# Impact Assessment of Measures to Support Sustainable Energy Investment in the Garment Sector

switchasia GRANTS PROGRAMME

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# List of Acronyms

| | |
|---|---|
| ABC | Association of Banks in Cambodia |
| ADB | Asian Development Bank |
| AFD | Agence Française de Développement |
| AII | Apparel Impact Institute |
| ARDB | Agricultural and Rural Development Bank |
| ASEAN | Association of Southeast Asian Nations |
| BAT | Best Available Technologies |
| BEPC | Basic Energy Plan for Cambodia |
| BGMEA | Bangladesh Garment Manufacturers and Exporters Association |
| CAPEX | Capital Expenditure |
| CBAM | Carbon Border Adjustment Mechanism |
| CCCA | Cambodia Climate Change Alliance |
| CCFF | Climate Change Financing Framework |
| CDC | Council for the Development of Cambodia |
| CEIA | Clean Energy Investment Accelerator |
| CGCC | Credit Guarantee Corporation of Cambodia |
| CGTI | Cambodian Garment Textile Institute |
| CMT | Cut, Make, and Trim |
| CP | Cleaner Production |
| CPA | Cleaner Production Assessment |
| CSFP | Cambodian Sustainable Finance Principles |
| DFI | Development Financial Institutions |
| DGE | Department of Green Economy |
| DPs | Development Partners |
| EAC | Electricity Authority of Cambodia |
| EBA | Everything But Arms |
| EDC | Electricite Du Cambodge |
| EE | Energy Efficiency |
| EE&C | Energy Efficiency and Conservation |
| EESDP | Energy Efficiency Sector Development Program |
| EIA | Environmental Impact Assessment |

| | |
|---|---|
| EMS | Environmental Management System |
| EnM | Energy Management |
| EnMS | Energy Management Standard |
| EPC | Energy Performance Contracting |
| ESCO | Energy Service Company |
| ESP | Energy Service Provider |
| EU | European Union |
| FIs | Financial Institutions |
| FIT | Factory Improvement Toolsets |
| FOLU | Forestry and Land Use |
| GBI | Green Building Index |
| GDP | Gross domestic product |
| GFT | Garment, Footwear and Travel |
| GHG | Greenhouse Gas |
| GIZ | Gesellschaft für Internationale Zusammenarbeit |
| GSP | Generalized System of Preferences |
| GTF | Garment, Textile, and Footwear |
| GTF | Green Transformation Fund |
| GTFP | Global Trade Finance Program |
| GTSF | Global Trade Supplier Finance |
| HVAC | Heating, Ventilation, & Air Conditioning |
| IFC | International Finance Corporation |
| ILO | Law on Investment |
| ISC | Institute of Standards of Cambodia |
| ISO | International Organization for Standardization |
| LEED | Leadership in Energy and Environmental Design |
| M&E | Monitoring and Evaluation |
| MEF | Ministry of Economy and Finance |
| MEPS | Minimum Energy Performance Standards |
| MFIs | Micro Finance Institutions |
| MGFP | Model Green Factory Program |
| MIH | Ministry of Industry and Handicrafts |
| MISTI | Ministry of Industry, Science, Technology, and Innovation |
| MLMUPC | Ministry of Land Management, Urban Planning and Construction |
| MME | Ministry of Mines and Energy |

| | |
|---|---|
| MoE | Ministry of Environment |
| MRV | Monitoring Reporting and Verification |
| MSP | Mekong Strategic Partners |
| MV | Medium Voltages |
| MW | Megawatt |
| NCDM | National Committee for Disaster Management |
| NCSD | National Council for Sustainable Development |
| NDC | Nationally Determined Contribution |
| NESAP | National Environment Strategy and Action Plan |
| NGOs | Non-Governmental Organizations |
| OPEX | Operating Expenses |
| PaCT | Partnership for Cleaner Textile |
| PPA | Power Purchase Agreement |
| PPPA | Public Private Partnership Authority |
| PR | Public Relations |
| PV | Photovoltaic |
| RE | Renewable Energy |
| RECs | Recommendations |
| REDD+ | Reduce Emission from Deforestation and Forest Degradation |
| RGC | Royal Government of Cambodia |
| IA | Impact Assessment |
| ROI | Return on investment |
| SAC | Sustainable Apparel Coalition |
| SBTi | Science Based Targets initiative |
| SCP | Sustainable Consumption and Production |
| SES | Sustainable Energy Sources |
| SGS | Standard Global Services |
| SIDA | Swedish International Development Agency |
| SME | Small and Medium Enterprise |
| TA | Technical Assistance |
| TAFTAC | Textile, Apparel, Footwear & Travel Goods Association in Cambodia |
| TOT | Training of Trainers |
| TUV | Technischer Überwachungsverein |
| U4E | United for Energy |
| UNEP | United Nations Environment Program |

| | |
|---|---|
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNIDO | United Nations Industrial Development Organization |
| US | United States |
| USAID | United States Agency for International Development |
| VFC | Vision Fund Cambodia |
| VITAS | Vietnam Textile & Apparel Association |
| WCS | Wildlife Conservation Society |

# EXECUTIVE SUMMARY

The garment sector is a key industry in the Cambodian economy, accounting for USD 8.3 billion and around two thirds of exports in 2019. While it was severely affected by the COVID-19 pandemic, the latest numbers on production and estimated exports for the year 2022 indicate a strong recovery. From a long-term perspective however, merely returning to pre-pandemic production levels will be insufficient for the continued strength of the sector and its contribution to overall growth. Rather, the sector will need to catch up to the global trends shaping garment supply chains, most notably those regarding sustainability. Against that background, Switch Garment is implementing a four-year project for Promotion of Sustainable Energy Practices in the Cambodian Garment Sector supporting manufacturers with the uptake of energy efficiency and renewable energy interventions to reduce environmental impact and production cost, thus enhancing competitiveness. The impact assessment of this Model Green Factory Program (MGFP) for individual factories and the sector was conducted based on a quantitative modeling approach, complemented by a qualitative analysis of the current sector positioning, its regulatory environment, and a stakeholder assessment.

While Cambodia is currently competitive in the high volume, low value cut-make-trim segment of garment production, a lack of skilled human resources, advanced production methods, backward linkages and sustainability performance together with rising wages pose a serious threat to prospects in the highly competitive global supplier market. From the buyer perspective, social sustainability has become the baseline, with environmental sustainability increasingly contributing to the key indicators for evaluating suppliers besides the 'hard' facts of price, quality, and logistics. The drive for decarbonizing fashion is based on consumer demand in line with global efforts to raise awareness of the need to combat climate change. The most widespread initiatives are the United Nations Framework Convention on Climate Change (UNFCCC), the Fashion Industry Charter for Climate

Action, and the Science Based Targets initiative (SBTi) with a focus on reducing GHG emissions in production, thus revolving around the key levers of energy efficiency and renewable energy. With brands operating along these guidelines, sustainability becomes a key requirement, especially for suppliers that want to secure higher quality contracts as in longer-term, higher volume, higher value contracts or even maintain customers once the low-value buyers shift production to countries with lower minimum wages. Increasing carbon regulations in importing countries add further urgency to sustainability improvements.

The current regulatory environment in Cambodia for sustainable production offers many policies and strategic frameworks in favor of environmental goals but has few concrete laws and regulations in place to achieve these goals. A draft has been developed for first steps towards MEPS and S&L standards, and the recently issued Cambodia Garment, Footwear and Travel Goods (GFT) Sector Development Strategy 2022 – 2027 is more specifically aiming towards an 'environmentally sustainable' industry by incentivizing energy efficiency and renewable energy. This should be further supported by the Law on Investment (2022) and its supporting sub-decree on incentives for green investments. However, the current regulations on solar PV disincentivize the adoption of solar energy by the private sector due to a cap of subscribed electricity demand, a lack of net-metering, feed-in options and off-peak rates. While solar panels are tax exempt for direct import by their user, this regulation does not apply to other green technology and businesses that retail equipment or aim to provide turnkey solutions.

