particularly for German and European service providers of climate friendly energy solutions specialising in energy efficiency and interested in entering the Cambodian market. The analysis highlights the state of energy efficiency in Cambodia, political measures to improve energy efficiency and key focus areas. The study offers insights into the market and energy efficiency status of garment, textile and footwear manufacturing, commercial building, rice milling and ice manufacturing, providing insights into their market size and energy efficiency status. The analysis also includes detailed descriptions of each sector's production processes and recommended short-to-long-term energy efficiency measures.

The analysis sheds light on the political, economic and technical preconditions for more energy efficiency in the economically emerging country. The sector analysis also presents the market entry conditions in the Southeast Asian kingdom offered to foreign investors and the special features that must be considered when doing business.

Zusammenfassung

Kambodscha verzeichnet laut lokalen Energieversorgern und Experten eine hohe Nachfrage nach Energieeffizienzdienstleistungen und -geräten. Durch Optimierungen in den Bereichen Industrie, Gewerbe und Bauwesen könnte das Land bis zu 40 % an elektrischer und thermischer Energie einsparen.

Die Sektoranalyse bietet insbesondere deutschen und europäischen Anbietern klimafreundlicher Energielösungen, die auf Energieeffizienz spezialisiert sind und einen Markteintritt in Kambodscha planen, wichtige Informationen zu Energieeffizienzanwendungen, dem aktuellen Marktzustand, zu Anreizregelungen und identifiziert Bereiche mit hohem Potenzial für Energieeinsparungen.

Die Analyse erläutert den aktuellen Stand der Energieeffizienz in Kambodscha, beleuchtet politische Maßnahmen und identifiziert Schlüsselbereiche. Dabei wirft sie einen Blick auf die Märkte für Bekleidungs-, Textil- und Schuhherstellung, gewerbliche Gebäude, Reismühlen und Eisproduktion, inklusive Marktgröße und Energieeffizienzstatus. Detaillierte Beschreibungen der Produktionsprozesse werden präsentiert, begleitet von Empfehlungen für kurz- bis langfristige Energieeffizienzmaßnahmen.

Die Analyse beleuchtet die politischen, wirtschaftlichen und technischen Voraussetzungen für eine Steigerung der Energieeffizienz in Kambodscha. Dabei werden auch die Markteintrittsbedingungen für ausländische Investoren sowie spezielle Aspekte für Geschäftsaktivitäten im südostasiatischen Königreich herausgestellt.

ENERGY EFFICIENCY IS GAINING IMPORTANCE

Cambodia's hunger for energy is growing - with population growth, a growing middle class and increasing industrialisation. In industry alone, electricity consumption increased more than tenfold between 2009 and 2019, and this trend continues.

At the same time, the unsustainable and comparatively expensive energy supply threatens to put the brakes on Cambodia's economic development. Outdated and inefficient machinery, a lack of knowledge about potential savings and financing problems prevent energy from being used more consciously and sparingly. Energy audits rarely take place. Only a few companies in Cambodia offer energy efficiency services. Their range of services and their scope are limited.

The country, with 17 million inhabitants, wants to take countermeasures to reduce energy costs and greenhouse gas emissions. The National Energy Efficiency Policy (NEEP) is the landmark legislation that puts forward several potential instruments that the government may consider to kick-start the development of the energy efficiency market. The NEEP aims to reduce energy consumption in industry and buildings by 25% and in the transport sector by 15%[1]. This new legislation paves the government's pathway in developing potential instruments in tax incentives on energy efficiency equipment and appliances along with energy efficiency promotion in buildings and industries.

1 The sector analysis was carried out during the stage of NEEP approval, commonly called a draft NEEP. The draft NEEP was approved in January 2023.

ENERGIEEFFIZIENZ GEWINNT AN BEDEUTUNG

Der Hunger Kambodschas nach Energie wächst - durch Bevölkerungszuwachs, einer wachsenden Mittelschicht und zunehmender Industrialisierung. Allein in der Industrie hat sich der Stromverbrauch zwischen 2009 und 2019 mehr als verzehnfacht, und dieser Trend setzt sich fort.

Gleichzeitig bedroht die nicht nachhaltige und vergleichsweise teure Energieversorgung das Wirtschaftswachstum Kambodschas. Veraltete und ineffiziente Maschinen, mangelndes Wissen über potenzielle Einsparungen und Finanzierungsprobleme verhindern eine bewusstere und sparsamere Nutzung von Energie. Energieaudits werden nur selten durchgeführt. Nur wenige Unternehmen in Kambodscha bieten Dienstleistungen zur Steigerung der Energieeffizienz an. Der Umfang und die Bandbreite ihrer Angebote sind begrenzt.

Um die Energiekosten und den Treibhausgasausstoß zu verringern, ergreift das Land mit seinen 17 Millionen Einwohnern Maßnahmen. Die Nationale Energieeffizienzpolitik (NEEP) ist ein wegweisendes Gesetz, das verschiedene mögliche Instrumente vorstellt, die die Regierung in Betracht ziehen könnte, um die Entwicklung des Marktes für Energieeffizienz anzukurbeln. Ziel der NEEP ist eine Reduzierung des Energieverbrauchs in Industrie und Gebäuden um 25 % sowie im Verkehrssektor um 15 %[2]. Diese neue Gesetzgebung ebnet den Weg für potenzielle Maßnahmen wie Steuervergünstigungen für energieeffiziente Geräte sowie die Förderung von Energieeffizienz in Gebäuden und der Industrie.

2 Die Sektoranalyse wurde in der Genehmigungsphase des NEEP-durchgeführt, die gemeinhin als NEEP-Entwurf bezeichnet wird. Der Entwurf des NEEP wurde im Januar 2023 genehmigt.

GERMAN EXPERTISE IS IN DEMAND

Working with German and European companies offering climate-friendly energy solutions is a promising opportunity for many Zambian local businesses and energy providers. By collaborating with regional electricity suppliers, German and European service providers can create a network of local contacts and establish the necessary relationships for successful company operations in Zambia. Having such local connections is critical for navigating the complex business landscape in the country and understanding the unique challenges and opportunities in the renewable energy sector.

For German and European service providers active in the energy sector, Zambia presents significant potential for business development. There are clear needs across the solar energy and storage value chain, including project development and financing, equipment manufacturing, system integration and contracting. In this context, German and European suppliers can benefit from engaging with Zambian industrial companies directly or working through local EPC contractors to deliver their products and services. By leveraging their expertise and technological capabilities, German companies can help to bridge the gap between Zambia's underdeveloped renewable energy sector and the growing demand for clean energy sources.

DEUTSCHE EXPERTISE IST GEFRAGT

Die Zusammenarbeit mit deutschen und europäischen Anbietern klimafreundlicher Energielösungen bietet vielversprechende Perspektiven für sambische Firmen und Energieversorger. Durch Partnerschaften mit regionalen Stromversorgern können deutsche und europäische Anbieter lokale Netzwerke aufbauen und Beziehungen für erfolgreiche Geschäftsaktivitäten knüpfen. Lokale Verbindungen sind entscheidend, um die komplexe Geschäftswelt des Landes im Bereich erneuerbarer Energien zu verstehen.

Für deutsche und europäische Anbieter im Energiesektor eröffnet sich in Sambia erhebliches Geschäftspotenzial entlang der gesamten Wertschöpfungskette von Solarenergie und Speicherung, einschließlich Projektentwicklung, Finanzierung, Herstellung oder Distribution von Ausrüstungen, Systemintegration und Vertragswesen. Deutsche Anbieter können durch direkte Kooperation mit sambischen Industrieunternehmen oder die Bereitstellung ihrer Produkte und Dienstleistungen über lokale EPC-Vertragspartner von dieser Entwicklung profitieren. Ihr Fachwissen und ihre technologischen Fähigkeiten ermöglichen es deutschen Unternehmen, die Kluft zwischen dem sambischen Sektor für erneuerbare Energien und der steigenden Nachfrage nach sauberen Energiequellen zu schließen.

1

Country profile – Cambodia

1.1 General information

The Kingdom of Cambodia is a Southeast Asian country and the direct heir of the Khmer Empire, which between the 9th and 15th century BC reigned over the majority of the Indochina Peninsula. The country reached its modern form when it became independent from France in 1953. The vast majority of Cambodians are part of the Khmer ethnic group, while small ethnic groups include the Cham, as well as Laotian, Thai, Vietnamese and Chinese communities (NIS, 2020). Buddhism is established as a national religion by Article 43 of the Constitution; over 95% of the population is Buddhist (NIS, 2020).

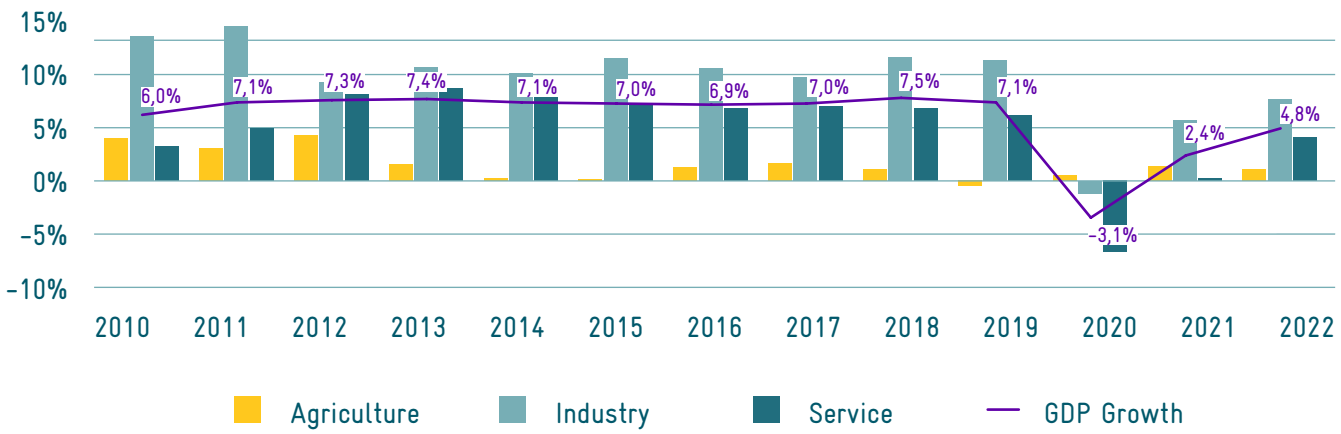
Cambodia is a constitutional monarchy, with His Majesty King Norodom Sihamoni reigning since 2004. The Royal Government of Cambodia (RGC) is headed by His Excellency Prime Minister Hun Sen. The Council of Ministers is comprised of representatives from the ruling Cambodian People's Party (CPP). Prime Minister Hun Sen and the CPP have been in a leadership position since 1985.

1.2 Cambodian economic development

Cambodia's GDP more than tripled between 1998 and 2019, growing at an average annual pace of 7.7% (World Bank, 2022). However, in 2020 the COVID-19 crisis had a detrimental impact on the four major sectors of Cambodia's economy: tourism, manufactured exports, agriculture and construction. The GDP contracted by 3.1% in 2020, its worst performance since 1994 (World Bank, 2022). In 2021, the RGC relaxed travel restrictions in an effort to sustain business activity and relaunch tourism, leading the GDP to an estimated USD 29.8 billion, a growth of 2.4% since 2020 (MEF, 2022).

Cambodia used to be a predominantly subsistence-based agricultural country and has been transitioning into a secondary and an industrial economy. In 2021, the GDP contribution share was divided between Service (36.6%), Industry (34.8%), Agriculture (22.4%) and other sectors (6.2%) (MEF, 2022). The Royal Government of Cambodia (RGC) has supported this economic transition through sound macroeconomic management, increasing foreign direct investment, ensuring high labour force participation, growing domestic resource mobilisation and improving public services. In particular, the RGC has clearly articulated the country's development objectives in its Rectangular Strategy (RGC, 2018).

FIGURE 1. Growth and breakdown of the Cambodian GDP per sector



Source: MEF (2022)

1.3 Key economic sectors of relevance

GARMENTS, TEXTILE AND FOOTWEAR

Since the end of the 1990s, Cambodia has built a considerable export-oriented Garment, Footwear and Textile (GFT) industry. The GFT industry is the largest manufacturing sector of Cambodia, accounting for close to 80% of the country's exports, with a total estimated value of USD 8 billion per year. Pre-COVID-19, the GFT sector employed approximately one million people in Cambodia. Approximately 800 factories are registered with Cambodia's National Social Security Fund – 600 of which are part of the Garment Manufacturers Association in Cambodia (GMAC). Established in 1996 and based at the Phnom Penh Special Economic Zone (PPSEZ), GMAC is the industrial trade body that represents garment, footwear, travel goods and other apparel-related products in Cambodia.

In 2019, imports represented USD 22.2 billion, while exports amounted to USD 14.9 billion (EuroCham, 2021). While Cambodia imports a wide range of commodities, exports are largely concentrated on manufactured garment and textile goods, as well as non-processed agricultural products to a minor degree. Most of Cambodia's factories are foreign-owned, with Chinese, Taiwanese, Singaporean and Malaysian investors being most prominent. With a predominant focus on labour-intensive, low-value-added assembly operations, investors benefit from the country's low-cost labour force. Indeed, Cambodia remains largely unable to weave fibre or extrude yarn because such production lines require adequate, reliable and low-cost electricity supply; as a result, such inputs are imported from other Asian countries. Therefore, a large share of Cambodian garment factories are merely operating in Cut, Make and Trim (CMT), whereas only one fourth of them are engaged in downstream production like embroidery, washing, packaging and, eventually, export of finished goods.

CONSTRUCTION AND REAL ESTATE

For the past decade, construction has been a key pillar of Cambodian economic development and has constituted a significant lever for growth: in 2018, construction accounted for 7% of the GDP (Trading Economics, 2022). Only low added-value and basic construction materials such as Portland cement, bricks, timber, sand, gravel and fabricated metal are sourced in Cambodia, while higher added-value products are overwhelmingly imported from Thailand, Singapore, Malaysia or China.

Since 2000, the Ministry of Land Management, Urban Planning and Construction (MLMUPC) has approved 43,136 construction projects representing a total land area of 114 million square metres, with an estimated total investment capital over USD 43 billion (GBN, 2020). These investments are largely foreign-led: 51% of 2019 foreign direct investment volume was targeted in construction. Key investors primarily come from China, South Korea and Japan. Large-scale projects are often offered as Build-Operate-Transfer concessions.

1.4 Investment climate and market entry for foreign companies

CAMBODIAN MARKET ENTRY

Although the United Nations still classifies Cambodia as a least developed country (UN, 2021), the Kingdom has adopted foreign-investment policies that are more in line with those of more developed countries. Consequently, Cambodia is often considered one of the most open economies of Southeast Asia. A variety of business structures are available for foreign entities seeking to enter the Cambodian market, as shown below; business registration requirements differ based on the structure. Most foreign entrepreneurs setting up a company within

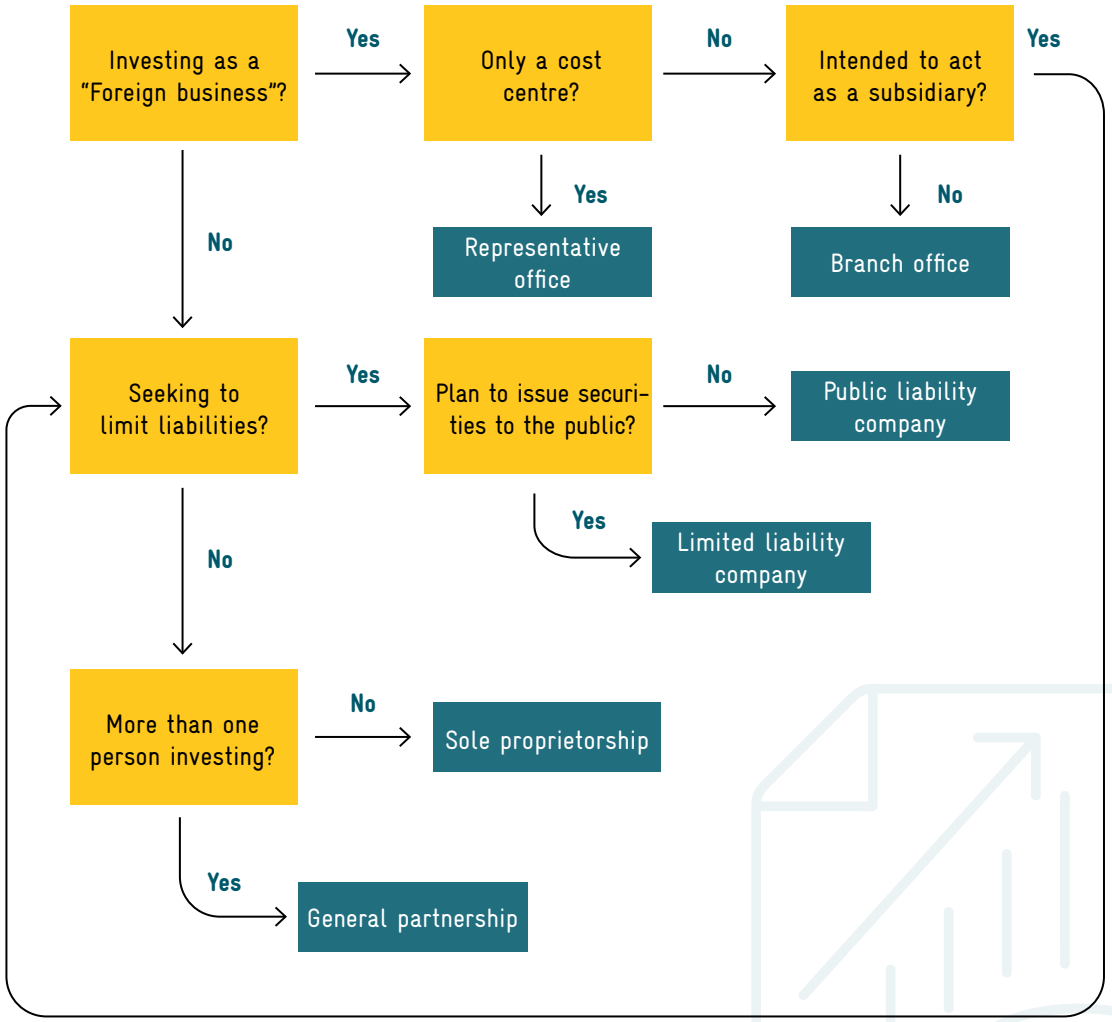
the Kingdom do so under a Limited Liability Company (LLC) structure, which limits the liabilities of shareholders to the capital invested in the company. Other business structures are also available, including some exclusively reserved for companies owned by a foreign parent company. There are few restrictions imposed upon foreign investment, with the notable exception of land ownership. Full ownership by foreigners is lawful, and the RGC provides incentives for foreign direct investment (FDI), including corporate tax holidays of up to eight years, a 20% corporate tax rate after the end of the tax-free period, duty-free import of capital goods and no restrictions on capital repatriation (USDOS, 2020).

FOREIGN DIRECT INVESTMENTS

FDIs have played a central role in Cambodia's economic development over the past decade and remain a top priority for the government.

In 2019, FDIs amounted to over USD 3.5 billion, marking a record 12% increase compared to 2018. Shifting from garment and textile manufacturing projects, the majority of approved FDI projects now focus on construction projects and real estate, followed by tourism.

FIGURE 2. Decision diagram for recommended business entity status for foreign investment in Cambodia



Source: Authors' own compilation, Sevea Consulting (2022), based on various sources

1.5 Cambodian relations with Germany

GERMANY-CAMBODIA BILATERAL RELATIONSHIP AND TRADE STATISTICS

Cambodia is one of the priority countries in Germany's development cooperation in Southeast Asia (Auswärtiges Amt, 2021). In 2020, German bilateral ODA funding to Cambodia amounted to USD 34.7 million in the form of grants, and USD 0.93 million in the form of gross loans (OECD, 2022). Overall, according to the Cambodian Rehabilitation and Development Board, Germany has contributed to 104 distinct bilateral ODA projects in Cambodia since the early 2000s, amounting to a total budget of over USD 700 million (CDC, 2021). A full list of completed and ongoing German ODA projects is provided in Table 16.

PRESENCE OF GERMAN COMPANIES IN CAMBODIA

Several large German firms have established a presence in Cambodia, either to strengthen their manufacturing operations in the country, or to distribute goods and services within the Kingdom. These include automotive brands, engineering and equipment manufacturing companies (Bosch, Siemens, Kärcher), financial and development institutions (Commerzbank, KfW), logistics groups (DB Schenker, DHL, Rhenus), as well as construction giant Bauer, inspection services company TÜV Rheinland, garment manufacturer and distributor Adidas and fastener supplier Würth.