Feedback on the proposed MGFP from key stakeholders such as the government, TAFTAC and its factory members, buyers, energy service providers, development partners and (development) financial institutions show that such a local initiative is seen as creating an indirect benefit to factories in terms of competitiveness through improving sustainability and thus improving the factories' performance in internationally used rating standards, such as the Higg Index. With this established standard in mind, intervention measures and processes should be in line with Higg procedures to avoid putting additional burden on factory operations. Establishing measurement systems at factories will generally be a first step towards wide scale onboarding of factories and provide a clearer picture of the sector in terms of energy management. An ample timeline for awareness raising and making a convincing business case – whether it be based on cost savings or better contract prospects – both a clear authority for implementation as well as technical assistance for capacity building among all stakeholder groups are seen as key for a successful launch. Another crucial supporting measure will be access to finance for smaller to medium-sized factories with less stable cash flow, especially for larger investments. Besides sustainably minded FIs, potential collaboration with dedicated concessional green funding through DFI initiatives from Proparco, an expected UNDP revolving fund for SE measures, and green funding through MSP's upcoming Green Financing Institution could be accelerators, along with targeted fiscal incentives or a modification of the current solar power tariff from the public side, and the development of ESCOs or ESCO-like services in the private sector.

The MGFP's emphasis is energy management, with retrofits of the key technologies lighting, boilers, sewing machines, ventilation, and compressed air units for improving energy efficiency and sustainable energy sources in the form of solar PV. A quantitative impact assessment of the proposed SE interventions with the System Dynamics model shows the effects across three factory profiles (high, medium, and low value production) and their products for a phase in of energy efficiency measures over 8 years from 2022 and a one-time investment in solar PV in 2030. The adoption of energy efficiency equipment reduces energy consumption and costs on average by 18.8% in 2030 across factory and product types when the full ambition is reached with a payback time of 3 years. Solar PV as a CAPEX investment leads to a cost reduction of 6.3% with a payback time of 7 years when 40% of electricity needs are produced, but higher savings can be achieved if the ambition were to be higher. However, smaller installations of 10% of energy needs and below as well as solar energy through a PPA would lead to cost increase because of the current electricity pricing mechanism. Overall

production costs see a decline after interventions by 1.1% on average across all products analyzed, resulting in higher profit of up to 101% by 2035 for companies operating on a low margin (of around 1-2%) and a profit increase of around 1-3% for those with a higher margin (of around 30%). With higher profits and profit margin, factories can reduce prices to compete on cost and or use their resources to increase production quality and secure better contracts. The reduced reliance on carbon intensive fuels will reduce the vulnerability of factories to volatile fossil fuel prices and the potential introduction of carbon taxes either in Cambodia or internationally, increasing economic resilience and competitiveness for Cambodian factories. Extrapolating to the sector with approximately 600 factories across factory types, the interventions translate into 1.9 million tons of GHG emissions saved each year or around 12% of annual emissions at the national level. Through investments in solar PV, 5,600 jobs could be created in manufacturing and installation and further 200 jobs for operation and maintenance.

While retrofits do not impact cash flow considerably because the savings are larger than the investment, and the investment is phased over 8 years, solar PV as a one-time investment results in negative net cash flow in that year but turns positive and higher when solar PV is operational. The investments range from USD 235,000 for energy efficiency and USD 342,000 for solar PV for a smaller, lower value segment factory to USD 1.5 million for energy efficiency and USD 2.4 million for solar PV for larger, higher value production. Countrywide, the total investment required may reach $485 million by 2030.

For implementation, TAFTAC would play a leading role as this is primarily an industry initiative, not only for ongoing communication to its members and all relevant stakeholders but also for execution and monitoring, and coordination as well as advocacy with the government. A steering committee comprising representatives from the key groups of TAFTAC, government (MISTI and MoE), buyers, and development partners can be a vehicle for more effective and efficient collaboration to ensure a successful launch. A potential shift to more formalization as a government led program or standard is only envisioned in the longer term, most likely with MISTI as the primary responsible ministry. Regardless of the actors in the lead, continuous and correct reporting of relevant indicators is key for the long-term implementation and success of the MGFP. The five main areas for a monitoring, reporting and verification (MRV) system are tracking of the adoption of energy efficient equipment and solar PV, monitoring of corresponding changes to energy consumption, estimations of changes in energy intensity in production, monitoring of economic performance of factories, and tracking of generated air emissions, all on an annual basis.

The potential impact by the MGFP as quantified by the model is considerable for individual factories, for the Cambodian garment sector and its long-term competitiveness and also on the economy as a whole through spillover effects of awareness and capacity building for greening not only garment production but also other sectors of the Cambodian economy.

# 1. Research Objectives

## 1.1. Switch Garment Project Background

The Switch Garment project "Promotion of Sustainable Energy Practices in the Cambodian Garment Sector" supports garment manufacturers in Cambodia in the adoption of sustainable energy practices and aims to facilitate improved access to finance to realize energy efficiency (EE) and renewable energy (RE) interventions. The goal is to reduce environmental impact of production as well as production cost and to enhance competitiveness of factories and of the Cambodian garment sector as a whole in the global supply chains.

As a policy tool, the Switch Garment team together with the Textile, Apparel, Footwear & Travel Goods Association in Cambodia (TAFTAC) has designed a 'Model Green Factory Program' (MGFP) in line with current and expected government laws and regulations, to be proposed to the Royal Government of Cambodia (RGC). This program will be an initiative driven by the garment industry under the leadership of TAFTAC with the aim of advocating for clean energy policy actions in the sector. While the program will be seeking government support for this policy vehicle, it is ultimately regarded as an industry initiative.

## 1.2. EMC Mandate and Approach

For the proposed MGFP and its possible intervention setups, an impact assessment (IA) is to inform the ideal regulatory scenario to support sustainable energy investments in the Cambodian garment sector. The MGFP consists of four compliance areas, from technology and equipment retrofits to environmental factory management processes. At its core, the IA is conducted with a simulation model that can show the impact of a specified intervention on several impact areas including social, economic, and environmental aspects. Key factors considered in the formulation of MGFP scenarios are the level of defined technical standards within the compliance elements (e.g. represented by the improved energy efficiency over the baseline), the time frame (e.g. represented by the trajectory to follow to comply with the standard assumed), supporting incentives (e.g. estimated based on the cost of complying with the standard, and the impact it would have on profitability) or the extent of standard enforcement (e.g. represented by the creation of a scenario that would represent full adoption of the standard by a given year).

The model analyzes the impact of intervention measures in the following areas:

- Overall economic, social, and environmental impact, considering (I) economic profitability, (II) employment and green jobs, (III) GHG emissions and other air pollutants, (IV) access to sustainable energy and (V) ecosystem services.
- Garment sector competitiveness in terms of production efficiency, product sustainability value addition, etc., also considering competition along the value addition spectrum of garment production in Cambodia.
- The analysis will focus on different types of firms, those that work in a business environment of low, medium, and highly value addition. These thre ''archetypes'' are drafted to capture changes in equipment (size, quality, and sophitication), related required investment an dimpact on profitability and impact on profitability, via the use of different equations and parameters, reflecting the realistic situation where a firm would tend to produce all products of the same type, either for low, medium, or high value addition buyers. Competitiveness will be analysed in the model as follows for the three different typologies of firms[1]:

[1] The lowest value addition segment, characterized by typically unbranded production without concerns for sustainability and focus on competitiveness by the lowest production cost possible can be assumed to be that averse to any sustainability efforts that they would need to be forced to compliance by law. Hence, a separate analysis for their business benefits and impact is excluded in favor of the suppliers with higher sustainability performance or potential that are more likely to be registered, exporting TAFTAC members and as such target of the MGFP initiative.

  - **Low Value Addition**: Few sustainability requirements, discount segment such as well know, large discount store chains. Competitiveness defined by production cost, but dependent on meeting selected production and facility standard requirements.

  - **Medium Value Addition**: Low profit margin brands but with sustainability goals, like well-known fast fashion labels. Competitiveness defined by production cost as well as sustainability outcomes which affect the potential for revenue generation (e.g., energy consumption and generation of emissions, water use efficiency and water pollution creation).

  - **High Value Addition**: Higher profit production for higher profile brands, such as high-end sporting goods labels, that pursue long-term supplier relations due to their sustainability and production requirements. Factories on this level usually have much farther advanced standards.

- General impact on businesses in the garment sector - broken down by the relevant variables size of factory, value segment and type of produced items.

The analysis relates to not only the factory / building level but also the sectoral level. An integration of both via a bottom-up approach based on the available data and permissible extrapolations provide maximum insights.

Similarly for the evaluation of policy effectiveness and the respective potential for investment realization and uptake of technology, two possible approaches are combined: the identification of the most ***effective*** policies to achieve the targets of efficiency and modernization of factories and of the policies that can ***share the cost most effectively*** between firms and government, should the government be willing to provide incentives.

Besides these quantitative modeling outcomes, certain analyses and insights are based on a qualitative assessment of other key aspects:

- Analysis of the regulatory environment and the positioning of the MGFP in the context of existing and developing policies and strategic plans of the government to evaluate the feasibility and impact of the proposed interventions.

- Suggestion on optimum institutional arrangements for implementation and governance of the MGFP in consideration of key stakeholders involved, complemented by a high-level framework for monitoring, reporting and verification (MRV) for ongoing impact assessment of the MGFP after introduction.

- Competitiveness of the Cambodian garment sector on business and industry level as assessed in the context of a global movement towards a greener production and supply chain with environmental sustainability as a new sourcing driver besides price and quality.

The quantitative and qualitative analysis address the question of how the garment sector in Cambodia can become more competitive for medium to high value addition garment production and to which extent this is related to environmental sustainability practices and investments.

# 2. Research Background: Competitiveness from the Buyer Perspective

## 2.1. Current Positioning of the Cambodian Garment Sector

**Key Facts of the Sector**

Exports from the garment, textile, and footwear (GTF) sector in Cambodia have played a significant role in the growth of the Cambodian economy. Production in the sector is dominated by apparel, with less footwear and accessories manufacturing in comparison. Cambodia's garment exports in 2019 amounted to USD 8.3 billion and for around two thirds of exports, with the majority going to the EU and the US. In 2020, Cambodia exported USD 7.4 billion; as far as numbers are available for 2021, garment exports total USD 6.5 billion between January and October, indicating a possible return to growth.[2]

COVID-19 has heavily affected the sector. In 2019, the garment industry contributed about 11 % to GDP. With the pandemic, garment exports dropped by around 9.9% resulting in a 3.4% reduction of GDP in 2020.[3] In 2020 at the beginning of the pandemic, supply chain issues were the main obstacle for production as fabric imports from China were interrupted. In 2021, production was suspended mainly due to lockdowns prohibiting onsite work in the factories. Towards the middle and end of the year, signs of recovery and return of production were seen for a fair share of brands and factories that had not shut down – around 120-130 factories were reported to have closed with approximately 71,000 to 150,000 workers affected.[4]

In 2019, the industry employed about 800,000 workers. Out of the more than 1,000 garment factories registered for business with then Ministry of Industry and Handicrafts (MIH), around 600 factories were registered with TAFTAC, including footwear and accessories producers.[5] As of April 2022, 623 GTF and 481 garment factories are listed under TAFTAC. Ownership of TAFTAC member factories is largely foreign, with Chinese, Taiwanese, Hong Kong and South Korean owners predominating against less than 5% Cambodian owners. Most factories employ up to 1,000 workers and only very few factories go beyond 4,0000 worker size.[6]

Garment production in Cambodia is a rather volatile business, mainly operating on short-term contracts that often cover only one or two years and usually peak at 5-year contract terms. Cambodia holds its competitiveness in the low-cost manufacturing segment as cut-make-trim (CMT) focused country, executing predefined designs with relatively little value add. With little automation in manufacturing, reliance on the relatively cheap labor force is high.

The table below shows an overview of key business features of the sector.

[2] Turton, S. (2019, August 16). *Cambodia Garment Exports at Risk as EU Wrap Up Tariff Review*. Nikkei Asia. Retrieved from: Link

[3] United Nations Cambodia. (2021, June 15). *Information Note #7: UN Cambodia's Support to Garment Workers in COVID-19 Response*. Retrieved from: Link

[4] Amarthalingam, S. (2021, May 7). *The Pandemic So Far-Taking Stock of Economic Losses, Starting with the Garment Sector*. The Phnom Penh Post. Retrieved from: Link; Switch Garment. (2021, May 19). *Webinar on Rooftop Solar*. Retrieved from: Link

[5] Turton, S. (2019, August 16). *Cambodia Garment Exports at Risk as EU Wrap Up Tariff Review*. Retrieved from: Link

[6] TAFTAC Database. (2022, April)

*Table 1: PESTLE Analysis for the Cambodian Garment Sector*

| Polical | Economic | Sociodemographic |
|---|---|---|
| + Political stability<br>+ Liberal foreign investment policies and ease of business (e.g., repatriation of profits)<br>+ Business and tax incentives | + GDP and growth trends before COVID-19 and expected rebound<br>+ Stable inflation<br>+ Stable exchange rate to USD<br>+ Preferential trade agreements for access to markets*<br>– Lack of backward linkages requiring import of inputs<br>– Rising worker wages<br>– High electricity costs | + Available and cheap workforce<br>– Lack of educated skilled workforce for higher productivity and more advanced production |
| **Technological** | **Legal** | **Environmental** |
| – Limited level of automation<br>– Necessary import of certain equipment | + Established social compliance for exports<br>• Few (environmental) operational regulations for manufacturing | + Connection to deep seaports |

+ Positive Impact on Business; - Negative Impact; • Ambivalent Factor

* Despite the partial withdrawal of the Everything But Arms (EBA) agreement by the EU in August 2020, preferential trade terms still exist, for instance also with the US, albeit the renewal of the GSP is still pending as of Jan 2021

**Sustainability Performance**

While the CMT part of garment production causes less pollution than textile manufacturing with its intense water and electricity consumption, use of toxic chemicals and generation and discharge of often untreated wastewater, the size of the sector within the economy makes it a major national polluter overall. Key issues currently are wood burning boilers using mixed forest wood contributing to deforestation and low energy efficiency in production due to dated, low end equipment and lack of energy monitoring and management processes.[7]

Sustainability wise, Cambodia is currently at the beginning and shows little uptake of environmental sustainability practices, due to little established awareness among businesses and little readiness to do more than the minimum required by law. Short-term contracts make for rather short-term business planning and often a focus on business expansion or increased productivity and profitability is still more imperative than sustainability when it comes to investments. Foreign ownership can be a barrier to more substantial investments required for renewable energy (RE) measures and their longer timeframe for ROI. Generally, cost savings based on energy efficiency are potentially less in focus due to the share of energy costs in production: At around 5% of total production cost per piece, the share is higher than in neighboring countries, but the biggest cost factor by far remains material input cost at around 60% when looking at the FOB price. The cost structure of the FOB price contains material (fabric and accessories

[7] KII with Li & Fung (2019), Sustainability Expert (2019)

such as sewing thread, labels, buttons etc.), logistics and the "CMT" part of production. In Cambodia, factories are predominantly not procuring material themselves, but receive it either from brands directly, through an agent or they are part of a larger company group in which the headquarter overseas procures the material and the factory receives a certain CMT budget to deliver the end products. With this budget, all operational costs such as labor, utilities and maintenance need to be covered; profit is derived out of this budget after all operational costs. As a share out of CMT, energy cost can amount to around 10 to 15%.