TABLE 1. Breakdown of the top 10 largest trades between Cambodia and Germany in 2021

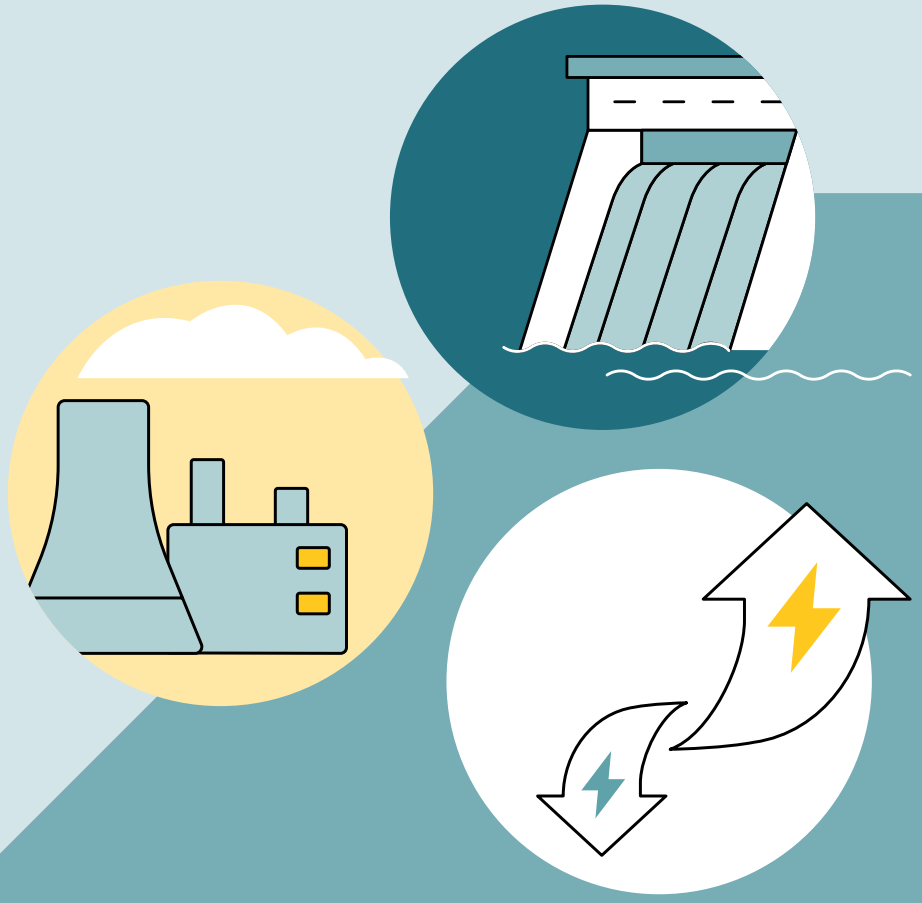
LARGEST EXPORTS FROM GERMANY TO CAMBODIA	
Machinery and mechanical appliances	USD 59 m
Vehicles	USD 52 m
Pharmaceutical products	USD 26 m
Products of the milling industry, malt, etc.	USD 19 m
Electrical machinery and equipment	USD 8 m
Paper, paperboard, articles of paper	USD 7 m
Products of animal origin	USD 6 m
Optical, photographic, etc. instruments	USD 6 m
Impregnated, coated, etc. textile fabrics	USD 5 m
Lac, gums, resins, vegetable saps	USD 5 m
Total in 2021	**USD 219 m**

LARGEST EXPORTS FROM CAMBODIA TO GERMANY	
Articles of apparel (knitted or crocheted)	USD 920 m
Articles of apparel (not knitted or crocheted)	USD 407 m
Footwear, gaiters and the like	USD 234 m
Vehicles (bicycles)	USD 188 m
Articles of leather, saddlery and harness	USD 38 m
Cereals (mostly rice)	USD 12 m
Headgear and parts thereof	USD 9 m
Toys, games and sports requisites	USD 8 m
Electrical machinery and equipment	USD 5 m
Other made-up textile articles, etc.	USD 5 m
Total in 2021	**USD 1,845 m**

Source: Statistsches Bundesamt (2022)

2

Cambodian power sector overview



2.1 Energy sector development policies and strategy for EE development

ENERGY SECTOR DEVELOPMENT

The energy sector in Cambodia has experienced significant growth since the early 2000s, driven by the government's focus on increasing energy access, reducing energy costs and enhancing energy security. The sector has primarily concentrated on large-scale centralised generation and transmission infrastructure, with involvement from the private sector.

Biomass, particularly wood and charcoal, is the primary source of energy in Cambodia, fulfilling about 50% of the total energy demand. It is mainly used for domestic cooking and increasingly for industrial purposes.

Cambodia relies entirely on imports to meet its oil demand. Attempts to exploit offshore oil and gas deposits in the Gulf of Thailand have been unsuccessful so far. The country lacks operational oil refineries, but imports petroleum products through various local and international oil companies, distributed via petrol stations and petroleum terminals.

Hydropower has seen significant growth, reaching a combined installed capacity of 1,331 MW in 2022, accounting for half of Cambodia's total installed power generation capacity. The country's untapped hydropower potential has led to plans for 12 new hydroelectric dam projects by 2030, adding 2,840 MW of capacity.

Cambodia's coal-fired power plants began operating in 2014, and now have a total installed capacity of 675 MW. The coal used is solely imported, primarily by barge. These plants do not fully adhere to international pollution control standards and are generally less efficient than newer facilities. However, Cambodia has pledged to no longer invest in new coal-fired power plants while continuing its existing contracts.

Cambodia benefits from abundant and reliable solar radiation levels, making solar power a viable option. Several solar farms with a total installed capacity of nearly 400 MWp have been commissioned since 2017 (EAC, 2021). However, solar power is expected to remain a relatively small share in the energy mix, with Electricité du Cambodge (EDC) aiming to cover 17% of electricity demand with solar energy by 2030 (CCIFC, 2022).

ENERGY EFFICIENCY DEVELOPMENT

Cambodia's economic transition, and, in particular, the development of the manufacturing and tourism industries, as well as the emergence of a growing middle class have significantly increased the use of energy per capita. Keeping up with the growth in power demand has been and continues to be a major challenge for the Cambodian energy sector. Energy efficiency in Cambodia is still in its infancy, although it has been recognised as a critical topic to ensure the sustainable and low-carbon development of the country while helping to relieve part of the growing pressure on the energy sector. In addition, the cornerstone of the development of Cambodia's EE sector is the National Energy Efficiency Policy 2021–2035, which defines five strategic pillars:

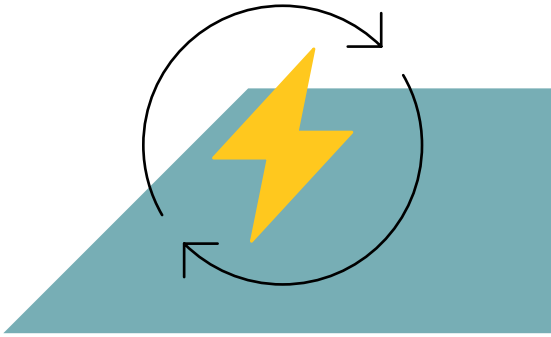
1. Creating a regulatory and legal framework for energy efficiency initiatives.
2. Setting up the governance structure for energy conservation.
3. Building capacity.
4. Raising awareness among the general population and energy operators.
5. Mobilising appropriate funding.

These strategic approaches in NEEP emphasise the need to drive retrofits of existing infrastructure in commercial and industrial sectors as well as the introduction of EE technologies and services through ESCOs, while providing them with an opportunity to position themselves efficiently. The NEEP provides the first step in developing the energy performance contract market in Cambodia. The policy is comprehensive and ambitious, and it will prove to be a helpful tool to drive the country's efforts in the future. Since Cambodia has a limited amount of resources compared to that of developed countries, it can use the experience accumulated by developing countries such as Germany that have already been down this road.

TABLE 2. Quantitative policy targets related to EE in Cambodia

KEY POLICY	SCOPE	TARGET
Cambodia's updated Nationally Determined Contribution (NDC) submitted to the UNFCCC (EAC, 2021)	Carbon emissions	To reduce GHG emissions by 42% in 2030 compared to the business-as-usual scenario, equivalent to an overall reduction of 64.5 MtCO2e per year When compared to a business-as-usual scenario, to reduce the annual GHG emissions associated with the energy sector by 40% and the industry sector by 42% in 2030
Cambodian Sustainable Development Goals (CSDG) Framework 2016–2030 (RGC, 2018)	Energy intensity	To reduce the ratio of the total primary energy supply with the GDP (toe/USD PPP) from 0.39 in 2015 to 0.32 in 2030 (Goal 7.3)
National Energy Efficiency Policy 2021–2035 (Draft) (RGC, 2022)	Energy consumption	Reduce final energy consumption in 2030 compared to business-as-usual: • 20% in the industrial sector • 34% in the residential sector • 25% in commercial buildings (including public buildings) • 29% in public services • 5% in the transport sector

Source: UNDP (2020)



2.2 Administrative division of responsibilities

The primary legislation regarding the use and development of the power sector is the Law on Electricity adopted by the National Assembly. Four government organisations provide the governance framework for all electric power supply and electrical services in Cambodia.

MINISTRY OF MINES AND ENERGY (MME)

Responsible for setting and administrating the government policies, strategies and planning in the power sector. The MME governs and is the main shareholder of EDC.

MINISTRY OF ECONOMY AND FINANCE (MEF)

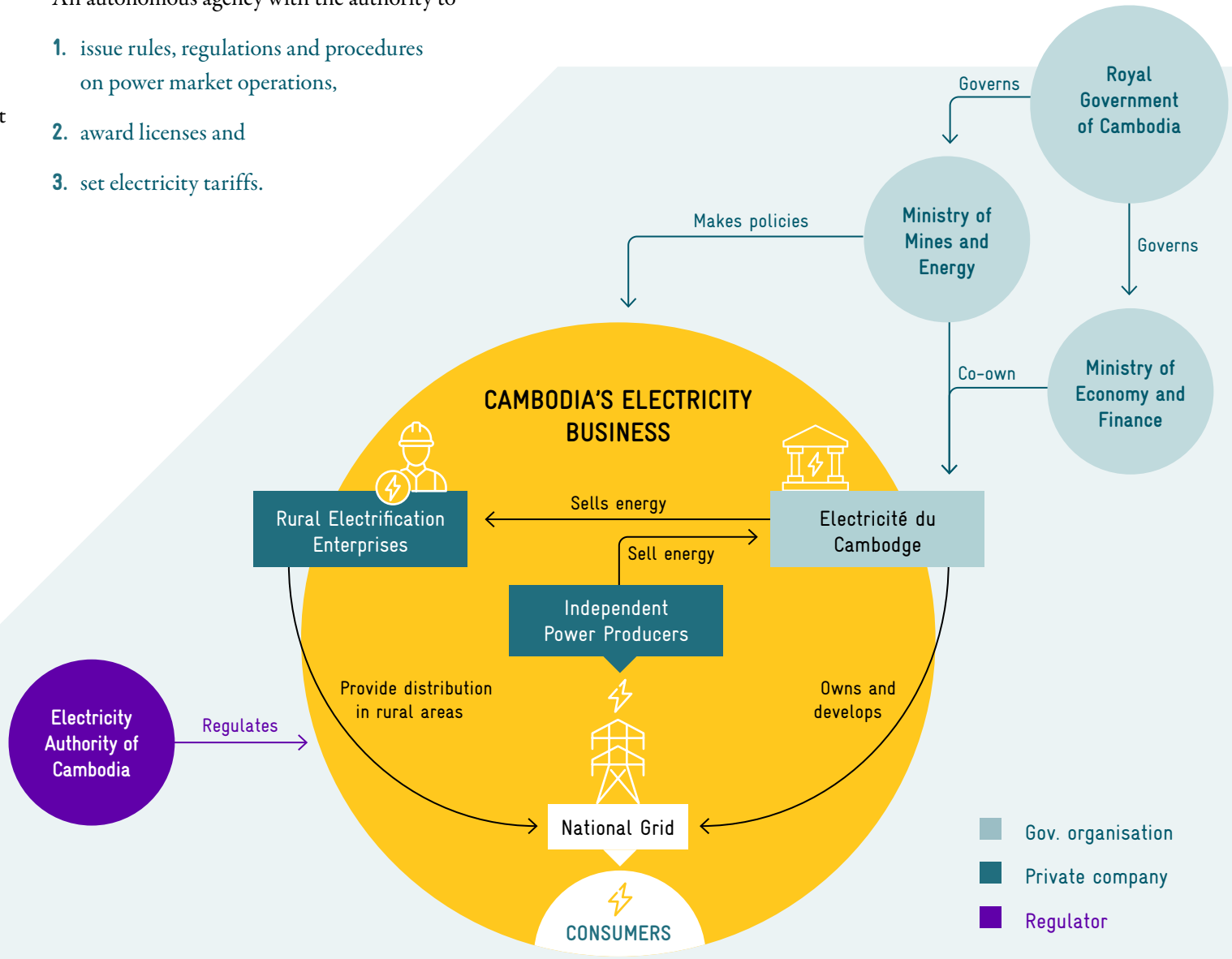
As co-owner of EDC, facilitates its access to long-term and concessional finance and plays an important role in setting the energy policy. The MEF is the government's focal point for structural reform, international economic and financial cooperation, and integration, lobbying for foreign aid and preparation of plans for borrowing and repayment of foreign loans.

ELECTRICITY AUTHORITY OF CAMBODIA (EAC)

An autonomous agency with the authority to

1. issue rules, regulations and procedures on power market operations,
2. award licenses and
3. set electricity tariffs.

FIGURE 3. Organisation of the Cambodian electricity business



Source: (EAC, 2021)

ÉLECTRICITÉ DU CAMBODGE (EDC)

EDC is the national power utility. It is in charge of transmitting and distributing electricity in areas assigned to it by the EAC. It is jointly owned by the MME and MEF and is the only public sector licensee of the EAC. EDC is in charge of all power purchase agreements both for energy imports and with independent power producers. Despite its prominent role in the power sector, EDC produces only a fraction of the national electricity.

2.3 Power generation and consumption

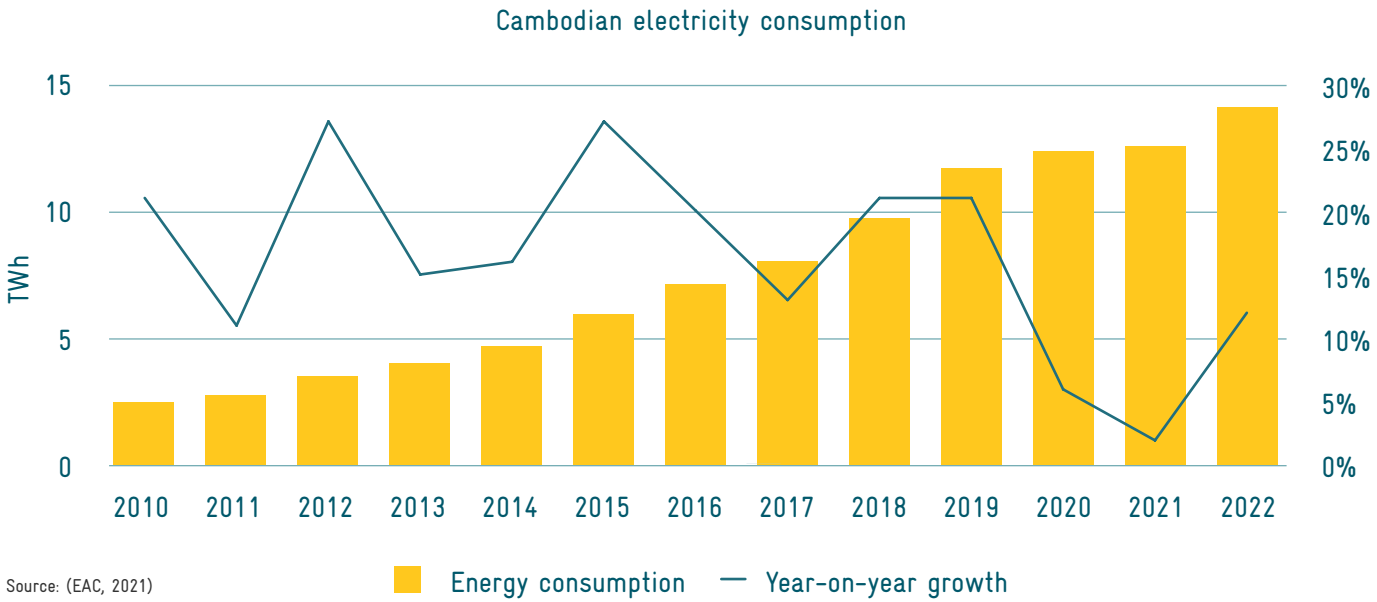
In line with Cambodia's steep economic development, the electricity sector has evolved exceptionally within the past 15 years. National electricity consumption has been increased fivefold since 2010, and reached 12.6 TWh in 2021, despite two years of relatively weak growth due to the economic slowdown caused by the COVID-19 crisis. However, electricity consumption picked up with force in 2022, and is expected to exceed 14 TWh (EAC, 2021).

Cambodia's electricity mix is largely supported by one-third local hydropower, one-third coal and one-third imports from Vietnam, Lao PDR and Thailand. In the upcoming years, the fossil-hydro-import mix will continue to be favoured by the RGC to address the restless growth of consumption. Current 2030 plans include the commissioning of 11 new coal-fired power plants with a total 2,970 MW of capacity, and 12 new hydroelectric dams accounting for 2,840 MW (CCIFC, 2022).

In 2022, over 99% of the grid connections were single-phase low voltage. Although the commercial and industrial sector represent only 0.6% of user connections, they account for 35.8% of the country's electricity consumption.

Since 2010, in line with the sharp development of the Cambodian economy as well as the rapid expansion of the industrial sector, both the electricity consumption per capita and the energy intensity of the GDP steadily rose, reaching 700 kWh per year in 2021 from 180 kWh in 2010.

FIGURE 4. Evolution of Cambodian electricity consumption



Source: (EAC, 2021)

2.4 Electricity and fuel tariffs, historic data, future forecast

FUEL

The fuel price is set at national level by both the Ministry of Mines and Energy and the Ministry of Commerce; every formal gas station in the country (i.e. having a licence with the MME) must follow these tariffs. Tariffs are re-evaluated every 15 days, based on

1. international oil prices,
2. discussions with the private sector,
3. economic prospects for the Cambodian economy.

Due to this regulation, the fuel price in the country has remained fairly stable.

ELECTRICITY TARIFFS

The electricity tariffs are set at national level by the Electricity Authority of Cambodia and apply to all licensees. Between 2011 and 2020 the tariffs were reduced on a yearly basis; however, the electricity tariffs have been frozen since the beginning of the COVID-19 crisis. Since 2018, a time-of-use (ToU) tariff with a promotional rate for night-time consumption has been introduced for consumers connected to MV or HV lines but has only been adopted marginally.

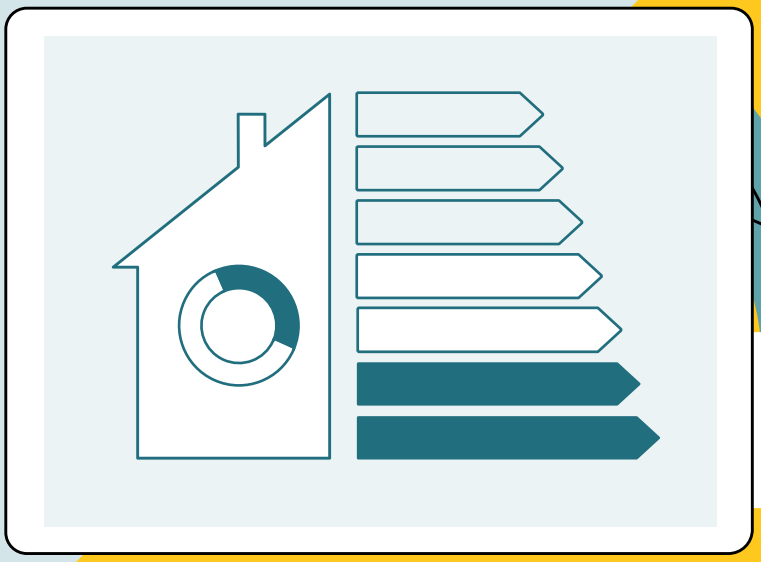
TABLE 3. Electricity tariff in Cambodia

TARIFF STRUCTURE	(I) GENERAL TARIFF	(II) TIME-OF-USE TARIFF			(III) SOLAR PV TARIFF	
Description	Flat-rate kWh tariff throughout the day. Still applies to a large majority of consumers.	The ToU tariff is divided into two parts: • Capacity charge (USD/kW): a fixed cost calculated based on the contracted capacity. • Electricity charge (USD/kWh): a variable cost based on the amount of energy consumed each month.			The solar PV tariff is compulsory for all PV system owners. Solar users are subject to the 2023 tariff until further notice for compensation tariff from EAC.	
Consumer		Monthly capacity charge	Peak hours tariff (7 am–9 pm)	Off-peak hours tariff (9 pm–7 am)	Monthly capacity charge	Electricity charge
Directly connected to a substation						
• High voltage	USD 0.1170/kWh	USD 2.00/kW	USD 0.1140/kWh	USD 0.0940/kWh	USD 2.90/kW	USD 0.1140/kWh
• Medium voltage						
• Phnom Penh and Ta Khmao	USD 0.1320/kWh	USD 2.50/kW	USD 0.1290/kWh	USD 0.0960/kWh	USD 4.00/kW	USD 0.1290/kWh
• Provinces	USD 0.1210/kWh	USD 2.50/kW	USD 0.1180/kWh	USD 0.0960/kWh	USD 3.10/kW	USD 0.1180/kWh
Connected to an HV or MV line						
• Industry & Agriculture consumers	USD 0.1370/kWh	USD 3.00/kW	USD 0.1300/kWh	USD 0.1100/kWh	USD 5.00/kW	USD 0.1300/kWh
• Commercial & Administration consumers	USD 0.1580/kWh	USD 3.50/kW	USD 0.1500/kWh	USD 0.1240/kWh	USD 5.80/kW	USD 0.1500/kWh
Connected to an LV distribution line						
• Residents (>200 kWh/month)	KHR 730/kWh	(approx. USD 0.1825/kWh)				
• Residents (51 to 200 kWh/month)	KHR 610/kWh	(approx. USD 0.1525/kWh)				
• Residents (11 to 50 kWh/month)	KHR 480/kWh	(approx. USD 0.12/kWh)				
• Residents (<10 kWh/month)	KHR 380/kWh	(approx. USD 0.095/kWh)				

Source: (EAC, 2023)

3

Analysis of EE applications and the market in Cambodia



3.1 Incentive regulation for EE by the government

To this day, the RGC is yet to publish specific regulations on EE incentives, except for the National Energy Efficiency Policy (NEEP), which was recently approved in March 2023. The policy allows the MME – in consultation with the MEF – to implement specific fiscal incentives using subordinate legislation. The legislation puts forward several potential instruments that the government may consider to kick-start EE market development:

- Tax incentives on EE equipment and appliances, as well as energy-efficient buildings and industries.
- Carbon emissions permit trading.
- Additional taxes to finance environmental protection measures.
- Incentives for the disclosure of EE activities in corporate annual reports.