More sustainability-minded brands need to take control with their own requirements. Based on that, a share of factories is already working on improving environmental sustainability standards. Up to an estimated third of factories are engaged at least to certain extent or work with the Higg Index criteria for assessment, an industry standard for assessing environmental and social sustainability throughout the supply chain.[8] For those factories that have implemented certain EE or RE interventions, another driver besides addressing compliance requirements of their buyers is a convincing strong business case of short payback periods with ROI after around one year. By tendency, larger factories tend to perform better on compliance issues, are better organized and equipped than smaller suppliers, often interconnected to serving higher-value segment brands with more quality and sustainability requirements.[9]

**Impact of Government Policies and Regulations**

The lack of stringent environmental regulations and lack of enforcement contributes to low sustainability standards. Additionally, the environmental score of factories is affected by national energy policies that have direct and indirect impact on the sustainability performance and competitiveness of the whole sector: As for indirect effect, the 'browner' the energy mix is in the national grid, the less attractive the sector and the country become as production site. Most international buyers operate based on Higg Index scores for their sustainability assessment and sourcing decisions, and this score is lowered automatically when grid electricity holds a higher share of non-renewable energy. This in turn requires more effort – and investment – from business side to compensate for the grid emission factor (see Table 2 below under Competition). [10]

Government regulations affect all factories aiming to use RE on their premises via installation of rooftop solar. Besides lack of net-metering and flexible nighttime tariffs for use of grid electricity, it is especially the current cap of RE use at 50% of subscribed demand that could have a major effect on the garment sector:

The movement of many brands towards a drastic reduction of carbon emissions with an eventual net zero target could make sourcing garment production in Cambodia impossible for them.

Thus, both development partners and private sector see the recent decisions on the energy mix – increase in the share of coal energy, a newly approved power plant and lack of development in solar energy regulations – with concern despite the government's commitment to no further coal plants beyond those already approved. The current situation with regards to stainability efforts risks putting Cambodia at a further disadvantage compared to competitors. With increasing commitment of buyers to sustainability, it is important for stakeholders and investors to have clarity on the national energy strategy before making any investment decision.

Looking at positive examples for regulatory impact, Vietnam and China are repeatedly mentioned, with governments and other actors pushing for sustainability and thus improving the economic standing of the sector. Considered crucial is a strong vision, clear target, and feasible roadmap by the government, supported by corresponding policies and practical implementation, to effectively advance

[8] KII with Green Move

[9] KII with JLC (2019)

[10] UNFCCC Fashion Industry Charter for Climate Change. (2021, June 30). *WG 4 Meeting on Promoting Climate Action in Cambodia.*

sectors and economies on sustainability efforts. For instance, China setting carbon neutrality by 2060 as national target, supported by policies to disincentivize use of coal, and making an impactful switch from lack of environmental monitoring to strict controls and fines for regulation breaches illustrates the impact of determined policy making.[11] A comparison of Cambodia with major peer garment producers Vietnam and Bangladesh is given below in Table 2 under ***Competition***.

**Competition**

With an overall buyer trend shifting away from China towards other countries in Southeast Asia and Asia, Bangladesh and Vietnam have been the garment producers to profit the most. Bangladesh has greater textile value addition with established in-country textile production and gaining share in the CMT production segment. Vietnam's textile sector has seen a boom in recent years as factories have demonstrated strong capacity for technological and sustainability advancements. While Cambodia is considered a key supplier by some buyers with potential for more business and a bigger role, this is dependent on improved sustainability performance and upskilling of factory capabilities, especially when rising minimum wages can be a concern that might need to be counterbalanced. The comparative overview of the competitiveness factors and policy environment for Cambodia, Vietnam and Bangladesh is shown in the table below.

*Table 2: Country Comparison for Cambodia, Vietnam and Bangladesh*

| Cambodia | | Vietnam | Bangladesh |
|---|---|---|---|
| **Competitiveness** | Efficient in high volume low value mass market segment | Better placed in higher value segment at lower volume and footwear production | High volume low value mass market segment but with backward linkages |
| **Labor Cost / Minimum Wages** | $ 192 (2021) | $ 191 (2021)[12] | $ 91[13] (2021) |
| **Industry Association** | TAFTAC more industry, less sustainability focused | VITAS involved in pushing for sustainability improvements | BGMEA involved in supporting and advocating for sustainability |
| **Environmental Regulations** | Limited environmental laws and controls | • Stricter control on water, waste, chemicals<br>• Mandatory smart meters and energy assessment reports for bigger factories every 3 years[14] | • For factories, mandatory plan for environmental management, pollution management, relocation<br>• Strict requirements for Environmental Impact Assessment for all industrial projects[15] |

[11] KII with adidas, H&M, Li & Fung, Puma, VFC

[12] In Vietnam, the minimum wage applies by production zone from zone 1 with $191 to zone 4 with $131.
Duy, K. P. (2022, February 1). *Vietnam: Regulation On Regional Minimum Wages In Vietnam.* Retrieved from: Link

[13] Salva, A. (2022, February 19). *The Pandemic Hit Asia's Garment Workers Especially Hard.* Retrieved from: Link

[14] KII with H&M, Puma; Webinar Net Zero Fashion. (2021, May 24). *Decarbonizing the Garment and Textile Sector.*

[15] ILO (2021, May). *Effective Regulations? Environmental Impact Assessment in the Textile and Garment Sector in Bangladesh, Cambodia, Indonesia, and Vietnam.* Retrieved from: Link

| | | | |
|---|---|---|---|
| **Grid Emissions** Operating Margin Grid Emission Factor, gCO2/kWh[16] | 1046 | 560 | 528 |
| **Solar Policy / Solar Tariff Regulations** | • Cap at 50% of subscribed electricity demand<br>• Higher grid electricity tariff if use of solar PV<br>• Zero export of generated electricity to grid | • Feed-in tariff (US$ 7.09-8.38 cent/kWh) for grid-connected (rooftop) solar projects[17] not exceeding 1MW[18]<br>• Solar PV projects can sell (all) electricity produced to EVN (Electricity Vietnam) and other purchasers for non-grid connected projects | • Feed-in tariff for rooftop solar (US$ 5 cent)[19] |
| **DPPA Framework**[20] | No | Yes | No[21] |
| **MEPS, Standards and Labeling (S&L)** | Draft stage | In force | In force |

Vietnam has been able to advance their garment sector with investments after initial growth, leading to increased backward value chain linkages, more advanced technologies, and a concerted effort with regards to sustainability performance, including governmental regulations that have been credited high impact. Whereas in Cambodia, there is a perceived need for greater awareness raising and specific illustration of the business benefit of environmental sustainability, both for cost savings based on reduced consumption and potential for higher quality sourcing contracts by attracting new, more sustainability-minded buyers.[23] The business case for the latter appears as the stronger argument in light of the rather moderate share of electricity costs out of overall production.

## 2.2. Sourcing Decisions by Brands and the Role of Sustainability

### 2.2.1. Purchase Criteria and Drivers

Based on interviews with brands and buyers[24] , the usual process for supplier selection and allocation

[16] Including for use in PCAF GHG accounting. UNFCCC IFI Technical Working Group on GHG Accounting. (2021, December). *The IFI Default Grid Factors v.3.0.* Retrieved from: Link

[17] Tilleke & Gibbins. (2020, April 10). *New Incentives for Solar Power Projects in Vietnam.* Retrieved from: Link

[18] DFDL. (2021, January 22). *Vietnam: Update on Rooftop Solar Power Policy (as of 22 January 2021).* Retrieved from: Link

[19] Ministry of Power, Energy & Mineral Resource. (2020, January 28). *Bangladesh: Legal Framework & Current Solar PV Development.* Retrieved from: Link

[20] DPPA (Direct Power Purchase Agreement) is a power purchase agreement in which businesses buy electricity not from the state but from independent power developers under long-term contracts.

[21] USAID. (2020, October 30). *System-Friendly Competitive Renewable Energy Procurement in Bangladesh*. Retrieved from: Link; Power trading by private actors is allowed, limited to trading with the state-owned utility. Large consumers may contract supply from virtual hybrids through corporate PPAs, but this market does not exist.

[22] An example are the obligatory energy assessment reports for bigger factories in Vietnam every 3 years. Factories submit or have a third party complete an improvement plan, that is evaluated by an independent agent appointed by the government who will review and assess the plan but also monitor the corrective actions. If improvements are not made, a fine is issued. (KII with Puma)

[23] KII with GAP, IFC (2019), H&M, Li & Fung, VFC

[24] KII with adidas, GAP, H&M, Li & Fug, Puma, VFC

of order volume involves a vendor scorecard and regular supplier evaluations on an annual or more frequent basis – H&M conducts quarterly monitoring on supplier factories example. The scorecard holds the sourcing criteria that commonly include quality[25], price/business[26], logistics/shipping time and sustainability criteria. The specific weighting of factors is not discussed by brands. Only VFC discloses that sustainability overall accounts for 20% of the vendor score. For the more mass market or low budget brands, a higher price sensitivity must be assumed in decision making which places much higher weight on factors such as labor costs, material cost, and other non-energy cost factors. Higher scores result in increased order volume, longer contracts or 'higher quality contracts', meaning product orders that allow a higher profit on factory side.

For sustainability, social compliance can almost be considered the baseline standard, and differentiation can be had via environmental sustainability which is becoming increasingly important for buyers. As fundamental compliance check, in-country evaluations can give the first indication where environmental violations are recorded and made public by the government. Beyond that, recurring evaluations take place according to the relevant standards used by a brand. The Higg Index criteria is most often used by buyers during initial and ongoing assessments which also considers factory compliance or violation of local legal standards. Key environmental sustainability evaluation criteria for buyers are GHG emissions, (waste) water management and chemical use if applicable. Suppliers are considered based on a permissible minimum score and once onboarded are generally required to show continuous improvement. In the case of H&M, this means 3-5% reduction of GHG emissions per product on a yearly basis. Key is credible supplier intent to improve processes and scores to achieve the required or continuously higher levels. A drop in scores or failure to meet necessary annual improvements will trigger feedback to the suppliers and request for corrective action. Brands usually are active in educating their vendors on their requirements and in promoting EE and RE to raise awareness of their benefits in the business relationship. Often, collaborations take place between brands and organizations like UNIDO, GIZ or IFC as additional support to improve supplier factory performance and business prospects, often with the motivation to keep longer-term supplier relationships.

This shows that environmental performance directly influences business for factories. More sustainable production usually does not warrant higher price points in contracts, and typically only guarantees eligibility for a prospective supplier. However, environmental sustainability performance has become an integral part of the sourcing decisions and increasingly provides concrete business advantages for supplier factories. This applies to differing degree, as for the more sustainably minded brands – more often in the luxury to higher value brand segment, and in sportswear or outdoor clothing – environmental performance ranks higher while for others it acts as one subset of sustainability with less impact on sourcing decisions. For brands in the low to medium value segment, the commitment differs based on company strategy, branding, and communications targets. The increasing importance of sustainability for brands is also reflected in restructuring of units, such as integration of the sustainability team into the regular business teams and sustainability becoming an integral part of all business and operational decision.[27]

Other value addition services, such as product design and development, can improve the competitiveness of a supplier and the price they can demand from a buyer. These additional value-added services were only mentioned in the context of the scorecard but not quantified from brand side or elaborated on as high potential for a brand expanding supplier relationships in Cambodia. This can be due to the fact that besides factory capabilities, country specifics

[25] At this point, quality criteria can even go hand in hand with environmental aspects, for instance as shown in testing for chemicals or residues (KII with H&M).

[26] H&M. (n.d.). *H&M Defines Business as Price and Negotiability.* Retrieved from: Link

[27] KII with H&M, Puma

are another factor for such value adding services: Cambodia lacks textile production and imports all material which makes it prone to CMT orders exclusive of further services.[28]

### 2.2.2. Role of Natural Resource Consumption

Buyers pay differing attention to going beyond given industry frameworks for environmental sustainability. When it comes to natural resource consumption in its contribution to local competitiveness, the most high-profile factor in Cambodia is biomass boilers, their efficiency, and a switch to certified or local plantation wood to avoid any deforestation impact.[29] The issue of sustainable biomass as a factor in brand sourcing decision is mixed since biomass boilers are considered carbon neutral in key sustainability rating schemes like the Higg Index.

The weight and requirement associated with sustainable biomass use depends on the individual company policies stating the role of mixed forest woods versus a sustainable alternative. GAP mentions sustainable biomass use as having a positive impact on the sustainability score. H&M has also indicated the growing focus on sustainable biomass use with plans to ban the use of unsustainable forest wood in the course of 2022 for their suppliers. To address the current lack of certification and traceability of wood, H&M has taken up a new initiative to develop an app as a tool for wood recognition. While not a proper certificate, the app provides a short-term, practical solution based on simple technology that allows smartphones to scan the wood in question and provide clarity on plantation origins. As of January 2022, the app is piloting in Cambodia and has not seen a comprehensive roll out yet. For the time being, it is meant for use by H&M suppliers but with plans for sharing the technology more broadly at a later point. Alternatively, H&M can also connect suppliers to suitable wood plantations for sourcing.

### 2.2.3. Cost-Sustainability Nexus

While in the years past, the relationship of sustainability and cost efficiency used to be largely an either or, the two seem to become increasingly compatible, if not even resulting in a ***cost efficiency through sustainability*** nexus. Especially in Cambodia where electricity costs are high, electricity savings can show noticeable impact and higher energy efficiency equals a cost reduction, in the most significant form by setting up rooftop solar. Rather than being a continuous cost driver, sustainability efforts can lead to more energy efficiency and other positive production impacts. Good energy management practices and investment in higher quality, more energy efficient equipment can also contribute to increased competitiveness due to reduced unplanned downtime, improved product quality, and higher worker productivity.[30] While most sustainability measures require an initial investment, the ROI for sustainable energy linked upgrades is usually good and, except for rooftop solar, measures can often be implemented without major CAPEX.

Investing in energy efficiency for cost savings might not seem a sufficient business case initially based on the assumption that savings might be limited due to the rather low average share of energy cost in Cambodian garment production. For factories operating on a CMT budget of their headquarters, energy typically accounts for approximately 10-15% of their production cost which translates to 5% of FOB price costing. However, the model shows the potential cost savings and profitability impact of energy efficiency measures (Chapter 6), and another key argument or such interventions is the need to show ongoing effort to reduce carbon footprint and GHG emissions to buyers to remain an eligible supplier. For annual improvements, incremental smaller scale reductions such as by energy efficiency upgrades can be a key instrument.

[28] KII with GAP, H&M

[29] Asian Development Bank (ADB). (2018, December). *Cambodia. Energy Sector Assessment, Strategy, and Road Map.* Retrieved from: Link

[30] KII with GAP, H&M, Li & Fung

However, increasing sustainability efforts, improving Higg Index scores, or getting LEED certifications for factory buildings does not automatically translate into higher pricing in contracts as experiences has shown in other countries. For example, in Bangladesh, numerous factories have put great effort to improve their sustainability profiles, such as pursuing LEED certification for their facilities, but have not necessarily seen a return on this investment in terms of higher product purchase price from buyers. Some buyers also concede that improving environmental performance is not a direct path to increasing revenue over price per piece, that it rather has more influence towards increasing contract size and securing longer-term sourcing relationships. On the other hand, forgoing green investments may lead to buyers dropping them in their supplier preferences or eliminating eligibility.[31] 66% of interviewed sourcing executives estimate that "sustainability will be the dominant selection criteria on for on-boarding new suppliers" by 2025.[32]

For such sourcing decision, differences between brands exist in terms of the weight attributed to sustainability vs cost (and other vendor scorecard items) as outlined above but sustainability has secured a place in the vendor scorecard. This applies not only before but to equal if not greater extent also after the pandemic.