The Law on Investment (adopted in October 2021, still needs to be promulgated through a sub-decree) identifies 19 priority FDI sectors that are eligible for tax incentives, among which "Green energy, technology contributing to climate change adaptation and mitigation" (RGC, 2021). Investment projects approved by the Council for the Development of Cambodia (CDC) are referred to as "Qualified Investment Projects" (QIPs).

In addition to fiscal incentives, the NEEP opens up the door to the creation of a public revolving fund providing concessionary loans to finance EE projects. The draft legislation does not elaborate on the concrete modalities of this credit line. However, the fund is expected to be implemented at the end of this year and should provide low-interest-rate loans to financial institutions on the condition that they, in turn, lend these funds for energy efficiency projects at below-market rates.

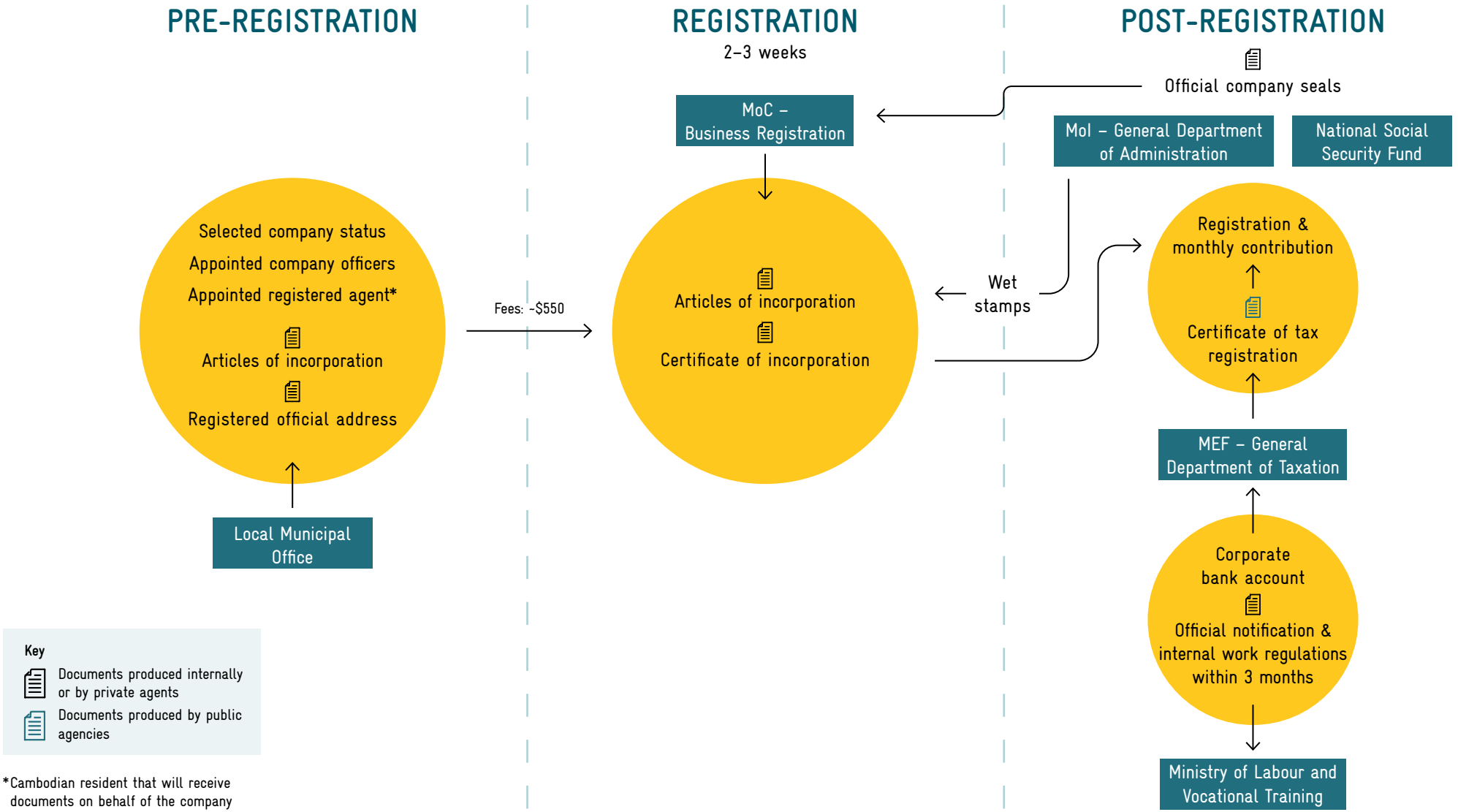
3.2 Investment procedures for EE application projects in graphs and diagrams

If an EE venture needs to be set up, the registration process is the same as that for other sectors. The RGC has recently pursued efforts to reduce processing times, including the development of the CamDX system, a one-stop service developed by the Ministry of Economy and Finance (MEF) for online business registration, which connects the information systems of all agencies involved in the process. However, the procedure is still long and complex.

Companies willing to register a business in Cambodia must first decide upon the legal status of the company, appoint directors and shareholders, apply for an official registered address through the mayor's office and draft the articles of incorporation. Documents must then be submitted to the CamDX system for review by the Business Registration Department within the Ministry of Commerce (MoC). Fees for registration and company name protection amount to approximately USD 550. The Certificate of Incorporation usually takes 2 to 3 weeks. The last fundamental document is the Certificate of Tax registration issued by the Ministry of Economy and Finance (MEF), for which the company can apply online. A list of formalities with different ministries ends the process: providing official corporate seals to the MoC, registering and contributing to the National Social Security Fund, notifying the Ministry of Labour and Vocational Training (MLVT) of the beginning of activities and providing them with internal work rules and conditions within 3 months (conditions of hire, wage payments, benefits, working hours, personal leave and health and safety measures).

Once the company holds stamped certificates of incorporation and tax registration, and stamped articles of incorporation, it can apply for Qualified Investment Project (QIP) registration. More details on the QIP registration process and required documents can be obtained **here**.

FIGURE 5. Decision diagram for recommended business entity status for foreign investment in Cambodia



Source: Authors' own illustration, Sevea Consulting (2022), based on ACCLIME website ACCLIME (2022)

3.3 Status quo of EE and contractual models

The EE market is currently limited within the Kingdom. The energy service company (ESCO) model does not yet exist, contrary to neighbouring countries such as Vietnam and Thailand, which tackled EE issues early on and identified ESCO as a key tool to boost EE retrofits.

The development of the market has been hindered by numerous obstacles:

- Absence of a regulatory framework for ESCO.
- Absence of EE-specific public procurement rules that account for the specificities of such projects.
- Overall lack of fiscal incentives from the RGC for EE projects.
- Lack of awareness from industrial players and residential/commercial building owners of the potential cost-saving opportunities.
- Limited monitoring, verification and evaluation (MVE) capacity.
- Lack of financing for EE retrofits.

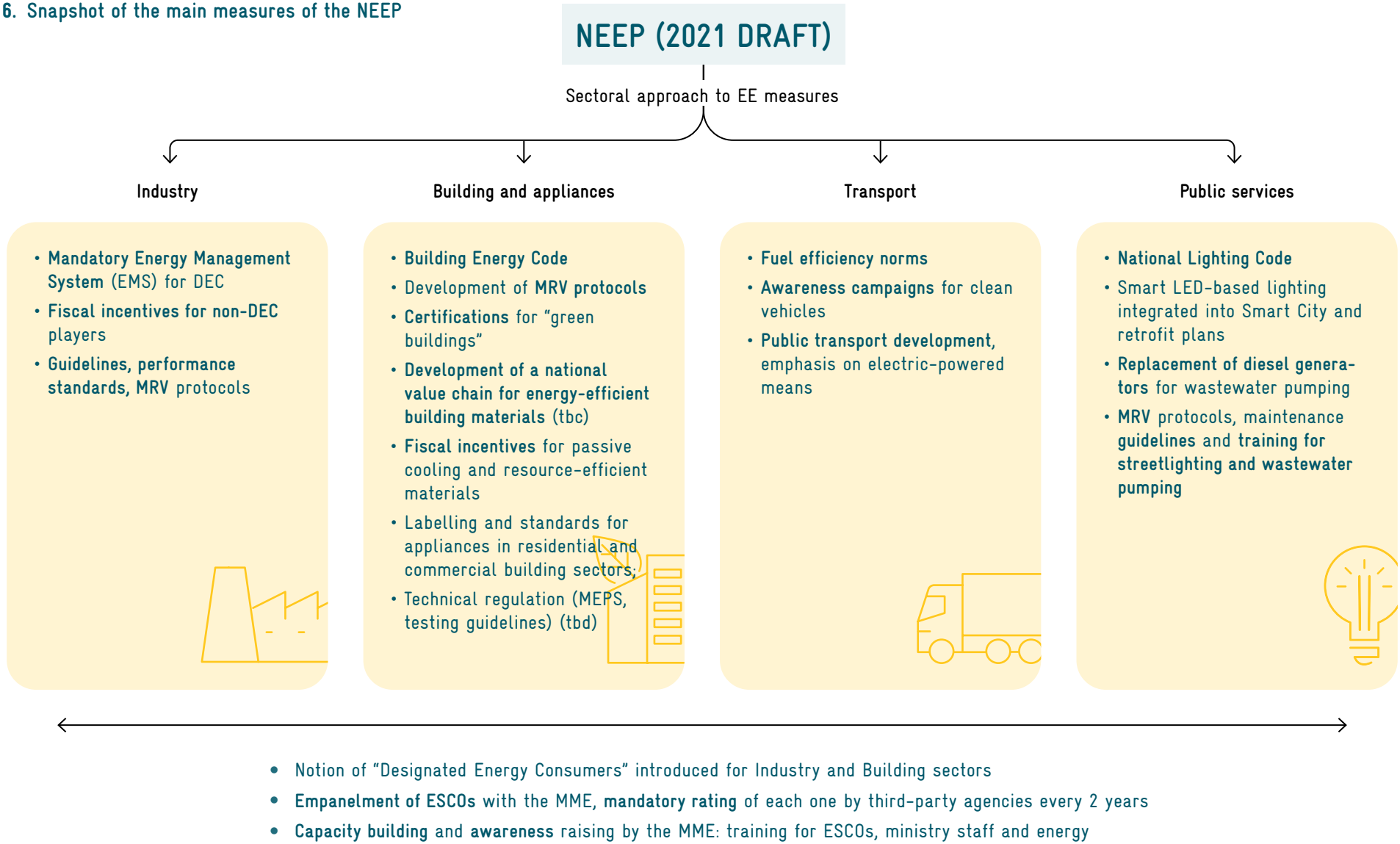
EE retrofits so far have been implemented by energy service providers (ESP), mostly foreign-owned solar firms, local Engineering, Procurement, Construction firms and local providers of energy-efficient technologies (machinery and equipment, appliances, lighting). Upfront costs are still the main criteria for purchasing decisions among industrial market players and building owners/developers, along with other traditional factors (quality, maintenance cost, after-sales services); energy efficiency is rarely considered. As a result, retrofits are dependent on concessional loans and grants, with two notable exceptions: LED lighting, which benefits from relatively short payback periods (1–2 years), and the solar panel market which is dominated by large foreign players and at a more advanced development stage (EMC, GGGI, 2021). Therefore, the NEEP regulation aims to overcome the aforementioned obstacles and kick-start the EE market in Cambodia by implementing a set of sectoral measures as described below.

3.4 Financing of EE projects

The EE market in Cambodia is underdeveloped, so is its financing. Although market data is insufficient to draw definitive conclusions, energy service providers generally let clients fully or partially assume financial responsibility for the project, requiring deposits that cover the upfront costs before purchasing the equipment needed. To cover the operational costs throughout the implementation of the project, they rely on follow-up payments from clients. When and if external funding is required, locally owned ESPs usually turn to capital and loans rather than traditional financial institutions, although a few have credit lines with local banks.

Along with the financial incentives mentioned in the "Incentive regulation for EE by the government" section, the government's main financial tool in the NEEP is the creation of a public revolving fund for EE projects.

FIGURE 6. Snapshot of the main measures of the NEEP



Source: Authors' own illustration, Sevea Consulting (2022), based on the draft NEEP, RGC (2022)

3.5 Local capacity for project implementation

Local capacity encompasses:

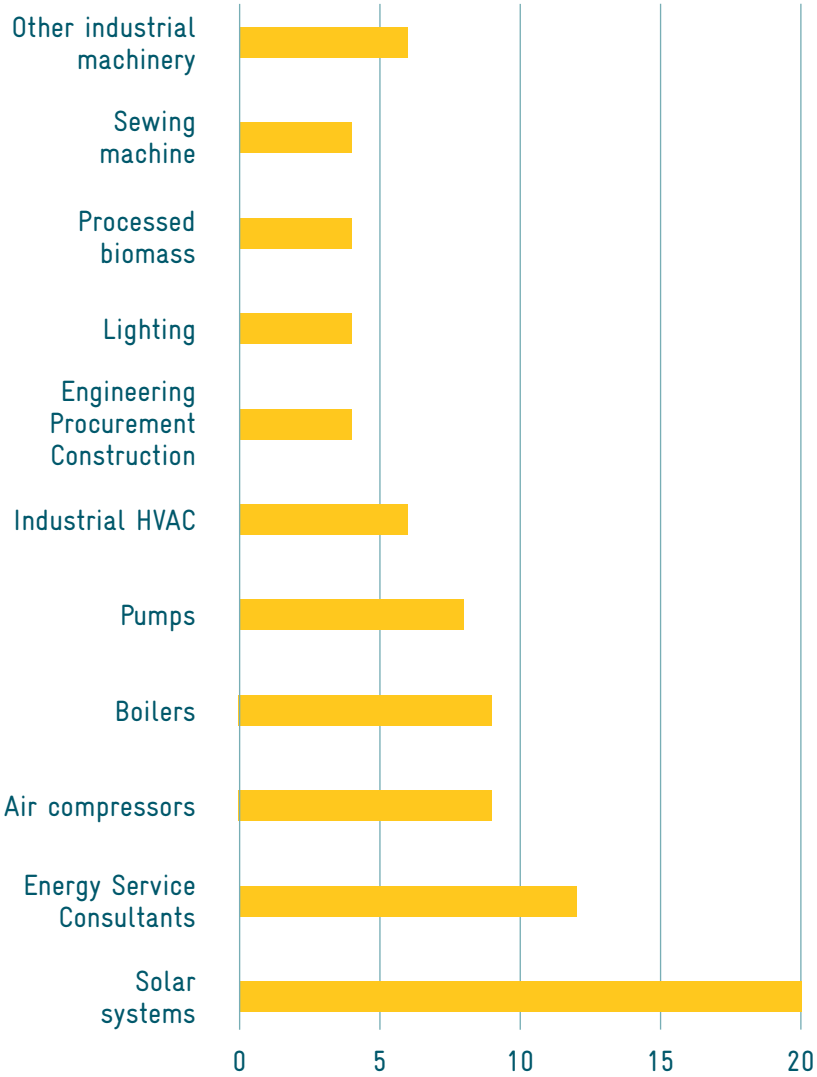
- a robust regulatory framework favourable to EE projects
- HR capacity for both internal hiring and to ensure efficient support from stakeholders (public agencies, energy auditors & consultants, construction)
- a robust supply chain and distribution networks within the country
- financial capacity (technical expertise from local financial institutions) – see previous section.

As far as the regulatory framework is concerned, it is very limited in Cambodia, but the NEEP and sub-legislation should provide for government support and a clear legal framework in the coming years.

In terms of HR capabilities, two sets of competencies are vital: "core competencies" that relate to technical hard skills (energy engineering and management, M&V, energy auditing, construction work, appliance installation, etc.) and "market competencies" (market positioning, sales, EE project financing, contracting, etc.). ESPs are already present and active within the country, although all of their activities are not EE-oriented. There are 86 providers active in the garment industry, the Kingdom's largest export industry (EMC, GGGI, 2021). Most of these ESPs are specialised in a single piece of machinery and equipment (50 in industrial machinery and equipment – represented in red in Figure 7, and 20 solar providers). Although such companies have developed "core competencies", they will lack the 360° project vision needed for EPCs (from project design to MRV) and are generally unfamiliar with the specificities of the ESCO business model.

The development of technical expertise and trained staff for EE projects will depend on the capacity of the RGC to design and roll out a plan to meet the HR capacity building objectives set out in the NEEP. The priority identified by the government is to identify knowledge gaps between required and existing skills and design courses (university and vocational training) to close the gap. Although the EE supply chain is not currently well structured due to the lack of an EE market, the sector will be able to capitalise on ESPs currently active in the country and on a well-developed construction sector, representing an estimated 15.3% of GDP in 2019 (NIS, 2021).

FIGURE 7. ESPs active in the garment sector



Source: EMC, GGGI (2021)

3.6 Opportunities and challenges for international actors

OPPORTUNITIES

Energy efficiency issues have barely been addressed in Cambodia so far, despite fast-growing energy demand that cannot be met with local energy production. The EE market potential is vast and remains almost entirely untapped. Following the NEEP regulation, the market is likely to grow from scratch and skyrocket in the first decade. Firstcomers will be able to build relationships with clients, public agencies, technical partners (energy auditors, construction) and financial institutions, co-developing expertise and seizing the most clear-cut energy-saving opportunities, therefore gaining a head start on future competitors.

Foreign ESPs with EE expertise will have a competitive advantage over local companies, especially if such firms have experience of EPC contracting, although such expertise will need to be adapted to the local context. In addition, large industrial and residential/commercial building owners will have needs covering multiple areas: replacement of several pieces of machinery and equipment, lighting, thermal insulation, etc. Therefore, large foreign ESPs/ESCOs with multi-sectoral expertise will have a competitive edge when it comes to winning large tender bids.

There are no significant restrictions for foreigners willing to set up a business in Cambodia, contrary to other Southeast Asian countries where full foreign ownership of local companies is not possible.

CHALLENGES

The NEEP legislation will need to be supplemented by related sub-legislation and technical guidelines, for which the release dates are still unclear. This creates uncertainty on the ideal timeline for the go-to-market strategy and provides a competitive advantage to local players who have more flexibility to make their move. Business registration and other initial formalities will take time and the Cambodian administration is notoriously complex to navigate. As a result, locally implemented businesses will benefit from a shorter time-to-market. However, most ESPs active in Cambodia are either unfamiliar with the specificities of the ESCO model or lack either the financial capacity needed for EPC contracting or the technical capacity to conduct large-scale EE retrofits. As an indication, the Garment industry ESP survey analysed 19 ESPs and only 2 of them had high ESCO suitability scores in both technical and financial capacities: the Lotus Green Team, an Engineering, Procurement and Construction company based in Phnom Penh specialised in the construction business, and NRG Solutions, a Cambodian solar energy provider which also offered energy consulting and commissioning/training services (EMC, GGGI, 2021).

The EE market is in its infancy in Cambodia and technical expertise is scarce. International players will need to compete with local companies to hire local engineering and technical sales teams with EE experience. Alternatively, international EE providers could resort to hiring foreign/regional staff or importing expertise from other countries in which they operate, but sales teams who speak Khmer and have local business knowledge may perform better.