### 2.2.4. Impact of COVID-19

Factories along with brands flexible enough to shift their product offer according to demand in the pandemic, for instance from office wear to sports and loungewear, were less affected if supplies were given, and COVID-19 measures still allowed factory work.[33] On an operational level, the pandemic illustrated the degree of supply chain dependencies and garment producing countries with backward linkages were at an advantage. However, this seemed not a noticeable driver for future sourcing decisions in interviews with buyers.

Regarding sustainability, brands and development partners saw some efforts stalled favor of maintaining operations and staying afloat during the business crisis; buyers supported prioritizing safety measures and staff health. Onsite sustainability initiatives were also affected due to restrictions and concerns around external parties entering the premises; annual Higg Index evaluations, however, have reportedly taken place as scheduled.[34] This is an indicator that the course towards higher sustainability will not be changed by the pandemic and its effects, potentially rather intensified with the heightened consumer awareness of global supply chains in addition to growing ethical and environmental consciousness. This means there will be a further increasing request from buyer side for sustainable manufacturing in which energy efficiency and use of renewable energy play a major role.

Stakeholders on brand and development side find it hard to judge to which extent COVID-19 will have a dampening or rather catalyzing effect as a turnaround opportunity in Cambodia with regards to sustainability. Substantial influence is seen in the success of current and future initiatives to provide information, raise awareness and drive change, whether implemented by brands, NGOs, or other industry stakeholders. Related to that, public investments to address not only recovery but also environmental sustainability with the long-term perspective for the sector in mind could have especially positive impact. As industry association, TAFTAC is not yet seen as major advocate for sustainability investments but considered a crucial actor in the process to keep the sector competitive, especially against peer producer countries' increasingly 'green' garment production. The aftermath of the pandemic could be an opportunity to pivot if environmental sustainability is given appropriate priority.

Overall, coping with the long-term impact of COVID-19 on the sector is seen as concerted effort of factories, brands, government, and TAFTAC as key stakeholders.

[31] The Business Standard. (2019). *Inadequate Policy Support Slowing Down Green Transition*. Retrieved from: Link

[32] Berg, A., Hedrich, S., Ibanez, P., Kappelmark, S., & Magus, K. (2019, October 17). Fashion's New Must-Have: Sustainable Sourcing at Scale. Retrieved from: Link

[33] KII with H&M, Li & Fung, VFC

[34] KII with H&M, ILO BFC, Li & Fung, VFC

## 2.3. Development Prospects of the Sector

### Competitiveness in low value addition production

As a broad rule, low value add garment production in the global supply chain moves where minimum wages are the lowest – when one country becomes too expensive due to rising wages and living standards, production relocates to cheaper grounds and countries with rising wages can remain competitive only if more advanced technologies, upskilling of the workforce and progress on other buyer demands such as sustainability has been achieved quickly enough, as demonstrated by the procession of lower value add locations from China to Vietnam to Cambodia, among others. Next in line and profiting from Cambodia's rising wages was Myanmar – scoring with a cheaper workforce with better education, similar infrastructure, bordering China and offering deep seaports – up until the military coup in February 2021.[35] Factories staying in Cambodia due to such external circumstances are however no strong base and guarantee for mid- to long-term prospects unless the sector can be made more competitive for higher value add production. A step in the right direction is the Cambodian Garment Training Institute (CGTI) partnering with ILO to pilot Factory Improvement Toolsets (FIT) in Cambodia to grow worker skills and establish training needs for the evolving industry.[36]

### General long-term trends[37]

According to industry experts from business and labor side, McKinsey and ILO, it is imaginable that accelerated by the pandemic and its impacts, the bifurcation of the industry progresses even more quickly. This trend leads the way to a split in favor of either luxury or discount brands, also leading the more advanced suppliers to become more successful, while the less sophisticated drop further to the bottom and get trapped in the cost reduction race due to insufficient other capabilities to address buyer needs. Adding to that, the industry trend towards consolidation of global supplier bases means that the more advanced factories stand a better chance to prosper long-term as they are able to form deeper relationships with bigger brands that provide contracts of higher value to a smaller pool of factories that can offer the required standards in quality and sustainability. This is already observable in relationships Nike or Adidas establish, often as exclusive buyers. In Cambodia, a similar development has been seen with suppliers that are in the H&M supplier network with fewer brands sourcing from one factory, increasing the partnership and leverage potential. Such consolidation processes can also mean suppliers taking on further roles and functions, such as product development or inventory management, depending on their capabilities. All these trends illustrate that equipment and technology, skilled labor and sustainability are key competitiveness drivers for long-term prospects.[38]

### Environmental sustainability concerns from consumer side

The entire fashion industry moving towards sustainability is also due to pressure from consumer side, causing brands to make public commitments; especially younger Gen Z shoppers pay attention to sustainability credits, whether it be goals for a circular fashion economy or reducing the carbon footprint of production. What started with social compliance centered around workplace safety, health and fair pay has evolved to included environmental sustainability – aided by the fact that the direct benefit of environmental sustainability to consumers is even clearer than for social compliance, for instance by

[35] KII with H&M

[36] ILO Peer Learning Hub. (2021, June 22). *Garment Factories, Associations, and ILO Partners Implement Factory Improvement Toolset across the Asia Pacific.* Retrieved from: Link

[37] It is not within the scope of this report to give a comprehensive analysis of the Cambodian garment sector in light of all general long-term trends and factors at play, such as the partial withdrawal of the Everything But Arms (EBA) agreement effective August 2020, but to consider factors that are in relation to factory performance and competitiveness, especially with regards to environmental sustainability.

[38] McKinsey. (2021, December 1). *The State of Fashion 2022: An Uneven Recovery and New Frontiers.* Retrieved from: Link ; ILO/ILR School. (2021, July 16). *The Post-COVID-19 Garment Industry in Asia.* Retrieved from: Link; KII with H&M, ILO Regional Office

use of organic material and reduction of chemicals in clothing. However, it is by now the omnipresent discussion about climate change and immediately necessary changes that ultimately forces any bigger brand to put environmental concerns on the agenda.[39] According to a McKinsey survey from 2020 in the UK and Germany, more than half of surveyed consumers has made significant lifestyle changes to reduce their environmental impact and this sustainability engagement has increased during the pandemic.[40]

**Decarbonization and emissions reduction in the fashion industry**

While for some brands this can be assumed to be more a matter of PR, public commitments are now being made by companies for not only internal operations but also for the supply chain, creating a need to monitor upstream and downstream processes including manufacturing suppliers.

The predominant initiatives which many international companies commit to are the United Nations Framework Convention on Climate Change (UNFCCC) Fashion Industry Charter for Climate Action of 2018 by which brands commit to achieving a reduction of GHG emissions by 30% until 2030 and net zero emissions by 2050, and the Science Based Targets initiative (SBTi) which helps companies set science-based targets for specified timeframes. The UNFCCC Charter draws on the methodology used by SBTi and center around the goal to limit global warming to well-below 2°C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C. They explicitly include the tier 3 scope of emissions that refers to all suppliers. Since buyers need to account for such emissions as their own, the environmental performance of all actors along the value chain becomes immediately crucial to their targets.

As the SBTi website shows, there is a dedicated sector guidance for garment production – accounting for the fact that in 2019, the fashion industry was responsible for 10 % of annual global carbon emissions, more than all international flights and maritime shipping combined.[41] As committed brands, some 125 companies have joined, a wide range from high-end luxury to fast fashion or budget brands, higher value segments by tendency showing more ambitious targets.[42] Likewise, all interviewed brands and buyers are committed to UNFCCC charter goals or follow the SBTi, stressing for the latter the importance to include scope 3 for the supply chain and factories.

While observers criticize the fact that commitments are often announced more prominently than they are executed on, and difficulties persist in exactly measuring GHG emissions throughout the supply chain, the call for more commitment from the private sector will rather increase than decline, with proponents of a shift from voluntary to mandatory requirements and standards due to a current lack of consequences in case commitments and targets fail to be met.[43]

While a lot of sustainability focus in garment production is on the more resource intensive textile production, any garment producing country will be affected by such environmental commitments on buyer side. As H&M estimates, with brands operating on 5-year plans, first movements might become visible by 2025 or 2026 in case it becomes clear that any 2030 targets cannot be met in Cambodia – either due to energy regulations, sector conditions or individual business performance of suppliers. For H&M, this will also be a crucial point with its ambitious goal of achieving net zero by 2030 and being climate positive – reducing more greenhouse gas emissions than its value chain emits – by 2040. Both goals will not be

[39] KII with Li & Fung, Sustainability Expert (2019); McKinsey. (2021, December 1). *The State of Fashion 2022: An Uneven Recovery and New Frontiers.* Retrieved from: Link

[40] Granskog, A., Lee, L., Magnus, K., & Sawers, C. (2020, July 17). *Survey: Consumer Sentiment on Sustainability in Fashion.* Retrieved from: Link

[41] Fleischmann, M. (2019, September 23). *How Much Do Our Wardrobes Cost to the Environment?* Retrieved from: Link

[42] Science Based Targets. (2022). *Companies Taking Action.* Retrieved from: Link

[43] Eavis, P. & Krauss, C. (2021, February 22). *What's Really Behind Corporate Promises on Climate Change?* Retrieved from: Link

possible in Cambodia under current circumstances and regulations.[44]

### Export country regulations

Besides buyer commitments and voluntary actions, pressure is also mounting from the regulatory side of those countries and regions on the receiving end of Cambodian exports. For instance, the upcoming EU supply chain act 'EU Due Diligence Law', expected to be approved as legislation in 2022 and expected to take effect from (earliest) 2023 can contribute to a further global framework for regulation, addressing human rights, governance but also environmental risks in direct supply chains for imports to the EU. Applicable to large undertakings, publicly listed SMEs and those operating in high-risk sectors.[45] Similarly, the upcoming European Carbon Border Adjustment Mechanism (CBAM) puts a carbon price on targeted imported products to ensure that ambitious European carbon reduction goals will not simply push carbon-intensive production outside Europe. Initially, the mechanism will apply only to specific goods at high risk of carbon leakage: iron and steel, cement, fertilizer, aluminum, and electricity generation with the first phase taking effect from 2023 and targeting upper income countries as main competitors first. But for both after a certain roll out time, the policy impact must be expected to eventually – towards the end of the decade – also affect garment importing brands and their supply chains, including producers abroad.[46]

### Automation

Same as for other countries and sectors, automation poses a threat to the Cambodian garment sector; almost half a million jobs of garment workers could be at high risk of automation. While more developed countries, also in Asia, have the necessary resources to adapt and take advantage of stronger reliance on technologies, Cambodia is confronted with its low-skilled labor force that is not easily transferred to higher skilled positions in automatic or semi-automatic production in garment or other manufacturing.[47]

While not all processes are easily automated in garment production, knit wear often uses comparatively more automated processed and auxiliary steps of spreading and cutting of fabric have generally seen the most uptake, commonly with the added benefit of increasing fabric efficiency and thus decreasing production cost and fabric waste. Globally speaking, automation in the garment sector has tended to be slow in comparison with other manufacturing sectors; the required investment comes up against relatively low wages in the main exporting countries. In Cambodia, another factor comes into play: high electricity costs and brown energy from the grid mean that automation might not only be more expensive than relying on manual labor but also that it could affect sustainability performance – the energy balance could look worse to an extent requiring rooftop solar to offset the effects which is not only costly but also limited in use. For the time being, this gives labor an advantage over automation in Cambodia and generally, the speed or scale at which automation will change the garment sector is still unclear.[48] While in the medium-term low-cost, labor-intensive production will continue as long as automated production is still more expensive, rising wages and decreasing cost of technologies make it likely for automation to take a stronger role, if not in Cambodia due to lack of a skilled enough labor force, then in other competing countries, also to the extent that reshoring gains relevance.[49] As a process, automation – with a human operator on the machine – holds a smaller risk and offers itself as a first step as compared to the use of robotics that

[44] McKinsey. (2021). *The State of Fashion 2022*; KII with H&M

[45] KII with Li & Fung; CBI Ministry of Foreign Affairs. (2021, July 1). *The European Due Diligence Act.* Retrieved from: Link; The National Law Review. (2022, July 1). *EU Mandatory Environmental and Human Rights Due Diligence Law.* Retrieved from: Link

[46] European Commission. (2021). *Carbon Border Adjustment Mechanism.* Retrieved from: Link; KII with ADB

[47] Chang, J. & Huynh, P. (2016, July). *The Future of Jobs At Risk of Automation.* Retrieved from: Link; KII with H&M

[48] KII with H&M; ILO/ILR School. (2021, July). *The Post-COVID-19 Garment Industry in Asia.* Retrieved from: Link

[49] Schmuecking, D. (2019). *The Risk of Industry 4.0 on Cambodia's Garment Sector: Analysis and Ways Forward.* Retrieved from: Link; KII with TAFTAC Board Member

require consistent and stable high speed internet on factory sites in order to allow production.[50]

### Re-shoring / Near-shoring of garment production

The pandemic has shown the vulnerability of global supply chains but the prospects of near-shoring or re-shoring – moving production closer to the importing countries, mainly in the US and EU – could be overstated, at minimum for the next few years. While automation once it becomes more affordable offers new opportunities and becomes increasingly appealing to US and European brands, the advantages of reduced logistics cost and time to retail might not be extensive enough to outweigh the limited manufacturing capacities near the key consumer markets and the advantages in Asia such as proximity to textile production. Nearshoring costs are also expected to differ by region and importing country, with Europe benefiting more from offshore production. Therefore, inputs and low-wage labor in current production hubs are expected to remain key in shaping the sourcing geography in the medium term.[51] Adidas made an unsuccessful neat-shoring experiment in 2015 building two fully automated factories in Germany and the US only to relocate those plants back to Asia in 2019 for proximity to "knowhow" and suppliers. It might have been a premature attempt that overestimated the technical possibilities of a robotic workforce, logistical savings, and economic feasibility[52] but not only might this change over time, another advantage of near shoring also as cited by H&M is the possibility to operate on 100% renewable energy in Turkey or Romania in the medium-term, at least with the use of RECs. The trend of customization instead of mass production – even possible in the medium value segment – can also favor proximity to markets.[53]

### General measures to increase competitiveness

Since the main input cost in Cambodian manufacturing is material in the form of fabric – making up around 55 to 60% of the FOB price per garment – reducing fabric waste is a lever to increase cost efficiency and competitiveness, even more so when supplying to a brand that is committed to a zero waste and circularity approach. While currently an average of 15% of fabric is turned into scraps that create cost for waste management, improvements to the cutting processes can reduce this share. Automated cutting machines play a big role, but this is also a matter of modifying processes which requires training and additional skilled labor. While the cost saving potential is considerable, it would require rather complex changes and the barrier to increase labor and change processes is high.[54] Since Cambodia needs to import practically all fabric used in garment production and resale of fabric is still illegal, such an approach beyond retrofits could be a worthwhile effort to increase material and cost efficiency, thus reducing waste and cost for its disposal. However, this would often mean savings not directly for the factory itself, unless they operate in the FOB model procuring their own material or can generate revenue by sales of fabric scraps.

While such general measures can undoubtedly have benefits, this project is focused on environmental sustainability and EE as well as RE interventions for improving competitiveness, for which the Switch Garment team has developed the policy tool of the Model Green Factory Program (MGFP).