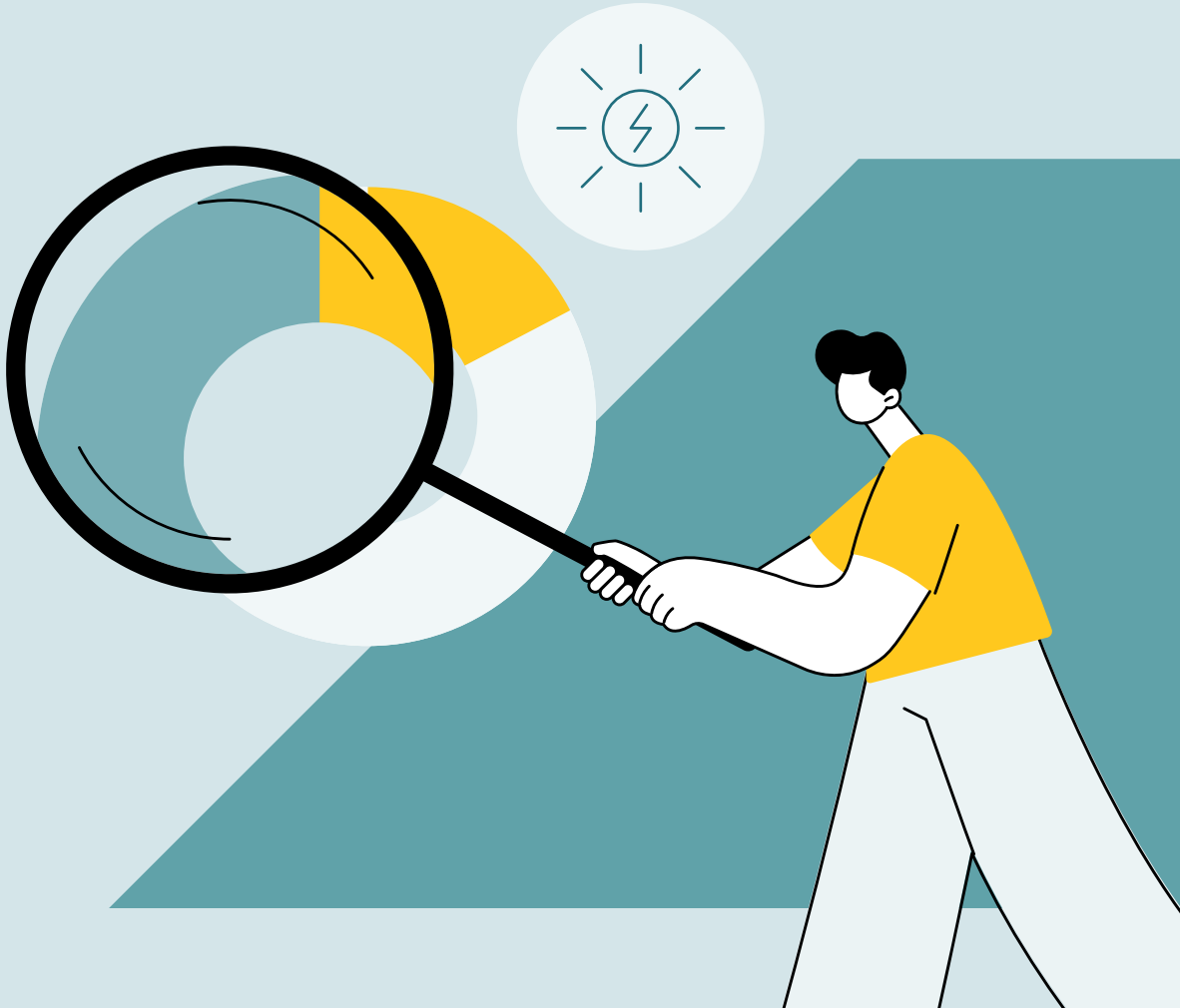
3.7 Recommendations for market entry

The topic of EE is relatively new in the Kingdom of Cambodia. Even though there are several existing laws, legislation, policies and strategies on energy, a solid policy and framework for EE is still to be issued. The development of a quality control label for different EE and RE sectors would be recommended to help raise awareness and trust amongst potential users of EE and RE technologies.

The new investment law aims to attract more investors by creating transparency, promoting investment within priority sectors, for small and medium-sized enterprises, and establishing the procedure and competent authority for registration. Under this new investment law, approval in the QIP registration process is within only 20 working days. It is recommended that foreign market players apply for QIP registration to avoid early taxation.

4

Economic sectors with high potential for EE applications



4.1 Sector overview

Priority target sectors were selected based on various criteria, including national economic significance, growth rate and relevance of the sector in the future, and an initial assessment of energy consumption levels. Subsectors were then identified based on:

1. the contribution of the subsector to the GDP and exports;
2. the potential for EE interventions;
3. the availability of information.

As a result of this cross-sectional analysis, 4 subsectors were identified: garment and textile; footwear; food processing (rice milling and ice factories); and commercial building.

TABLE 4. Garment and textile sector overview

Sector description	Cambodia's garment sector remains an assembly operation platform for low value-added apparel, with low manufacturing costs but relatively low productivity. The capital and material costs are predominant in the garments and apparel industry, 43.5% and 42% of total costs, respectively, while labour costs only account for 8.7% of costs. Energy is not a major item of expenditure but still represents 5.3% of total costs, while water expenses are insignificant – 0.5% (GGGI, 2018). Although productivity is lower in the Cambodian garment industry than in other established garment markets, such as Vietnam and China, the labour pool is younger, larger and less expensive. However, training costs are quite high as the fast-growing garment sector is forced to resort to hiring unexperienced labour.
Categorisation of companies into small, medium and large	Based on information from GMAC, garment factories can be split between three groups: small – approximately 500 employees, medium – 2,000 to 4,000 employees and large – between 5,000 and 15,000 employees.
Market export values	Exports: USD 10.3 bn, making up 53.2% of total exports in 2021 – including articles of leather, fur skin products (real or artificial) and excluding footwear and mattresses/linens (Department of Customs and Excise, 2022).
Number of actors	1,100 factories and branches, according to the Ministry of Labour and Vocational Training (MLVT) in 2020
Key industrial/ manufacturing processes	Garment factories have several energy-intensive operations that require a variety of different energy sources. Even though energy prices are high, energy management practices are not widespread, and neither are energy audits. Wood and electricity are the most used types of fuel. Wood-burning boilers are commonly used due to the low price of wood compared with other energy sources (coal, oil, electricity and gas) for steam generation. The steam is used for washing, drying and ironing processes. Motors are widespread among the sector to power sewing machines and dryers.
Level of technological advancement	The garment sector in Cambodia is highly dependent on its cost-competitiveness compared to other garment industries, and margins are quite low, which limits the long-term projection and investment capacity of garment factories. Furthermore, energy efficiency is currently not commonly perceived as a priority, for lack of awareness of the related benefits and of financial capacity. As a result, the industry is not particularly technologically advanced, particularly regarding energy-efficient machinery and boilers.
Number and type of audits realised	The Switch Garment Survey found that only approximately ¼ of garment factories had conducted energy audits in the past (EMC, GGGI, 2021). As part of the GGGI Switch Garment project, 50 additional audits were conducted.

Source: Authors' own compilation, Sevea Consulting (2022), based on various sources

TABLE 5. Footwear sector overview

Sector description	Footwear exports have increased steadily in past years, from USD 0.6 bn in 2015 to 1.4 bn in 2021, a 14% compound annual growth rate (CAGR), benefiting from the same trade opportunities as the garment sector in the US and the EU. All shoe factories but one use leather and polyvinyl chloride (PVC) as main materials, many of them also use textiles and polyurethane (PU)5. The raw materials come from many different sources: China, Korea, Thailand, Pakistan, Taiwan, Hong Kong, Vietnam, Italy, India, Spain and Bangladesh. Eight footwear factories are owned by Cambodian investors while the remaining 90% are foreign-owned.
Market export values	Exports: USD 1.4 bn in 2021 (Department of Customs and Excise, 2022) – 7.2% of total exports in the country[3].
Number of actors	In 2019, there were 83 effectively operating footwear factories in Cambodia (B2B, 2020).
Key industrial/ manufacturing processes	Production of footwear is structured by means of different assembly lines which each manufacture one model. Although similar to garments, the quality requirements of footwear production are higher, which result in lower production capacity per hour. The footwear manufacturing process includes a range of machines used for cutting, pattern making, sewing, lasting, closing, bottoming, finishing, insole making, shoe repairing. The main machinery used to complete the process are driving motors, air compressors and thermal ovens to fuse the rubber parts together.
Level of technological advancement	Penetration of energy efficiency technologies in the footwear manufacturing sector is limited. Similar to the garment industry, labour and technology efficiency is also lower in the footwear sector in Cambodia than in other established markets, such as Vietnam and China.
Number and type of audits realised	Approximately 10 walkthrough energy audits were conducted by the GGGI-funded Switch Garment project.

Source: Authors' own compilation, Sevea Consulting (2022), based on various sources

3 Note: Turnover for the garment and footwear sectors was not provided as (i) both subsectors are not dissociated in the statistics provided by the National Institute of Statistics and (ii) sales data from the NIS is inconsistent with export revenue figures: total sales in the NIS' 2021 statistical yearbook for the apparel, clothing and footwear sector total $4.4 bn only in 2019 vs $10.1 bn in exports the same year.

TABLE 6. Food processing (rice milling and ice manufacturing) sector overview

Sector description	Rice milling is amongst the most energy-consuming industries in Cambodia – electricity costs account for approximately ¼ of the total processing costs (National Cleaner Production Office, 2010). The ice making subsector was selected for this analysis due to the reported high energy costs related to the use of refrigerant gases and high air compressing needs. These costs drive drown profit margins for the industry, which could lead to EE measures to limit operating expenses. Much of the ice produced is sold on the domestic market. In December 2009, the European Union made an important decision to include milled rice under its Everything but Arms (EBA) system of preferential duties for least developed countries, expanding Cambodia's access to EU markets. This policy provided Cambodian rice exporters with duty-free access to the EU market, a significant 30–40% tariff advantage over neighbouring Vietnam and Thailand. The EBA scheme was followed by a sharp increase in industry investments and improved milling capacity, which resulted in rising rice exports.
Market export values	Turnover: data for specific rice and ice subsectors are not publicly available. Exports: 610,000 tonnes of milled rice in 2021 with a total value of USD 527 m, mostly exported to China (Khmer Times, 2022).
Number of actors	12,000 custom mills and 518 commercial mills (World Bank, 2018). There is no consolidated data for ice-making factories.
Key industrial/ manufacturing processes	Main processes for rice milling consist of cleaning, husking machine, milling and blending. Generators and dryers are extensively used to provide power and heat. Technologies used: • Furnaces (dehydration) • Mechanical threshers • Milling machine: separator, cleaner, huller, whitener, grader, dehusker, destoner, cleaning (IRRI, 1997). The processes to produce ice use ammonia and brine as refrigerants. Ammonia withdraws heat from brine and then the brine does the same for water, resulting in the transformation to ice using a refrigeration, cooling water and brine circuit.
Level of technological advancement	The Cambodian rice milling sector was relatively uncompetitive compared to neighbouring countries prior to the EBA scheme, partly due to higher fuel costs: many local rice mills did not have access to grid electricity and were forced to rely on inefficient fuel generators to operate their mill. However, the situation is changing with generalised grid access and the higher profit margins enabled by the EBA scheme. Penetration of energy efficiency technologies was observed to be very low with few business cases implemented via projects implemented by UNIDO.
Number and type of audits realised	Minimal

Source: Authors' own compilation, Sevea Consulting (2022), based on various sources

TABLE 7. Commercial building sector overview

Sector description	The commercial building sector is one of the fastest growing sectors in Cambodia with high investment levels in newly built compounds. As a result, the commercial building sector is expected to further burden the national energy demand. New buildings of more than 2,000 m² have been subject to a Building Energy Code (BEC) since 2009, which was revised in 2020 and now includes accreditation for the use of solar energy. The revision is applicable to buildings with a surface area of more than 5,000 m² and will also be applicable to those of more than 2,000 m² in 2023. Regarding the hotel subsector, operations are expanding, despite the hit taken by the industry amidst the COVID-19 pandemic, to anticipate a rising demand for accommodation as 28 million local and international tourists are expected by 2030 (IPS, 2020). Ann Sothida, Managing Director of CBRE Cambodia, one of the leading real estate companies in the country, recently provided an insight into the fast recovery of the commercial building market post-COVID 19. The office sector is expected to be the fastest growing commercial building subsector in the country in the coming years, followed by industrial estates and the retail market (Boken, 2021).
Market turnover and export values	The Cambodian building construction market size was valued at USD 10.1 billion in 2021. The market is projected to grow at a CAGR of more than 9% during the period 2023–2026 (GlobalData, 2022).
Number of actors	Schools and universities: over 5,000 with a total built-up surface of 1.78 km². Hotels: over 900 with a total built-up surface of 1.21 km². Healthcare centres (hospitals and two infirmaries): over 1,900 with a total built-up surface of 0.49 km². Office buildings: total built-up surface of 3.14 km². Retail stores: 1,800 with a total built-up surface of 1.99 km² (ADB, 2021). As per the projections in Cambodia's Power Development Plan, the built-up surface of commercial buildings (including public buildings) is projected to increase between 2021 and 2030 at a CAGR of 8.19%.
Key industrial/ manufacturing processes	Main categories of potential energy-efficient technologies are HVAC, lighting, boilers and pumping systems. The rest of the energy was mostly consumed by appliances/equipment such as lifts, escalators and other receptacle loads such as computers and other plug loads.
Level of technological advancement	Recent buildings of more than 2,000 m² – constructed since 2009 and the implementation of the first BEC – have had to comply with basic energy requirements, but sustainable energy management practices for existing buildings are still limited. Passive cooling technologies are also promoted through the 2021 Cambodia National Cooling Action Plan (CNCAP) implemented by the MoE. A project led by the Cool Coalition and ESCAP with funding from the Clean Cooling Collaborative aims to (i) assist the RGC in integrating passive cooling into the NEEP legislation and the next revision of the NDC, (ii) raise awareness and demonstrate the benefits of passive cooling in buildings and (iii) build capacity among both public bodies and private actors. The project aims to retrofit 2% of the existing building stock with passive cooling technologies. Based on both walkthrough audits and consultant experience from prior studies, it is evident that the potential for energy efficiency retrofits in commercial buildings is tremendous, especially regarding HVAC and lighting replacement.
Number and type of audits realised	Data on energy audits for the commercial building sector and subsectors are not readily available. However, based on walkthrough audits and discussions with market stakeholders, it seems that facility managers do not yet have the technical knowledge and expertise needed to drive the installation of EE equipment on their own. The Cambodian Energy Efficiency Competition initiative has been monitoring energy consumption and encouraged participants to implement EE measures in various private office buildings, universities and ministry buildings in 2021 and 2022.

Source: Authors' own compilation, Sevea Consulting (2022), based on various sources

4.2 Value chains, related actors and production/ service processes

The energy efficiency market in the Kingdom of Cambodia is still in its infancy – market players are either focused on providing services, such as energy audits and consulting, or standalone equipment. There are relatively few Engineering, Procurement and Construction companies in Cambodia and, if they provide energy efficiency services, their product range is centred around one or several technologies – they lack the holistic view required to design and implement large-scale projects. Due to a lack of norms and quality performance standards, quality and cost vary greatly across the different technologies and services offered. Finally, while demand exists throughout the country, most companies are based in Phnom Penh and tend to focus their marketing efforts on the capital city and its region.

Further information on the EE value chain in Cambodia is provided in the analysis of EE applications and the market in Cambodia section.

GARMENT SECTOR PROCESSES

In general, the textile and garment industry consists of three sub-groups:

1. the upstream industry, which includes the artificial man-made fibre and spinning industry;
2. the midstream industry, which includes fabric weaving, knitting, dyeing and finishing; and
3. the downstream industry, which includes garment and wearing apparel, ready-to-wear clothing and other finished textile products.

Considering the general process categories, most of Cambodia's garment industry falls into the downstream industry. Two main models co-exist in this section of the value chain: the cut-and-sew model, and the knit-to-shape model. The difference is whether the individual parts or components of a garment product are cut to the necessary shape from flat fabric or are produced directly in the form needed.

The garment and apparel manufacturing process includes an accompanying step of labour and machinery use; production starts with material inspection, patterning, cutting, sewing and assembly, finishing, ironing and packing. Electricity and wood are the types of fuel most used.

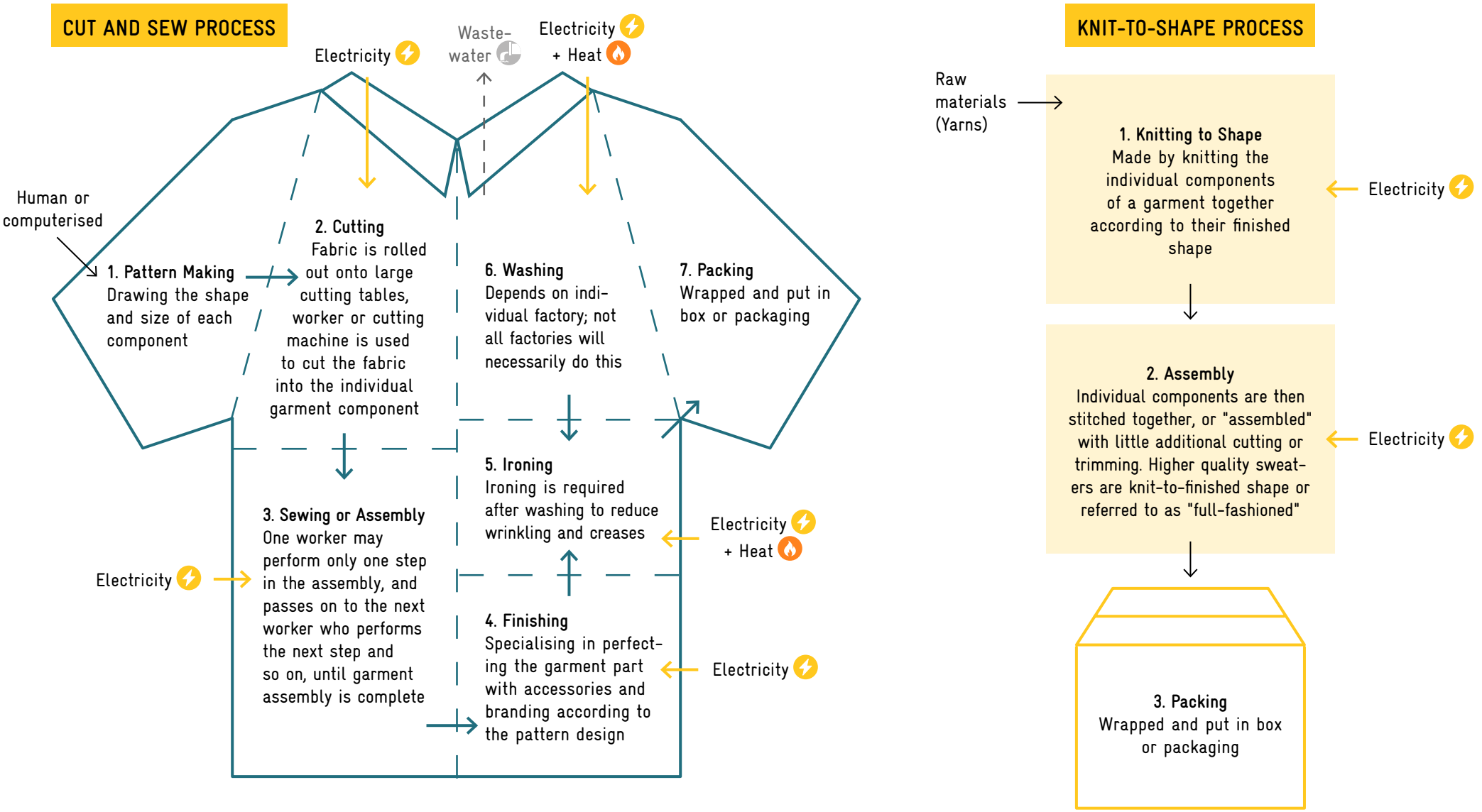
GARMENT SECTOR VALUE CHAIN

The type of factory ownership could have a direct impact on Cambodia's capacity to move up the garment value chain because the present structure prevents knowledge spillovers from foreign specialists into the widespread economy. Nearly all foreign-owned firms are vendor factories. The parent companies operate as original equipment manufacturers (OEM) and as original design manufacturers (ODM). As a result, the factories situated in Cambodia are inclined to be strictly controlled by offshore owners, making it very difficult for local initiative or entrepreneurship to arise.

In this system, orders from the parent company are distributed amongst foreign-owned factories across several countries, including Cambodia, in accordance with capacity, the required skill level and unit production costs. Therefore, the factory itself has little or no possibility of generating its own orders or identifying markets in which it can expand. The top-down management structure in the Cambodian garment sector, in which many of the decisions for the factories are made offshore, prevents the domestic industry's capacity to move up the value chain. Main brands with Cambodian subsidiaries include H&M, Levi's, Calvin Klein, Gap, Marks & Spencer, Next and New Look.

Factories that operate with vendor-type contracts have the advantage of scale through their relationship with the parent company, which provides access to finance, regional suppliers and global markets. This gives them a distinct advantage over the smaller, locally owned factories, which produce only for the domestic market and sub-contract to larger producers. This is one of the main reasons why locally owned factories make up just over 6% of the garment manufacturing sector.

FIGURE 8. Manufacturing processes in the garment sector



Source: Own illustration by the IIEC (2022) compiled from various sources

FOOTWEAR MANUFACTURING PROCESSES

Footwear manufacturers are categorised into three groups according to the production technology of

1. traditional manufacturing: almost every stage of production is done using basic hand tools without any machinery;
2. semi-mechanised manufacturing: basic hand tools and machinery; and
3. fully mechanised manufacturing: machinery used at every stage of production.

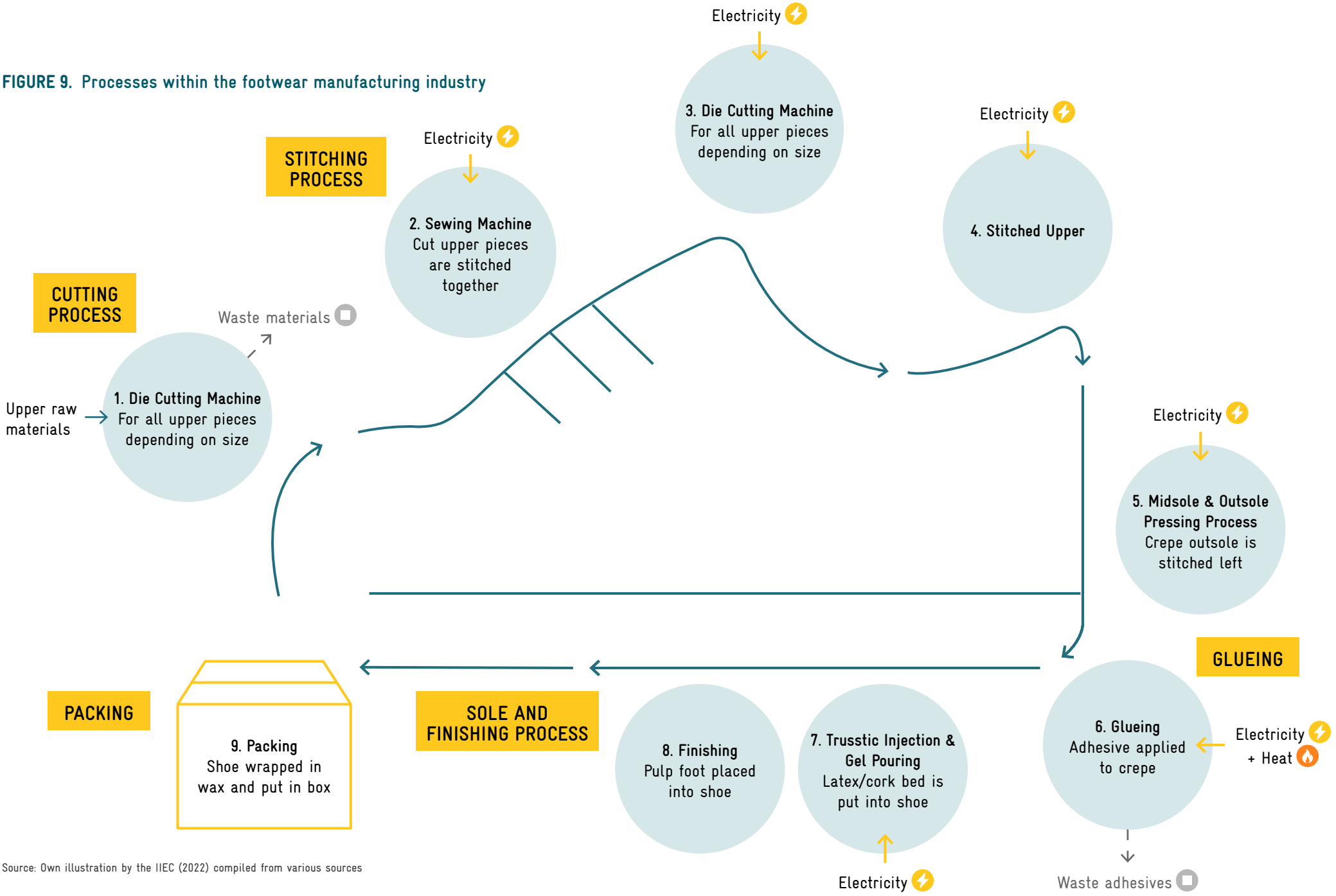
Although the footwear industry in Cambodia is still heavily reliant on inexpensive labour, every step of the manufacturing process is either fully mechanised or partially mechanised, with machines such as sewing machines operated by employees.

FOOTWEAR VALUE CHAIN

All currently existing factories producing footwear have some level of foreign ownership. Growth strategies differ between vendor factories and contract manufacturers. Operations of vendor factories are controlled offshore while contract manufacturers are more responsive to local markets. Overseas managers make around half of the decisions regarding the market and product value of exports. The remaining half of the decisions are made locally. Nonetheless, these factories are smaller and have a lower chance of moving up the value chain.

The top brand purchasers of footwear products from Cambodia are the United States and the European Union, where they engage in product design and large orders. These brands include H&M, Nike, Adidas and Puma, as well as many more. Buyers can be divided into two segments: speciality retailers who focus on specific products and target certain markets like H&M and Nike; and the mass merchandisers offering mass variation of products to stores like Walmart and Target. Some buyers, however, go through intermediaries, others with vendor factories and some others place the orders directly with local factories or contract manufacturers.

FIGURE 9. Processes within the footwear manufacturing industry



Source: Own illustration by the IIEC (2022) compiled from various sources

RICE MILLING PROCESSES

The rice milling processes could be classified into three categories in accordance with the type of power machinery used, which include:

1. a rice mill equipped with a steam engine powered by rice husk;
2. a mill that uses an electric motor to drive the rice milling machine; or
3. a mill that uses a diesel engine to drive the rice milling machine.

Most of the small-scale rice millers will only use electricity – either from a diesel generator or electricity from the grid. The medium-to-large factories that process white and par-boiled rice will make use of both electricity and steam engines – they use steam in the heating process for paddy drying and steaming.

All equipment operates continuously and works harmoniously from the paddy cleaning stage through to final packaging, where all steps are powered by electricity.

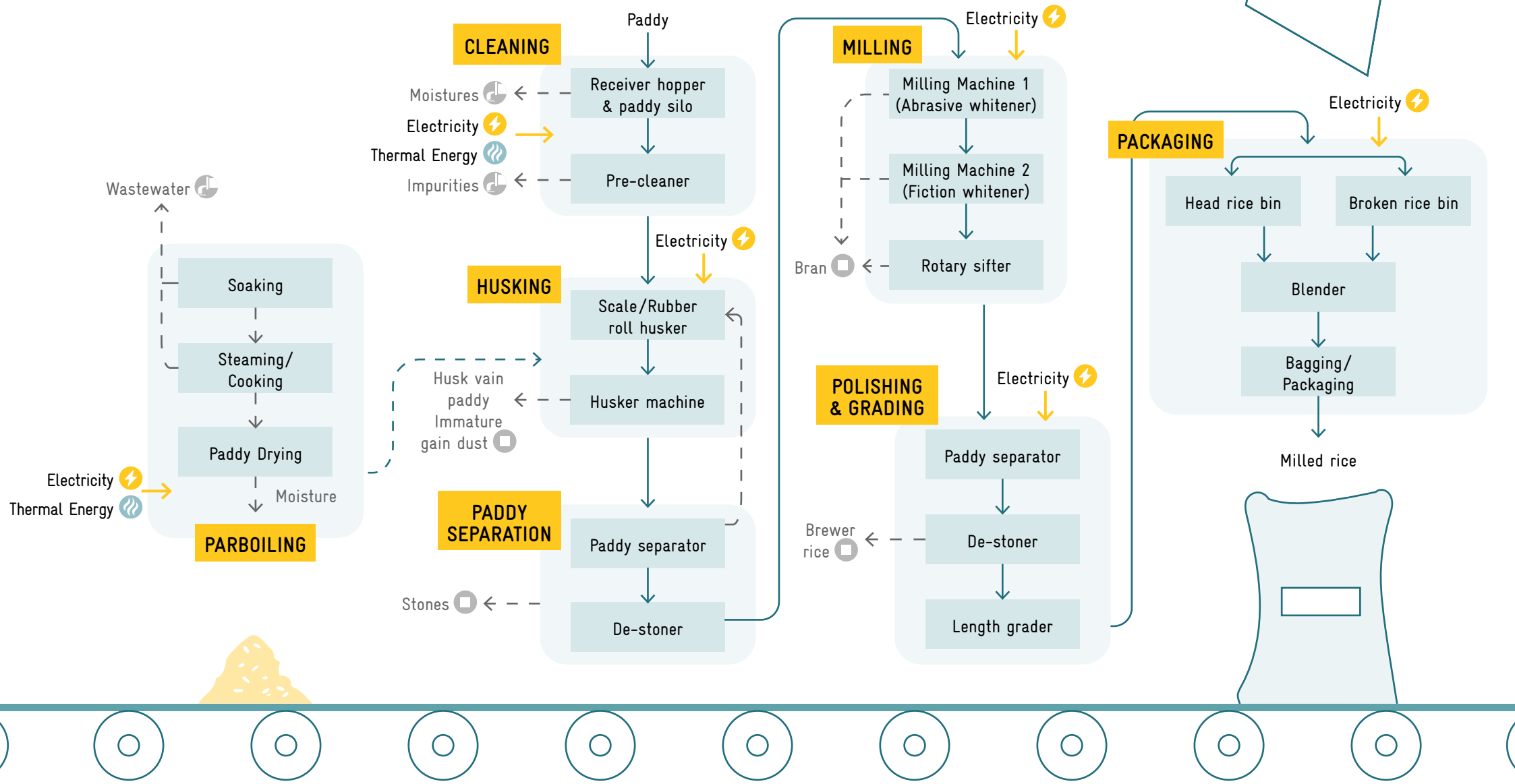
The main pieces of machinery and equipment used are rubber shellers, polishers, dryers, whiteners, boilers, elevators, air compressors and motors. The rice mill motor can consume up to 80–85% of the total electricity. The major biomass fuel used to generate heat and/or electricity is rice husk, which is salvaged from the milling process itself.

Most small rice mills in Cambodia use obsolete milling technology, and diesel engines are still common, resulting in high energy costs. However, it is also common to see rice husk gasification power plants (Indian technology) installed in medium and large milling plants; approximately 80% of medium and large milling plants are equipped with this.

RICE MILLING VALUE CHAIN

Smaller rice mills (with technology capable of milling 1 tonne of rice per hour) situated within short distances of rice production areas usually serve the domestic market, while larger rice mills have the equipment to adjust rice processing to international standards: mechanical dryers to adjust rice moisture levels prior to milling, colour sorters and packing techniques (CIRAD, 2017).

FIGURE 10. Flowchart of the rice milling process



Source: Own illustration by the IIEC (2022) compiled from various sources

ICE MANUFACTURING PROCESSES

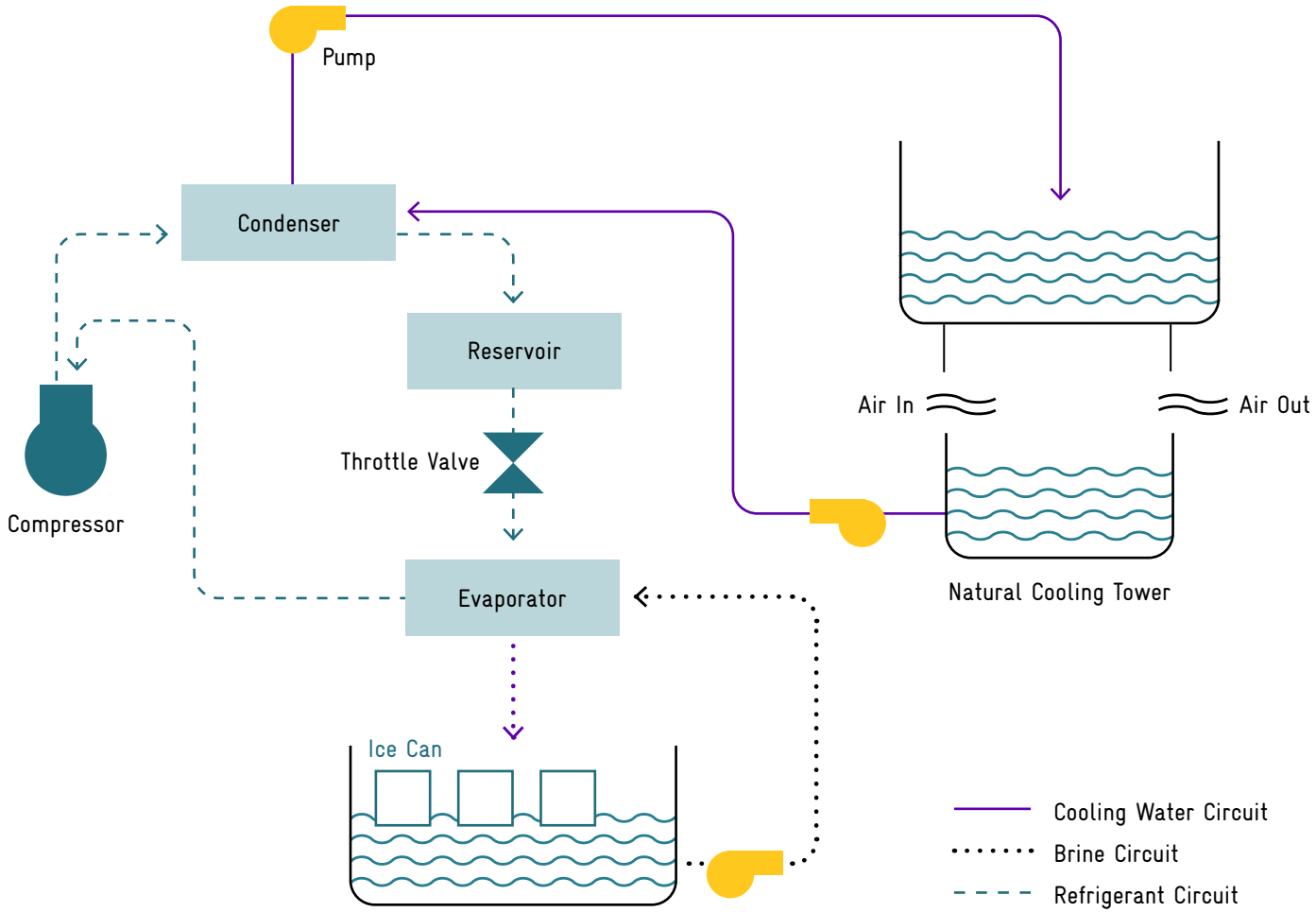
An ice manufacturing plant operates in a similar manner to a household fridge. The main distinction is the ice-making stage. An ice plant uses separate ice-freezing circuits. The cold temperatures are "produced" in one circuit and transferred to the water cans through another circuit. Ammonia and brine are the main two refrigerants - ammonia (the primary refrigerant) withdraws heat from the brine and brine (the secondary refrigerant) takes heat from the water to produce ice.

The process occurs when low-temperature and low-pressure ammonia leaves the throttle valve and is vaporised by attaining the latent heat from the brine. Thus, the brine cools, which is then circulated within the brine circuit to freeze the water, resulting in ice formation.

ICE MANUFACTURING VALUE CHAIN

Ice manufacturing is a promising subsector in the agro-processing industry. However, publicly available data and information are scarce. Such factories are usually located near demand centres to avoid the logistical complexity associated with ice transportation. Many ice factories start the production process very early – 3–6 am, and final ice blocks are distributed to markets and small informal-sector retail outlets using trucks and tricycles. Ice can either be crushed before distribution for ease of application or distributed as blocks. formation.

FIGURE 11. Process flowchart of an ice manufacturing plant



Source: Gujarati (2011)

COMMERCIAL BUILDINGS

The main type of energy-consuming appliances and equipment can be found in all commercial building types: HVAC systems for space cooling, lighting systems (indoor and outdoor), refrigeration systems, boilers and other energy-consuming systems such as escalators, lifts, pumps, cooling fans and small plug-in electrical appliances. However, cooling demand typically represents about 70% of total energy consumption in the majority of commercial buildings in Cambodia. As per the projections in Cambodia's Power Development Plan, the building sector is expected to grow and increase from ~ 21.56 to 43.79 million square metres between 2021 and 2030, at a CAGR of 8.19%. This is expected to increase energy demand from the commercial building sector, resulting in increased power production and import investments. With no building regulations and energy codes in place, the energy performance of buildings and the performance of appliances and energy-consuming systems used within them remain unknown.

COMMERCIAL BUILDING VALUE CHAIN

Foreigners have limited land ownership rights in Cambodia. However, they can still own property and invest in construction companies. The construction and real estate sector received over half of the total FDI inflows in 2019. More information on the commercial building sector is provided in the section below.

4.3 Energy demand and consumption profile

In 2021, the total energy generated and delivered by all power licensees in Cambodia was 11,816 GWh. The big-medium industrial and commercial sector (MV/HV grid connection) consumed more than one third of the total electricity consumption. For the low-voltage (LV) consumer groups, which include small businesses and services, small commercial and industrial consumers consumed about 28.03%, and the residential sector consumed 35.80%, respectively (EAC, 2021). The overall energy consumption of the industry sector rose from 30,345 TJ in 2009 to 73,478 TJ in 2019, a 9.2% compound annual growth rate. In the same period of time, electricity consumption by the industry skyrocketed, rising from 1,163 TJ in 2009 to 12,270 TJ in 2019 (IEA, 2022), a 26.5% annual growth rate, and the trend is expected to continue.

As a result of the sector overview analysis presented in Section 4.1 above, the subsectors with high EE potential identified include the garment and textile, footwear, agricultural processing (rice milling, ice factories) and commercial building sectors.

Sub-sectoral-specific energy consumption data is not publicly available in Cambodia as most companies in the industry and building sectors have not yet undertaken energy audits. Therefore, the analysis in this section is presented based on the available secondary data from the sectoral assessment reports of past projects, studies in Cambodia, a combination of publicly available energy audit reports and walkthrough energy assessments conducted by the consultant.

GARMENT SECTOR

The garment sector in Cambodia is still heavily reliant on wood and diesel, as shown in Figure 12, although the share of electricity in the total overall energy consumption is not insignificant (25%).

A 2009 study by the ILO and IFC found that the average energy input for the garment sector was 42 GJ/tonne (USD 560/tonne), but the energy intensity varied greatly, from 2 GJ/tonne (USD 30/tonne) to 273 GJ/tonne (USD 1,737/tonne). Factories employing more than 3,000 staff tend to have a higher energy intensity per tonne of product (ILO & IFC, 2009). Although this data is relatively old, it showcases how energy-inefficient the garment sector is in Cambodia compared to other countries in the region (UNDP, 2015). The baseline specific energy consumption (SEC) for the large garment industry in Cambodia was estimated at 1,056 kWh/1,000 pieces, and SEC for SME at 1,173 kWh/1,000 pieces.[4]

Electricity is mostly used for electrical appliances - lighting, ventilation and air conditioners (49%), sewing machines (35%) and compressors (12%).

The largest factories may be equipped with larger chiller systems for cooling or evaporative cooling systems in the working space. But for small and medium-sized factories, air conditioners are only used in office areas, while large cooling fans are used in the production areas.

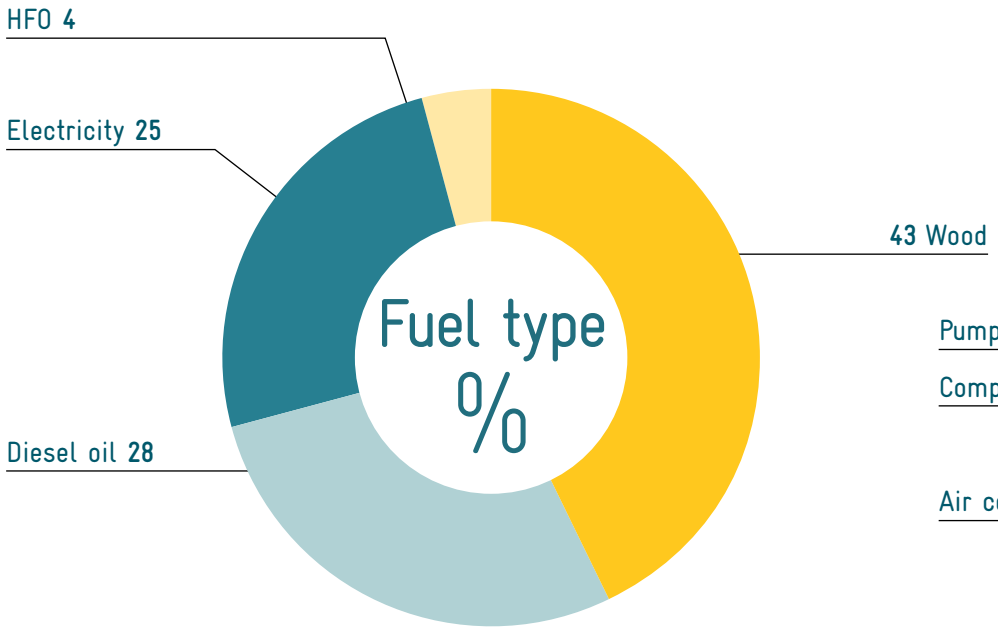
Boilers in the garment industry in Cambodia usually produce heat for manufacturing processes only, as space heating is not necessary. The steam produced is used in processes such as heating water for washing machines, drying and ironing. Most boilers are powered with firewood (fired tube boiler), hence the heavy reliance on wood in the total energy consumption.

Machines used in the garment industry are typically operated inefficiently, and equipment maintenance is often inadequate. Lack of investment in maintenance and ineffective spare parts stock control often leads to a considerable loss in production (UNDP, 2015). Even

4 Note: SEC is calculated based on the estimated baseline energy consumption in the garment sector in Cambodia at 0.09 toe/1,000 pieces for the large garment industry and 0.10 toe/1,000 pieces for an SME garment factory, by using a conversion ratio of 1 toe = 42.244 GJ, 1kWh = 3.6 MJ.

FIGURE 12. Total final consumption by fuel type – garment sector

Source: GGGI (2018)



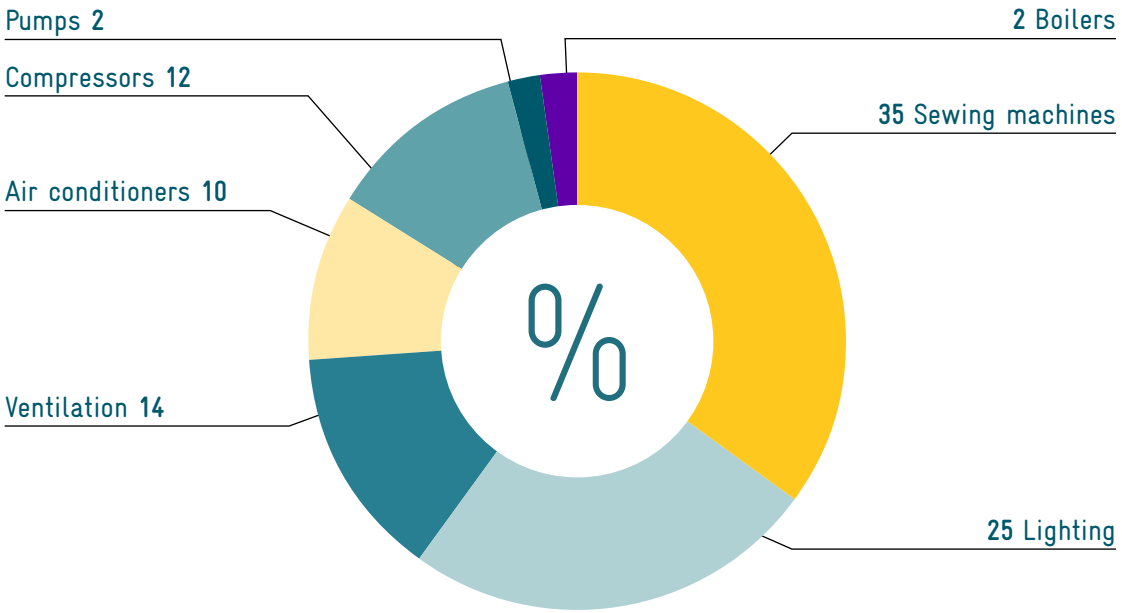


FIGURE 13. Share of each machine and appliance type in electricity consumption for a typical garment factory

Source: Authors' own illustration, Sevea Consulting (2022), based on walkthrough audits and interviews

though energy consumption and prices are high in Cambodia, energy management practices are not widespread in Cambodia's garment factories, and neither are energy audits. Based on the factory survey as part of the Switch Garment project by the GGGI, only 50 of the factories had undertaken energy audits. Players in the garment industry are aware of their high energy costs, but rarely act on it due to insufficient technical capacity, lack of human resources and financing constraints. The majority of boiler sizes are less than 2 tonnes per hour and are mostly older than 5 years. Air compressors used mostly range between 25-100 hp, and the rotary screw-type compressor is the most common in the factories.

Due to the high share of thermal energy in the overall energy consumption, thermal energy technologies such as boilers have high overall energy-saving potential. Because of this high potential energy efficiency measures in boilers, motors and fans have emerged as high priority interventions in large and SME industries in the garment and apparel subsector.

FOOTWEAR SECTOR

We were unfortunately unable to conduct walkthrough energy audits in the footwear subsector. However, based on our interviews with the footwear association and discussions with the GGGI as part of the Switch Garment project, the energy profiles of the garment and footwear subsectors are very similar. The share of wood is typically reported to be approximately half of the total energy consumption, while electricity accounts for approximately one third. Diesel covers the rest of the energy needs.

The footwear industry needs high amounts of heat, whereby wood-powered boilers are extensively used for manufacturing processes, similar to the garment industry. Most boilers range in size between 1 and 3 tonnes per hour and have been used for 1 to 5 years. Air compressors used mostly range between 25 and 100 hp, which are predominantly rotary screw-type compressors.

Based on interviews with industry experts, the footwear sector is even less proactive in seeking energy-efficiency endeavours than the garment sector – an approximate 10% of the factories have undertaken energy audits as part of the Switch Garment project.

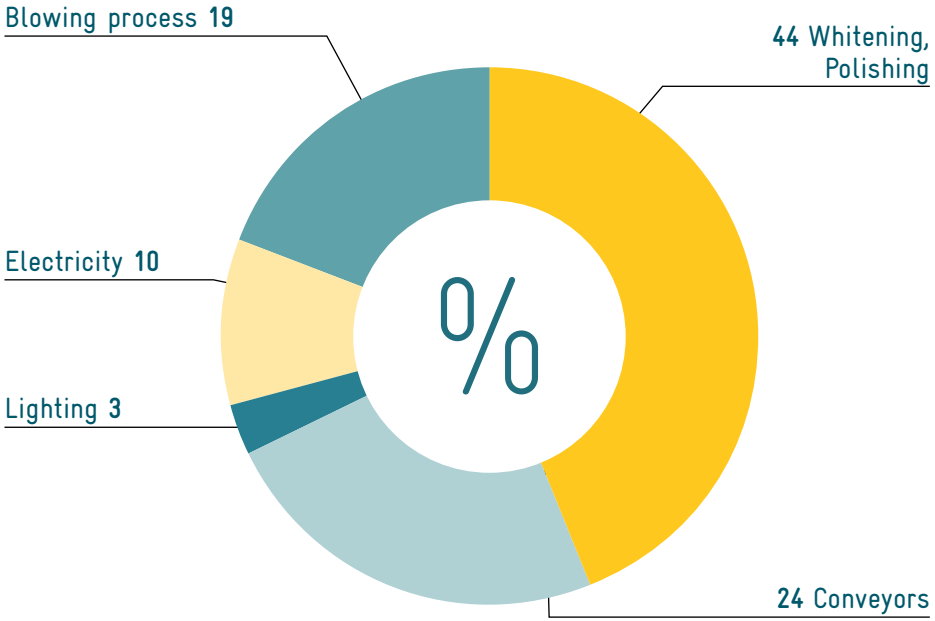
FOOD PROCESSING: RICE MILLING

An overwhelming majority of rice milling enterprises are small businesses, i.e. companies with yearly operating expenses below USD 50,000 – 99.1% in 2012 (JICA, 2013). As these very small companies are an unlikely target for EE endeavours, the focus will be on medium-to-large rice milling and processing companies.

Walkthrough audits show that a typical medium-to-large rice milling factory is powered mostly by electricity (60%) and rice husk (40%). The husk, which is reused from the milling process or sourced from small rice milling businesses, is mostly used as fuel in furnaces to dry the rice. Rice husk gasification power plants made in India are also common in large power plants: in 2012, approximately 80% of medium and large milling plants were equipped with such devices (JICA, 2013), which convert rice husk to syngas (a combustible fuel) that can later be used in the dehydration process or to produce electricity that can be re-supplied to the system. This electricity can either be used to convert rice husk left over from the drying process into electricity or to power an electric boiler as a replacement for the traditional furnace. The milling process is conventionally powered by electric motors and air compressors. To a lesser extent, electricity is also required in the drying process, to blow the husk into the furnace, to supply oxygen into the furnace with a fan and to remove ash.

FIGURE 14. Electricity consumption of a typical rice milling and processing factory

Source: Authors' own illustration, Sevea Consulting (2022), based on walkthrough audits and interviews



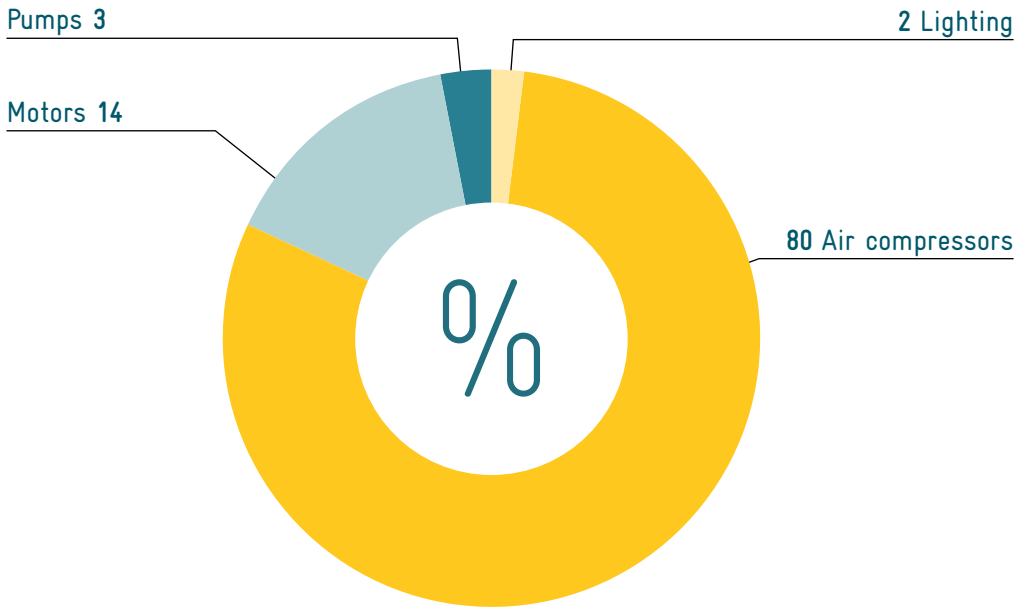


FIGURE 15. Electricity consumption of a typical ice factory

Source: Authors' own illustration, Sevea Consulting (2022), based on walkthrough audits and interviews

On one of the audited sites, Golden Rice, the 17 furnaces used in the drying process were mostly sourced from Vietnam and had been in use for 7 years and an estimated 2,400 hours per year.

In many of the rice mills, the milling equipment – the paddy cleaners, separators, rubber shellers, cleaner, whiteners, elevators, graders, etc. – are driven by an old electrical motor and sometimes connected to a common shaft-drive system. In these common-drive systems, all pieces of equipment are connected by a long belt drive which transmits mechanical energy from the motor. The current single-drive system has many drawbacks:

- High transmission losses due to longer belt drive systems.
- Low efficiency of the motor during under-loading, when only one or two pieces of equipment are operated.
- Motor potentially running idle for longer time periods.
- Higher probability of production loss in case of motor, drive-belt or equipment failure.
- Low power factor due to partial load operation.
- Even small equipment like the elevator or the paddy cleaner needs to be operated at high capacity, resulting in losses.

The subsector is characterised by very limited EE knowledge and a scarcity of energy audits. Most of the audits were conducted with funding from development partners, such as UNIDO in 2015–2016.

ICE MANUFACTURING

Ice manufacturers primarily rely on electricity, although diesel generators may be used as backup systems in case of power outages. The bulk of electricity consumption for the ice manufacturing sector arises from air compressors that apply pressure on coolants (mostly ammonium) inside the pressure chamber to transform them into a vapour flow towards the condenser.

The industry mostly relies on fixed-speed compressors that are generally quite energy-inefficient compared to VFD compressors. The energy intensity of the sector was estimated to be approximately 780 kWh/tonne of ice.

The number of energy audits conducted seems to be very minimal based on interviews conducted with industry experts. Facility owners do not have sufficient knowledge and information on available EE technologies. The demonstration of business cases with guaranteed energy savings would provide reassurance to business owners and would encourage them to consider EE investments.

In built-up surface, retail stores and office buildings are the main commercial buildings, but both building types vary greatly in size, from small to very large, making them a very non-homogenous potential customer base. Education centres are the third largest opportunity, with 5,100 potential clients with an average built-up surface of 350 m^2. The energy use intensity (EUI) is typically used to compare the energy efficiency of buildings. As show in Figure 16, retail stores are the largest energy consumers per m^2 with an average EUI of 312 kWh/m^2/y. The ADB study showed large discrepancies between stores depending on their size: small retail outlets (less than 1,000 m^2) tended to have a higher EUI – 164 kWh/m^2/y to 944 kWh/m^2/y than medium stores (1,000 m^2 to 7,500 m^2) – 130 kWh/m^2/y to 368 kWh/m^2/y – while very large retail locations (>7,500 m^2) were even more efficient – 57 kWh/m^2/y to 136 kWh/m^2/y (ADB, 2021).

Office buildings followed a similar pattern to retail stores, with small and medium buildings consuming more energy/m^2 – up to 606 kWh/m^2/y – than large counterparts – 68 kWh/m^2/y to 197 kWh/m^2/y, with an average 217 kWh consumed per m^2. Hotel chains and healthcare centres have a similar consumer profile, with respective average EUIs of 126 kWh/m^2/y and 153 kWh/m^2/y. Discrepancies in hotel chain

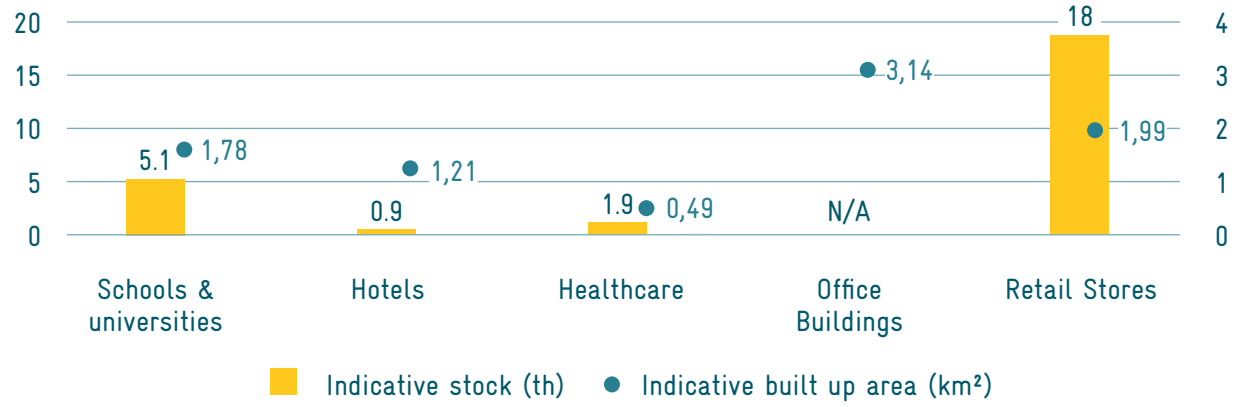
energy intensity were not as significant, with variations from 53 kWh to 260 kWh, and a slightly more efficient large hotel subsector, while healthcare building EUI varied from 73 kWh/m²/y to 224 kWh/m²/y.

Lastly, educational centres (schools and universities) are least energy-intensive commercial buildings with an average consumption estimated at 84 kWh/m²/y, varying greatly from one centre to another – between 21 kWh/m²/y and 318 kWh/m²/y. Although large education centres tend to be less energy-intensive on average, energy efficiency and size are not perfectly correlated – a 619 m² building from the ADB study consumed 21 kWh/m²/y while a 9,000 m² building reported an EUI of 104 kWh/m²/y.

Large variations are also documented between provinces. Various factors can explain such variations between both provinces and building sizes:

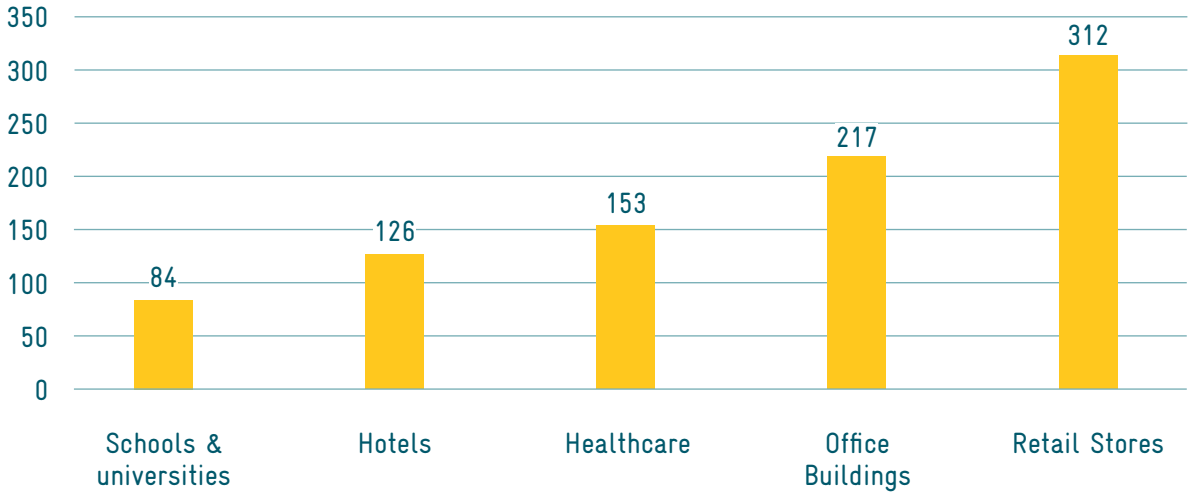
1. inefficient/outdated energy-consuming equipment/appliances,
2. oversizing of equipment such as HVAC, AC, chillers, etc.,
3. lower space utilisation levels and
4. increased operational hours (ADB, 2021).

FIGURE 16. Indicative stock number (in thousands) and built-up surface (in km²) for main commercial buildings



Source: ADB (2021)

FIGURE 17. Average EUI per building type in kWh per m² and per year



Source: ADB (2021)

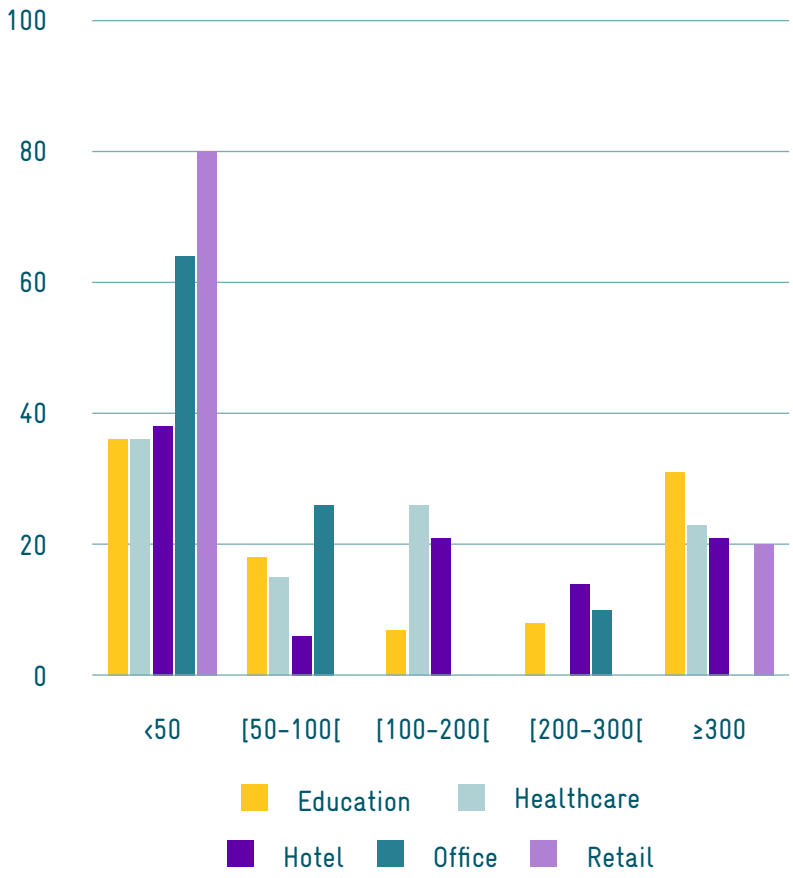
As anticipated, electricity is the main source of energy for commercial buildings (estimated at 95% of the total final consumption through interactions with building representatives and walkthrough energy audits), while diesel was mainly used as a back-up solution in case of power outages. The bulk of energy is consumed in air conditioning – approximately 65%, while lighting accounted for 20% of the TFEC, as shown in Figure 19. From the interactions with building representatives and walkthrough energy audits, it was observed that in buildings with more than 50% air-conditioned space as a percentage of built-up surface, HVAC systems (including fans) and lighting systems together accounted for more than 70% of the total electricity consumption.

The rest of the energy was heavily consumed by appliances/equipment such as boiler systems, water pumps, lifts, escalators and other receptacle loads such as computers and other plug loads. However, during the walkthrough exercise, appliance/equipment-level energy consumption could not be established due to the absence of sub-metering in all surveyed commercial buildings. In terms of air conditioning, the bulk of commercial buildings have relatively low cooling requirements, especially small office and retail spaces. However, a significant share of hotels, schools and universities, hospitals and retail outlets – those with a larger built-up surface and a high share of cooled area over total area – have cooling requirements exceeding 300 TR and could be primary targets for energy-efficiency endeavours if they have sub-efficient air-cooling technology.

Air conditioners (AC) have very high penetration rates in all commercial building types, especially healthcare, offices, hotels and retail stores. Most buildings are equipped with split AC, which may play a complementary role with another AC technology – centralised AC systems or variable refrigerant flow (VRF) systems. The overall penetration of a central chiller and VRF systems stood at 10% and 9%, respectively. Centralised AC was found to be more common in hotels (16%), followed by retail (15%), healthcare (13%) and office buildings (7%). On further analysis, it was found that the centralised chiller-based HVAC systems were installed in large buildings with a built-up surface of over 10,000 m^2. Only a few of the healthcare buildings and retail stores were found to have window air conditioners.

There is opportunity to increase the penetration of more energy-efficient VRFs and centralised air conditioners depending on the feasibility of such systems as a replacement for or to compliment conventional split and packaged air conditioners.

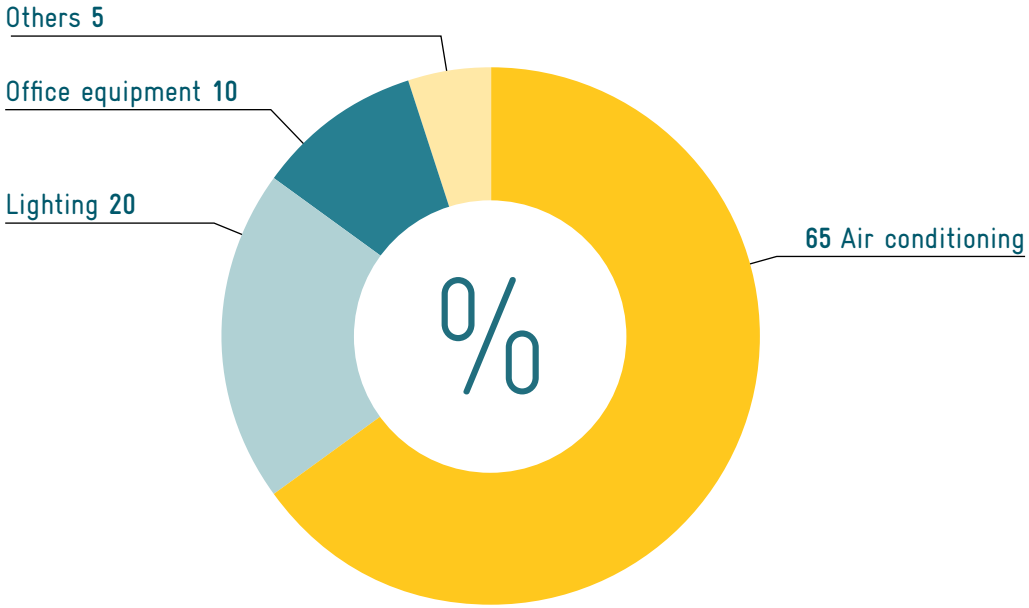
FIGURE 18. Share of buildings by cooling requirements for each commercial building type



Source: ADB (2021)

FIGURE 19. Electricity consumption of a typical commercial building

Source: Authors' own illustration, Sevea Consulting (2022), based on walkthrough audits and interviews



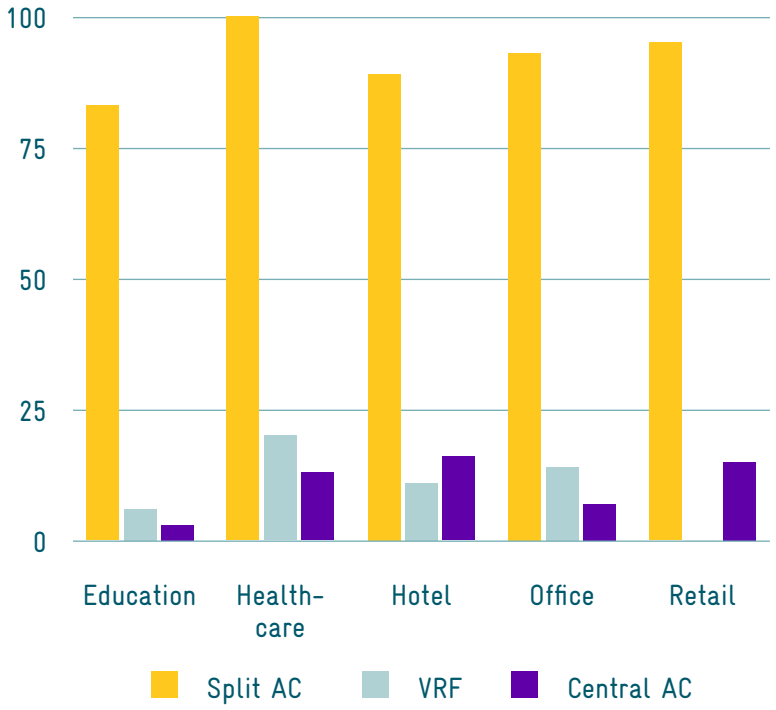


FIGURE 20. Penetration of split AC, VRF and central AC by commercial building type

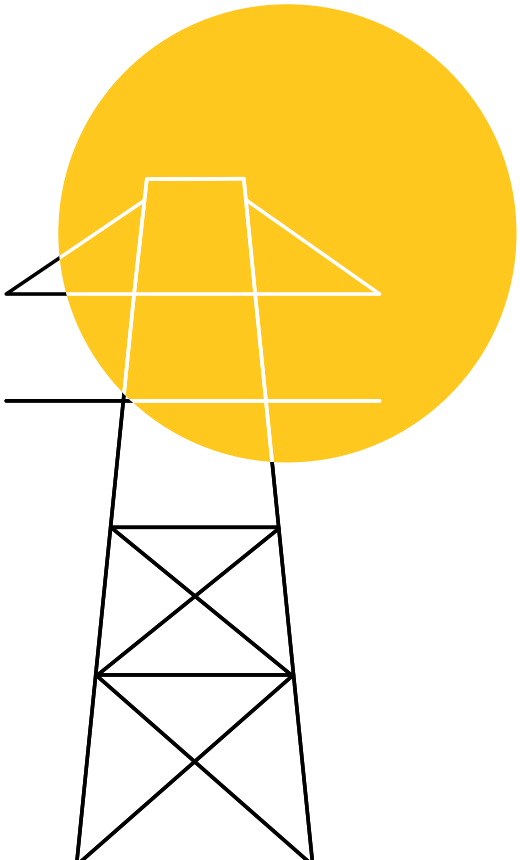
Source: ADB (2021)

4.4 EE initiatives and programmes

Cambodia's garment industry still continues to be the country's dominant exporter. Therefore, most of the main programmes involved in energy efficiency in Cambodia are involved in the garment sector. The majority of these programmes consider the implementation of sustainable energy practices, and, therefore, German ESPs will have a competitive advantage over local companies, especially if such firms have experience of EPC contracting and provide complex solutions in multiple areas, such as the replacement/upgrade of boilers, heat recovery applications, lighting and HVAC upgrade, etc. With the approval of the national energy efficiency policy, there are a number of potential opportunities for German SMEs as local capacities are still yet to be developed. Some of the initiatives where technical solutions and services from German SMEs may be relevant include:

Switch Garment is a four-year EU-funded project through the SWITCH-Asia programme for the promotion of sustainable energy practices in garment factories across Cambodia that started in 2020. It is implemented by the Global Green Growth Institute (GGGI) in conjunction with Geres, a French NGO that works to ensure viable access to energy through sustainable energy solutions, climate change mitigation and adaptation, and the Garment Manufacturing Association in Cambodia (GMAC). The aim of the project is to increase the competitiveness of Cambodian garment factories and reduce the industry's environmental impact through the adoption of sustainable energy practices and by facilitating investments in clean energy technologies (Switch Asia, 2020). As part of the project, 50 energy audits were conducted in garment-sector factories. Implementation of identified measures is expected. Expansion and inclusion of more garment-sector factories are expected to implement sustainable energy practices.

The International Finance Corporation's (IFC – a member of the World Bank Group) Cambodia Improvement Program (CIP) has been implemented since 2019 with the support of the Korean Ministry of Economic and Finance. Cambodia has set a national target to reduce 40% of its greenhouse gas emissions by 2040; therefore, the aim of the CIP is to increase competitiveness, productivity and the overall sustainable growth of the garment sector. The CIP is an initiative that is part of the broader attempt to decarbonise manufacturing industries across Asia by means of knowledge exchange and expertise on resource efficiency, renewable energy and, ultimately, a circular economy (IFC, 2022). To facilitate these targets, the IFC provides access to short- and medium-term financing options to factories.



Waste to Energy in Rice Milling Sector in Cambodia project initiated by SWITCH-Asia from 2012 to 2015. The objective of this project entailed the promotion of the sustainable production of milled rice by replicating existing waste-to-energy rice milling technologies based on rice husk gasifiers. Ultimately, the main goal was for the rice milling industry to switch to an alternative energy source. The reasons for this included the fact that industrial operations were powered by diesel engines, a lack of grid connectivity, rising electricity prices, restricted access to technology and logistical issues leading to high market prices. The project was a success: the total project budget equated to around EUR 2.2 m (EU contribution: 89%). The final product was a platform developed for policy makers, SMEs and the finance sector to make contributions to the rice milling industry by applying environmentally sound technologies (SwitchAsia, 2017).

With the approval of the NEEP, it is expected to create a designated energy consumers (DEC) list containing factories and commercial buildings consuming a large amount of energy. DECs will be obliged to reduce energy consumption, including energy audits and further implementation of EE solutions, which also create a demand for services and solutions that German SMEs could provide. Therefore, working with a local partner, such as local ESPs/ESCOs, is recommended to be an effective way to reach end users. A local partner may facilitate market entry through market knowledge and established networks. In Cambodia, personal relationships can also be the key to successful business transactions. A list of local ESPs/ESCOs is currently being created in an effort to create an ESCO association in Cambodia.[5]

4.5 Recommendation for lead identification from the sector

The targeted reduction in the industrial revolutions was analysed based on the overall energy-saving potential of their corresponding sets of technologies. The key criteria for technology selection included: (i) technology should be scalable and (ii) technology should have high overall energy-saving potential. The recommended catalogue of EE measures is based on walkthrough assessments and case study reports, interviews with industry experts, as well as desk research.

5 https://www.eurocham-cambodia.org/esco_directorylist

GARMENT AND TEXTILE INDUSTRY

TABLE 8. Garment and textile sector overview

RECOMMENDED MEASURES	DESCRIPTION
EE retrofit of air compressors	Compressors that run at variable loads currently do not have VFD, which results in the unnecessary running of the compressor motors during the unloading period. The compressors running at variable loads consume significant energy in unloading conditions. It is recommended to use VFD in compressors to control the speed of the motor during the offloading period, which will conserve electrical energy.
Replace the old cooling fans with BLDC fans	It is typical for garment-sector factories to have exhaust fans (cooler fans) to meet the space-cooling requirements. Compared to a conventional cooler/energy-efficient fan, BLDC fans consume 30–40% less power to deliver the same air volume (m3/min). Presently, most factories do not have any control over the air cooler fans and pumps. With the BLDC fan, the new EC control system can change the speed of the fan based on how hot or cold the production hall is.
Upgrading the lighting systems from old lights to LED-based lights	Lighting is estimated to consume about 10–20% of the total electricity consumption in the garment sector. Based on the walkthrough energy assessment and interviews with industry experts, it can be concluded there are still many factories utilising T5 FL lamps. Walkthrough energy assessment results have revealed that LED lights are not yet fully in use, and T5 FL lamps consume around 30–40% of lighting electricity. Potential savings from LED replacement is about 30%.
EE upgrade of boilers	Many boilers in the garment sector are imported from Vietnam and use wood as a primary fuel source. No heat recovery system was observed during the walkthrough assessment. In some factories, no condensate recovery system causes heat loss and inefficiency. The heat distribution system was found to be uninsulated. Potential measures include EE boiler upgrades and heat recovery systems.
Replacement of ACs	Although inverter ACs are common on the market, non-inverter ACs were still found to be in use in a number of facilities visited by the consultant. It is recommended to replace non-inverter ACs with inverter-type ACs.

Source: Authors' own compilation, Sevea Consulting (2022), based on walkthrough audits and interviews

TABLE 9. Energy saving potential and window of opportunity for each measure in the garment and textile

CATALOGUE OF EE MEASURES	ENERGY SAVING POTENTIAL	WINDOW OF OPPORTUNITY
EE retrofit of air compressor (VFD, leakages)	+	Medium to long term
Replace the old cooling fans with BLDC fans	+++	Short term
Upgrading the lighting systems from old lights to LED-based lights	+++	Short term
Clutch motor replacement with servo motor	+	Medium to long term
EE upgrade of boilers	+++	Short term
Replacement of ACs	++	Medium to long term

\+ Low priority , long-term (>7 years) impact, <10% savings

\++ Medium priority, medium-term (3–6 years) impact, 10–20% savings

\+++ High priority, high impact, >20% savings

FOOD PROCESSING (RICE MILLING AND ICE MANUFACTURING) – RICE MILLING

TABLE 10. Recommended measures for the rice milling industry

RECOMMENDED MEASURES	DESCRIPTION
Heat recovery in husk furnace	The typical electricity cost in rice milling is about 20% to 30% of total energy consumption and the rice husk consumption cost by boilers is about 70% to 75% of total energy consumption. Hence, about 60% to 70% of the total energy cost in parboiled rice milling plants is from the boiler alone. Rice husk is burnt using a fan, and the majority of rice mills appeared not to have any waste heat recovery system from the flue gas. The flue gas from the boiler outlet is typically leaving at a temperature of around 120–140°C. This temperature can be recovered by installing the waste heat recovery system. The sensible heat from the flue gases can be recovered to an extent. Complete recovery of waste heat is neither theoretically possible nor economically viable, and hence only an optimum quantity of the heat can be recovered during this process.
Use variable speed drive (VSD) in electric motors	Reducing the speed of large electric motors and the power surge of machines upon start-up, such as the whitening polishing machine and mist polishing machine, demonstrates good potential – up to 15% savings.
Upgrading the lighting systems from old lights to LED-based lights	Lighting is estimated to account for 10–20% of the total electricity consumption in the rice milling sector. Many factories utilise FL lamps. Walkthrough energy assessment results have revealed that LED lights are not yet fully in use, and FL lamps consume around 30–40% of lighting electricity. Potential savings of approximately 30%.
Replacement of non-VSD air compressors with VSD air compressors	A VSD air compressor can operate anywhere in the range between its minimum and maximum speed, and it automatically adjusts the speed so that the production of compressed air matches demand in real time. This capability saves energy because the compressor does not have to run flat out whenever it is on. The net pressure on a VSD compressor can be set lower than the unloaded pressure on a fixed-speed compressor. Typically, if there is no overpressure, each bar can save between 5% to 7% of energy.

TABLE 11. Energy saving potential and window of opportunity for each measure in the rice milling industry

CATALOGUE OF EE MEASURES	ENERGY SAVING POTENTIAL	WINDOW OF OPPORTUNITY
Heat recovery in husk burner	++	Medium to long term
Use variable speed drive (VSD) in electric motors	+++	Short term
Upgrading the lighting systems	++	Short term
Replacement of non-VSD air compressors with VSD air compressors	+	Medium to long term priority

\+ Low priority , long-term (>7 years) impact, <10% savings

\++ Medium priority, medium-term (3–6 years) impact, 10–20% savings

\+++ High priority, high impact, >20% savings

Source: Authors' own compilation, Sevea Consulting (2022), based on walkthrough audits and interviews

ICE FACTORIES

TABLE 12. Recommended measures for the ice manufacturing industry

RECOMMENDED MEASURES	DESCRIPTION
Upgrading the lighting systems from old lights to LED-based lights	Lighting is estimated to account for approximately 10–20% of the total electricity consumption in the ice manufacturing sector. Many factories still utilise T5 FL lamps. Walkthrough energy assessment results have revealed that LED lights are not yet fully in use, and T5 FL lamps consume around 30–40% of lighting electricity. Potential savings from LED replacement is about 30%.
Replacement of non-VSD air compressors with VSD air compressors	A VSD air compressor can operate anywhere in the range between its minimum and maximum speed, and it automatically adjusts the speed so that the production of compressed air matches demand in real time. This saves energy because the compressor does not have to run flat out whenever it is on. The net pressure on a VSD compressor can be set lower than the unloaded pressure on a fixed-speed compressor. Typically, without overpressure, each bar may result in 5% to 7% energy savings.
Solar PV and automatic transfer switches	Due to existing solar regulation in Cambodia, the installation of grid-connected solar PV may not yet be feasible. However, the installation of automatic transfer switches was studied and found to be a good alternative. Automatic transfer switches provide a reliable means of transferring load between a primary and alternative source of electrical power. As the current regulations for solar in Cambodia are only applicable for grid-synchronised systems, it is imperative that an open transition transfer switch is selected. Typical payback time is around 7–9 years based on an assumed electricity tariff of USD 0.137/kWh and a solar system cost of USD 720/kWp.

TABLE 13. Energy saving potential and window of opportunity for each measure in ice manufacturing

CATALOGUE OF EE MEASURES	ENERGY SAVING POTENTIAL	WINDOW OF OPPORTUNITY
Variable frequency drive (VFD) in compressor motor control	+++	Short term
Upgrading the lighting systems	++	Short term
Installation of Solar PV	+	Medium to long term

\+ Low priority , long-term (>7 years) impact, <10% savings

\++ Medium priority, medium-term (3–6 years) impact, 10–20% savings

\+++ High priority, high impact, >20% savings

Source: Authors' own compilation, Sevea Consulting (2022), based on walkthrough audits and interviews

COMMERCIAL BUILDINGS

TABLE 14. Recommended measures for the ice manufacturing industry

RECOMMENDED MEASURES	DESCRIPTION
Replacement of chillers	Chillers represent around 70% of the total energy consumption in commercial buildings and have significant potential for EE upgrades. The average age of chillers across commercial buildings was over 7 to 10 years (based on visited sites and interviews). With an average system efficiency of around 1.2 kW/TR (based on industry experience for old water-cooled systems and discussion with hotel staff). The cooling capacity of a centralised chiller system ranges between 160 and 700 TR. Cambodia's penetration rate of higher energy-efficient centralised chiller systems and VRF is still low.
Replacement of ACs	Generally, most commercial buildings in Cambodia have an air conditioning system installed to provide thermal comfort. Amongst the types of AC technologies, split AC is the most commonly used, with a penetration rate of nearly 85% to 90% or more in office buildings, hospitals and other healthcare buildings, retail stores and hotels. Although inverter ACs are common on the market, non-inverter ACs were still found to be in use.
Upgrading the lighting systems from old lights to LED-based lights	Lighting is estimated to consume about 10–20% of the total electricity consumption in the commercial building sector. Many factories still utilise FL lamps. Walkthrough energy assessment results have revealed that LED lights are not yet fully in use, and FL lamps consume around 30–40% of lighting electricity. Potential savings are about 30%.

Source: Authors' own compilation, Sevea Consulting (2022), based on walkthrough audits and interviews

TABLE 15. Energy saving potential and window of opportunity for each measure in the commercial building sector

CATALOGUE OF EE MEASURES	ENERGY SAVING POTENTIAL	WINDOW OF OPPORTUNITY
Replacement of chillers	+++	Short term
Replacement of ACs	+++	Near term
Upgrading the lighting systems	+++	Near term

\+ Low priority , long-term (>7 years) impact, <10% savings

\++ Medium priority, medium-term (3–6 years) impact, 10–20% savings

\+++ High priority, high impact, >20% savings

4.6 Conclusions

The sector analysis focused on an energy efficiency assessment of the commercial building and industrial sectors with high energy potential and covered the garment and textile, footwear, food processing (rice milling and ice factories) and commercial building sectors. The key aspect of the analysis involved reviewing various market entry requirements and, most importantly, energy efficiency and energy-saving opportunities.

The assessment results show that it is evident that the majority of facilities in Cambodia are lagging behind other Southeast Asian countries in the penetration of energy efficiency technologies, mainly because of a lack of experience, funds and technology solutions. Many EE initiatives mostly take the form of research and demonstration projects, while EE is strongly encouraged by the government.

Although financing and administrative barriers and a lack of EE technologies are generally the most critical, all of the barriers are interrelated and may often require the implementation of technical solutions and finance or sometimes energy audits to identify and demonstrate EE savings. Therefore, German energy service providers and EE equipment suppliers can significantly impact the local EE market at this early stage of development.

Interviews with local ESPs and experts conducted as part of this analysis showed a massive demand for energy efficiency services and equipment. The walkthrough assessment undertaken as part of this analysis confirmed that there is potential to save up to 40% of electrical and thermal energy. This is particularly relevant for the industrial sector, where high-efficiency motors (HEMs) appear not to be widely installed among the factories and have great implementation potential. In addition, the current stock of boilers within the garment and footwear factories is relatively old.

The limited technical capacities of public- and private-sector actors on energy efficiency constrain their ability to identify, design and implement energy efficiency projects. For example, many garment factories were found to be in need of more appropriate knowledge and information on EE solutions for boilers, air compressors and heat recovery solutions. In addition, factory and building owners generally have a low level of awareness of the benefits of energy efficiency. Due to this, there is a need to have more competencies, especially for energy audit professionals, to identify EE opportunities and present possible solutions. The local energy services market must still be ready and familiar with the ESCO business models. Therefore, this provides an excellent opportunity for German SMEs to introduce innovative ESCO business models and facilitate the implementation of EE projects.

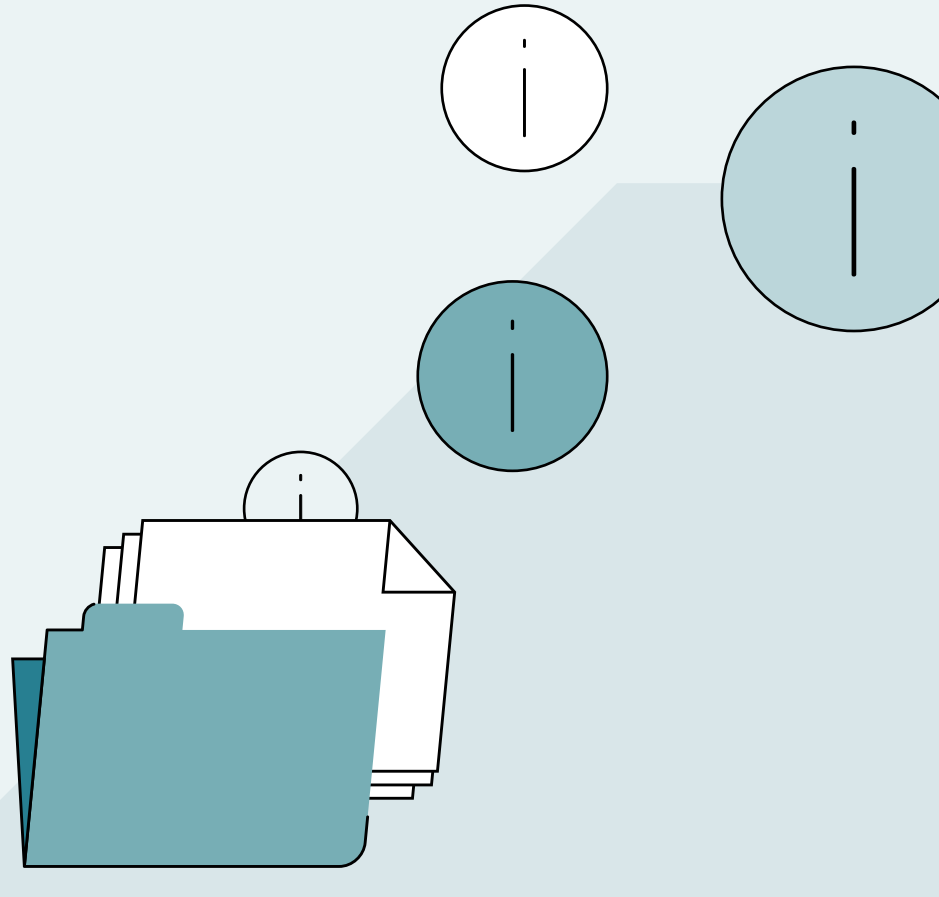
As mentioned above, the industrial sector in Cambodia is dominated by the private sector, with minimal penetration of energy efficiency technologies, both sector-specific and cross-cutting. Garments, textiles and rice are among the major export products of Cambodian industries, which are the focus of this analysis and have witnessed rising competition from other countries lately. In the case of export-oriented industries, while international buyers often require compliance with specific environmental and EE standards, the planning, implementation capacity and awareness of these industries of energy efficiency still need to be improved.

Their lack of capacity is further exacerbated by the incipient development of energy service companies (ESCOs). Therefore, German SMEs have an enormous opportunity to provide EE services and solutions and support the factories to meet these compliance standards.

European products and Germany, in particular, as one of the leading producers of EE products and services, are well regarded in Cambodia; as such, local ESPs/ESCOs are also increasingly interested in becoming distributors for German companies or building partnerships to provide services or supply equipment. Therefore, partnerships with local ESPs may be an effective way to enter the market.

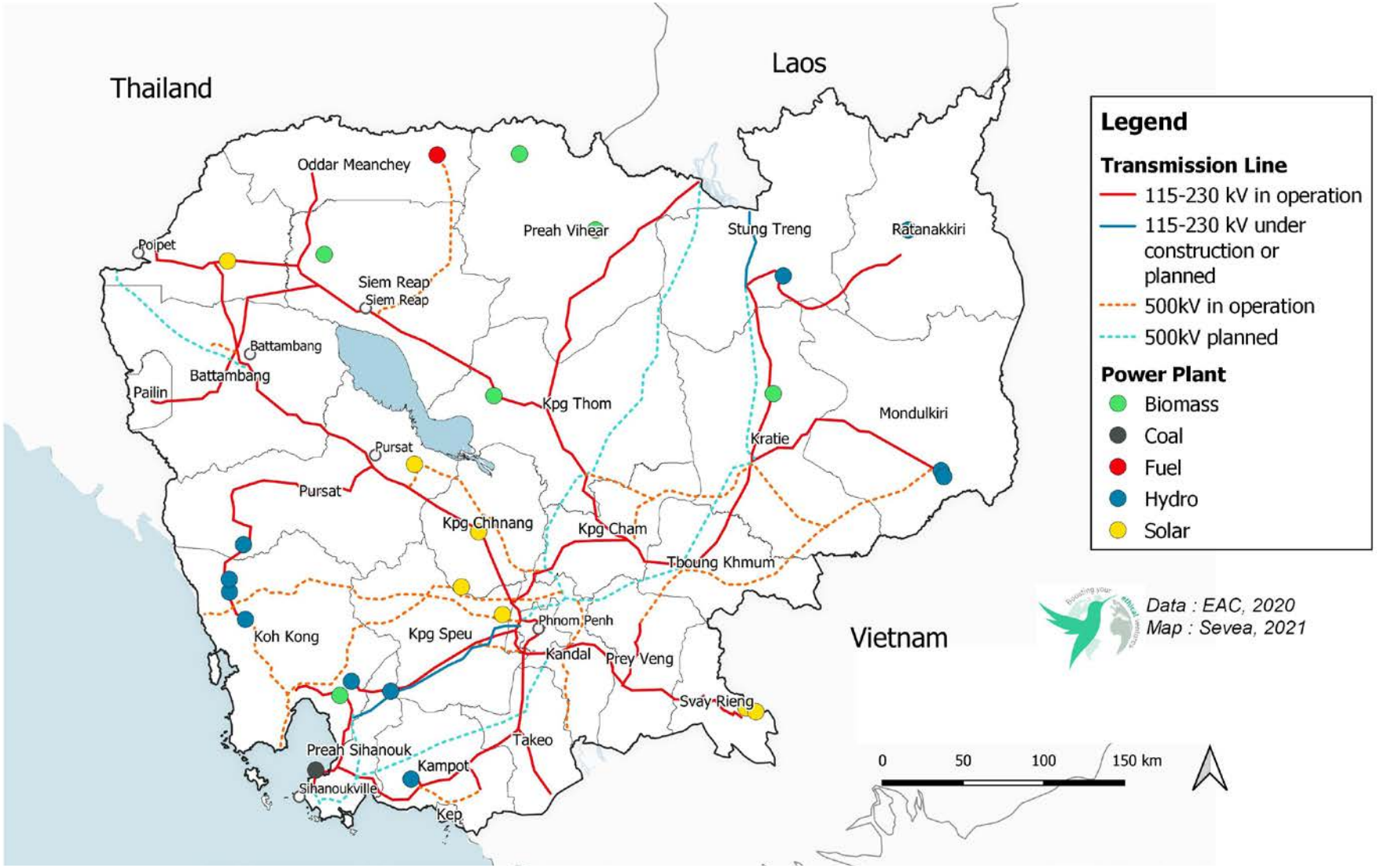
German companies should conduct due diligence on potential local partners to ensure that they have the credentials and qualifications to conduct business. German companies should also ensure that the partnership agreements they put in place comply with Cambodian law: thoroughly documenting the rights and obligations of each party and stipulating dispute resolution procedures.

Annexes



Annex 1 Cambodian national electricity grid

FIGURE 21. Cambodian national grid and development plan



Source: (EAC, 2021)

Annex 2 German development projects in Cambodia

TABLE 16. Official German development projects registered with the CDC

#	OFFICIAL NAME	STATUS	START	END	BUDGET
1	Study and Expert Fund (TC)	Completed	02/95	12/16	EUR 9,852,932
2	Sector-related Programme for Health I	Completed	01/01	01/07	EUR 4,192,593
3	Sector-related Programme for Health III	Completed	01/01	01/07	EUR 7,669,378
4	Sector-related Programme for Health II	Completed	01/01	01/07	EUR 2,556,459
5	Telecommunications I	Completed	01/01	12/07	EUR 7,669,378
6	Tertiary Rural Road Improvement Programme II (TRIP II)	Completed	01/01	01/07	EUR 4,090,335
7	Flood Damage Repairs of Rural Road	Completed	06/01	09/07	EUR 7,669,378
8	Rural Development Programme I - Kampot & Kampong Thom	Completed	04/02	03/08	EUR 5,400,000
9	Support of Gender Equity and Promotion of Women's Rights	Completed	06/02	06/06	EUR 2,300,000
10	Tertiary Road Improvement Programme III (TRIP III)	Completed	09/02	10/07	EUR 5,112,919
11	Study and Expert Fund II (FC)	Completed	10/02	12/14	EUR 1,022,584
12	Promotion of Small and Medium-sized Enterprises I (SME I)	Completed	04/03	12/07	EUR 3,000,000
13	Reproductive Health I	Completed	08/03	01/07	EUR 5,112,919
14	Trade Policy and Trade Promotion	Completed	04/04	02/08	EUR 810,000
15	Administrative Reform and Decentralisation	Completed	01/05	01/08	EUR 2,460,000
16	Private Sector Promotion Programme	Completed	01/05	12/07	EUR 3,089,000
17	Tertiary Road Improvement Programme IV (TRIP IV)	Completed	02/05	05/09	EUR 9,805,882
18	Land Management	Completed	06/05	02/11	EUR 4,650,000
19	Support to the National Audit Authority I	Completed	10/05	12/08	EUR 1,022,000
20	Promotion of Small and Medium-sized Enterprises II (SME II)	Completed	10/05	12/08	EUR 4,590,335
21	Building Capacity at Grass-roots Level to Control Avian Influenza	Completed	12/05	11/08	EUR 2,600,000
22	Targeting - Identification of Poor Households	Completed	04/06	04/12	EUR 5,895,000
23	Promoting Women's Rights II	Completed	07/06	06/11	EUR 4,000,000

Source: CDC (2021)

#	OFFICIAL NAME	STATUS	START	END	BUDGET
24	Support to the Health Sector Reform (Phase 2)	Completed	12/06	06/09	EUR 3,690,000
25	2008 Population Census of Cambodia	Completed	01/07	12/08	EUR 1,882,704
26	Reproductive Health II	Completed	01/07	05/13	EUR 7,000,000
27	Land Allocation for Social and Economic Development (LASED)	Completed	02/07	02/11	EUR 3,900,000
28	Transmission Line Takeo – Kampot	Completed	02/07	07/14	EUR 12,169,378
29	Regional Economic Development – Green Belt Siem Reap Province 1	Completed	10/07	12/10	EUR 4,152,936
30	Administrative Reform and Decentralisation	Completed	01/08	06/13	EUR 7,950,000
31	Assistance via Church, NGOs, Political Foundations	Completed	01/08	12/12	EUR 9,024,000
32	Emergency Assistance	Completed	01/08	12/08	EUR 1,710,000
33	Other German Public Institutions (Departments, Bundeslaender)	Completed	01/08	12/08	EUR 2,906,000
34	Personal Assistance (CIM, ZFD etc.)	Completed	01/08	12/13	EUR 25,524,000
35	Support to Private Sector Development in Rural Areas	Completed	01/08	06/11	EUR 3,400,000
36	ASEAN Regional Microfinance Training Center (ACLEDA)	Completed	01/09	06/15	EUR 610,000
37	Rural Infrastructure Programme I (RIP I)	Completed	01/09	12/12	EUR 9,808,824
38	Support to the National Audit Authority II	Completed	01/09	12/13	EUR 2,200,000
39	Social Health Protection (TC)	Completed	07/09	06/11	EUR 3,212,000
40	Reproductive Health III	Completed	01/10	04/14	EUR 5,000,000
41	Rural Electrification of Southern Cambodia I	Completed	01/10	12/14	EUR 6,000,000
42	Rural Electrification of Southern Cambodia II	Completed	01/10	05/15	EUR 4,000,000
43	Social Health Protection Programme I (Vouchers for Reproductive Health Services) (SHPP I)	Completed	01/10	07/14	EUR 2,500,000
44	Renewable Energy	Completed	07/10	06/12	EUR 3,200,000
45	Access to Justice for Women I	Completed	12/10	12/13	EUR 5,046,500

Source: CDC (2021)

#	OFFICIAL NAME	STATUS	START	END	BUDGET
46	Regional Economic Development – Green Belt Siem Reap Province 2	Completed	01/11	08/14	EUR 7,057,099
47	Support to the Cambodian Land Reform Programme I	Completed	03/11	06/14	EUR 8,555,330
48	Rural Infrastructure Programme II (RIP II)	Completed	05/11	05/15	EUR 11,200,000
49	Social Health Protection Programme II (TC)	Completed	07/11	06/14	EUR 10,100,000
50	Support to the IDPoor Programme	Completed	05/12	02/16	EUR 4,920,000
51	Support to Decentralisation and the Decentralisation Programme	Completed	07/12	04/16	EUR 6,430,000
52	Flood Repair Measures for Rural Infrastructures	Completed	07/12	05/15	EUR 11,100,775
53	MUSKOKA (Mother and Child Health Improvement Programme)	Completed	08/12	12/15	EUR 5,640,000
54	Support to the National Audit Authority III	Completed	01/13	12/14	EUR 1,000,000
55	Support to ASEAN Supreme Audit Institutions (ASEAN SAI)	Completed	03/13	04/15	EUR 2,500,000
56	Mother and Child Health Improvement Programme (MUSKOKA FC)	Completed	06/13	06/16	EUR 3,000,000
57	Social Health Protection Programme III (FC) (Vouchers for Reproductive Health Services III)	Completed	06/13	12/17	EUR 7,000,000
58	Social Health Protection Programme II (FC) (Vouchers for Reproductive Health Services II) (SHPP II)	Completed	06/13	12/16	EUR 6,000,000
59	Rural Infrastructure Programme III (RIP III)	Completed	11/13	11/16	EUR 4,400,000
60	Access to Justice for Women II	Completed	01/14	12/17	EUR 3,909,000
61	Civil Peace Service (TC)	Completed	01/14	12/17	EUR 3,737,030
62	Land Rights Programme II	Completed	07/14	06/16	EUR 5,612,000
63	Regional Economic Development Programme Phase III (RED III) (TC)	Completed	09/14	03/18	EUR 9,198,900
64	Improvement of Livelihoods and Food Security of Former Landless Households in Cambodia (TC)	Completed	10/14	11/20	EUR 5,500,000
65	Economic Infrastructure Programme to Sustain Land Reform Implementation (FC)	Completed	01/15	12/18	EUR 9,900,000

Source: CDC (2021)

#	OFFICIAL NAME	STATUS	START	END	BUDGET
66	Social and Labour Standards in the Textile and Garment Sector in Asia (SLSG) (TC-Regional Programme)	Completed	02/15	06/19	EUR 5,675,000
67	Multi-Sectoral Food and Nutrition Security in Cambodia (MUSEFO) (TC)	Ongoing	03/15	03/26	EUR 24,300,000
68	Support to ASEAN Supreme Audit Institutions II (ASEANSAI II) (TC-Regional Program)	Completed	05/15	12/18	EUR 4,000,000
69	German Contribution to the Cambodian Health Sector Programme (HSSP2) (FC)	Completed	06/15	12/15	EUR 5,988,535
70	Social Health Protection Programme III (TC)	Completed	09/15	12/18	EUR 8,732,280
71	Rural Infrastructure Programme Phase IV - Capacity Building (FC)	Completed	01/16	12/18	EUR 880,000
72	Rural Infrastructure Programme Phase IV (RIP IV) (FC)	Completed	01/16	12/18	EUR 12,100,000
73	Study and Expert Fund II (TC)	Ongoing	01/16	01/25	EUR 8,242,751
74	Support to the Identification of Poor Households Programme Phase IV (TC)	Ongoing	03/16	04/22	EUR 16,880,091
75	Improvement of Livelihoods and Food Security of Former Landless Households in Kampong Chhnang, Kampong Speu, Kampong Thom and Kratie	Ongoing	07/16	06/22	EUR 6,000,000
76	German Contribution to the Cambodian Health Equity and Quality Improvement Programme (H-EQIP) (2016-2019)	Ongoing	09/16	07/22	EUR 22,650,000
77	Rural Infrastructure Programme Phase V (RIP V) (FC)	Completed	01/17	12/18	EUR 9,900,000
78	Lower Mekong Basin Wetland Management and Conservation Project (Regional) (FC)	Ongoing	04/17	12/21	EUR 4,400,000
79	Accompanying Measure (2017) for the German Contribution to the Health Equity and Quality Improvement Programme (H-EQIP)	Ongoing	08/17	12/22	EUR 2,000,000
80	Civil Peace Service KH - Reconciliation and Justice Concerning the Khmer Rouge Tribunal (TC)	Ongoing	01/18	04/21	EUR 2,536,000
81	Rural Infrastructure Programme Phase VII (FC)	Ongoing	01/18	12/21	EUR 7,000,000
82	Regional Economic Development Program Phase IV (RED IV) (TC)	Ongoing	04/18	04/22	EUR 10,517,210
83	Rural Infrastructure Programme Phase VI - Capacity Building (FC)	Ongoing	05/18	04/21	EUR 600,000
84	Rural Infrastructure Programme Phase VI (FC)	Ongoing	05/18	04/21	EUR 5,100,000

Source: CDC (2021)

#	OFFICIAL NAME	STATUS	START	END	BUDGET
85	Social Health Protection (SHP) Programme IV (TC)	Ongoing	08/18	06/22	EUR 13,374,355
86	Development Support to Micro, Small, Medium-sized Enterprises (TC)	Ongoing	11/18	02/22	EUR 3,000,000
87	EU Arise Plus (TC)	Ongoing	12/18	06/23	EUR 9,350,000
88	Promotion of Sustainability in the Textile and Garment Industry in Asia (FABRIC) (Regional Programme – TC).	Ongoing	04/19	01/23	EUR 9,323,400
89	Decentralisation and Administrative Reform Programme II (TC)	Ongoing	05/19	04/22	EUR 5,040,000
90	German Contribution to Cambodia Nutrition Project (2018)	Ongoing	07/19	06/24	EUR 10,000,000
91	Civil Peace Service/CPS Southeast Asian University Partnership for Peacebuilding and Conflict Transformation	Ongoing	08/19	12/22	EUR 1,715,000
92	Accompanying Measure (2018) for the German Contribution to the Energy Efficiency in Rural Power Supply	Ongoing	12/19	12/23	EUR 2,000,000
93	Energy Efficiency in Rural Power Supply	Ongoing	12/19	06/25	EUR 30,000,000
94	Sustainable Community Fisheries and Aquaculture in Cambodia	Ongoing	12/19	06/23	EUR 4,500,000
95	Contribution to World Bank Multi-donor Trust Fund to Support the Implementation of Social Accountability Framework	Ongoing	03/20	06/24	USD 5,000,000
96	German Contribution to the Cambodia Pre-Service Training for Health Workers Project I	Ongoing	05/20	06/26	EUR 10,000,000
97	Rural Infrastructure Development for Cambodia (RID4CAM) EU AIF	Ongoing	12/20	11/26	EUR 8,334,580
98	Rural Infrastructure Programme VIII-Rural Infrastructure Development for Cambodia (RID4CAM)	Ongoing	12/20	12/26	EUR 30,000,000
99	Rural Infrastructure Programme VII-Rural Infrastructure Development for Cambodia (RID4CAM)	Ongoing	12/20	12/26	EUR 7,100,000
100	CPS Justice and Reconciliation post Khmer Rouge Tribunal	Ongoing	01/21	12/23	EUR 2,250,000
101	Strengthening the Resilience of Poor Population Groups under Climate Change in Selected ASEAN Countries, under Special Consideration of COVID-19 Effects	Ongoing	04/21	02/24	EUR 4,990,319
102	Improving Social Protection and Health	Ongoing	10/21	09/24	EUR 14,000,000
103	Sustainable Textile Industry in Cambodia	Ongoing	11/21	10/24	EUR 5,000,000
104	German Contribution to the Cambodia Nutrition Project (CNP) II	Ongoing	11/21	12/26	EUR 10,000,000

Annex 3 Cambodian membership in international organisations

INTERNATIONAL ORGANISATION	MEMBERSHIP
Food and Agriculture Organization of the United Nations (FAO)	1950
World Health Organization (WHO)	1950
United Nations Educational, Scientific and Cultural Organization (UNESCO)	1951
United Nations International Children's Emergency Fund (UNICEF)	1952
United Nations (UN)	**1955**
International Criminal Police Organization (INTERPOL)	1956
United Nations Development Programme (UNDP)	1958
International Maritime Organization (IMO)	1961
Asian Development Bank (ADB)	**1966**
United Nations Industrial Development Organization (UNIDO)	1966
Universal Postal Union (UPU)	1969
International Monetary Fund (IMF)	1969
International Bank for Reconstruction and Development (IBRD)	1970
International Development Association (IDA)	1970
International Fund for Agricultural Development (IFAD)	1992
World Bank	**1993**
World Intellectual Property Organization (WIPO)	1995
International Finance Corporation (IFC)	1997
Multilateral Investment Guarantee Agency (MIGA)	1999
International Labour Organization (ILO)	1999
Association of Southeast Asian Nations (ASEAN)	**1999**
World Customs Organization (WCO)	2001
World Trade Organization (WTO)	**2004**
Asian Productivity Organization (APO)	2004
International Centre for Settlement of Investment Disputes (ICSID)	2005

TABLE 17. List of memberships in international organisations

Source: Authors' own compilation, Sevea Consulting (2022), based on organisations' websites.

Annex 4 Trade agreements from Cambodia

TABLE 18. List of trade agreements from Cambodia

TRADE AGREEMENT	TYPE OF AGREEMENT	DATE
Armenia, Australia, Belarus, Canada, Chile, China, European Union, Iceland, India, Japan, Kazakhstan, Kyrgyzstan, Montenegro, New Zealand, Norway, Russia, South Korea, Switzerland, Tajikistan, Taiwan, Thailand, Turkey, United Kingdom, United States.	Individual unilateral agreements due to Cambodia **Least Developed Country** (LDC) status under the UN, or **Generalized System of Preferences** (GSP) status under the WTO.	
ASEAN Regional Group	Plurilateral	1994
ASEAN Integration System of Preferences	Plurilateral	2002
China's special preferential duty	Unilateral	2004
ASEAN-China FTA	Plurilateral	2005
ASEAN-Korea CECA	Plurilateral	2008
ASEAN-Japan EPA	Plurilateral	2009
ASEAN-India FTA	Plurilateral	2010
Australia-ASEAN-New Zealand FTA	Plurilateral	2011
Cambodia-Korea FTA	Bilateral	2021
Cambodia-China FTA	Bilateral	2022
Regional Comprehensive Economic Partnership	Multilateral	2022

Source: ITC (2022).

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