[50] Schmuecking, D. (2022, March 24). *The Risks of Industry 4.0 on Cambodia's Garment Sector: Analysis and Ways Forwards.* Retrieved from: Link

[51] ILO/ILR School. (2021, July). *The Post-COVID-19 Garment Industry in Asia.* Retrieved from: Link; McKinsey & Company 2019

[52] Manchanda, S. & Schlorke, S. & Schmitt, M. (2020, December). *Innovation, Investment, and Emerging Opportunities in Today's Textile and Apparel Value Chain*. Retrieved from: Link

[53] KII with H&M

[54] KII with CGTI, H&M

# 3. Model Green Factory Program (MGFP)

## 3.1. Introduction and Background

The proposed Model Green Factory Program (MGFP) in development by the Switch Garment project proposes multiple sustainable energy interventions. It is designed to support Cambodian factories to accelerate adoption of sustainable energy technologies and practices. The aim of the program is to assist participant factories to reduce costs and improve their capacity to offer buyers greater "green value addition" to products by increasing energy productivity and reducing GHG emissions associated with manufacturing operations. The MGFP core emphasis is energy management and targets key energy systems emphasizing transition to equipment with minimum energy performance standards and best design, operation, and maintenance practices. Participant factories will be eligible to be awarded a basic and advanced level of recognition.

The MGFP is not designed to add compliance burden on a factory. Rather the MGFP is designed to onboard factories to greening operations regardless of their current environmental sustainability performance. After completing the MGFP, the aim is to support the factory to improve their environmental benchmark performance or support the factory to initialize their new green credentials through registration with industry recognized schemes like Higg. After participation in the MGFP, factories will be trained, be enabled to put into operation a robust energy management system and have a practical sustainable energy action plan that can be used to prioritize investments in technologies and practices.

The development of the program and scenarios draws on sources and examples from several other garment producing countries, such as MEPS for air compressors from India or work from the United Nations Environment Program (UNEP) United for Energy (U4E) initiative that has developed model regulations guidelines on motors and lighting among others that aim to simplify the adoption of regulations in developing and emerging markets.[55] Importantly, the MGFP also considers the ASEAN context and the recommendable harmonization with ASEAN energy and energy efficiency standards, such as the ASEAN Standard Harmonization Initiative for Energy Efficiency (ASEAN Shine) aimed at increasing energy efficiency of air conditioners and lighting through harmonizing standards.[56]

The MGFP currently focuses on sustainable energy technologies and practices. However, if successful, the program is envisioned to be expanded to additional areas of environmental performance that could include waste management and circularity and workplace environmental safety dimensions such as hazardous chemical management.

## 3.2. Intervention Structure and Compliance Areas

An overview of the compliance areas and their elements is shown in the table below. Variations in implementation can occur via the multiple elements in each compliance area and the depth to which they are applied, indicated by differing KPIs for the elements used.

[55] United Nations Environment Program (UNEP). (2019, October). *U4E: Energy Efficiency and Functional Performance Requirements Based on International Standards.* Retrieved from: Link

[56] The ASEAN Center for Energy ("Enhancing Energy Connectivity and Integration in the ASEAN Region") publishes relevant reports on endorsed initiatives, such as (i) Regional Policy Roadmap on Harmonization of Minimum Energy Performance Standards (MEPS) for Air Conditioner in 2017, (ii) Regional Policy Roadmap on Harmonization of MEPS for Lighting in 2019, and (iii) Guidelines of Integration of Energy Efficiency into ASEAN Electrical and Electronic Equipment (EEE) Mutual Recognition Arrangement (MRA) in 2019. This follows the ASEAN Plan of Action for Energy Cooperation (APAEC) which is the energy component of the ASEAN Economic Community Blueprint 2016-2025 directing ASEAN towards energy security and sustainability for the region. (ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025, 2020; ASEAN Center for Energy. (2021, February). *Harmonizing on Energy Efficiency Standards for Room Air Conditioners in Southeast Asia.* Retrieved from: Link; ASEAN Center for Energy. (2019, September 4). *Harmonization of Energy Performance Standards for Lighting a Regional Policy Roadmap.* Retrieved from: Link

*Table 3: Model Green Factory Program Overview*

| Model Green Factory Program | | |
|---|---|---|
| **Compliance Areas** | **Breadth of Elements** | **Depth** |
| **Equipment Minimum Energy Performance Standards (MEPS)** | • Lighting<br>• Conventional AC motors<br>• Sewing Machines<br>• Boilers<br>• Air Compressors<br>• Chillers<br>• Direct exchange air conditioning<br>• Others (to be determined) | • Performance Levels |
| **Energy Management Standards (EnMS)** | **Management System (ISO 14001 / ISO 50001)**[57]<br>• Energy management and green procurement<br>• Qualified staff and training<br>• Use of energy sub-metering<br>• MRV (monitoring, reporting, verification) of energy and key variables (boiler emissions and blowdown, air temperature etc.) | • Auditing, KPI<br>• Energy, GHG, etc. |
| **Best Energy System Operation and Maintenance Practices (BAT)** | **Energy System, Performance and Operations**<br>• Lighting systems<br>• Heating, ventilation, and air conditioning (HVAC)<br>• Sewing machines<br>• Steam generation<br>• Hot water generation<br>• Air compressor systems<br>• Chillers<br>• Direct exchange air conditioning<br>• Backup power systems<br>• Reactive load management (power factor)<br>• Others (to be determined) | • Associated emissions standard |
| **Sustainable Energy Sourcing (SES)** | **Energy from Sustainable Sources**<br>• Solar PV<br>• Green biomass<br>• Solar hot water | • Weight % |

[57] ISO 14001 is the Environmental Management Standard whereas ISO 50001 is the Energy Management Standard. The main difference is the scope of the standards. ISO 14001 looks at environmental protection in general (e.g., resource use, waste management and pollution) whereas ISO 50001 narrows its focus to energy usage (e.g., energy performance indicators, equipment, systems, and processes used to ensure the maximum energy performance).

# 4. Regulatory Environment

The regulatory environment is an important enabling factor for investment. In Cambodia, where sustainable energy practices are still at an early stage, a supportive regulatory environment can accelerate adoption. Compared to other countries in ASEAN, Cambodia is far behind in EE progress with only overall supportive national policies in effect and EE specific policies still in development.

This chapter holds a collection of Cambodia's existing and upcoming laws, regulations, policies and projects on relevant national development frameworks, sector specific strategies and action plans (such as policies on environmental protection and climate change, energy sector development, equipment standards), sustainable finance policies and ongoing projects of development partners. The policies are laid out in chronological order of year of publishment. Regulations that are older and related to the wider context of the MGFP are included in the Annex.

*Figure 1: Regional Comparison of EE Policy Measures*

| Sl. No. | Country | Laws and regulation | Designated factories & Buildings | Energy manager | Appliance S&L | Building EE Code | Financial support |
|---|---|---|---|---|---|---|---|
| 1 | Cambodia | In-process | | | In-process | | In-process |
| 2 | Lao PDR | | | | In-process | | |
| 3 | Myanmar | In-process | In-process | In-process | In-process | In-process | In-process |
| 4 | Brunei Darussalam | | | | | | |
| 5 | Indonesia | | | | | | |
| 6 | Malaysia | | | | | | |
| 7 | Philippines | | | | | | |
| 8 | Singapore | | | | | | |
| 9 | Thailand | | | | | | |
| 10 | Viet Nam | | | | | | |

| Legend | Present | | Absent/ In process | |
|---|---|---|---|---|

Source: PwC analysis, ERIA

## 4.1. Overview of Laws, Policies and Projects

### 4.1.1. Existing Regulations, Policies, and Projects

Industry and energy are prioritized sectors by the Royal Government of Cambodia (RGC), along with sustainable development. The government reiterates the three areas' importance in the Rectangular Strategy IV, the National Strategic Development Plan, Industrial Development Policies, Cambodia Climate Change Strategy, and other policies. For strategic planning frameworks for Cambodia, the Rectangular Strategy is the primary guide for development prioritization, and it has set goals for a low carbon, climate-resilient and sustainable development. Major national strategies also highlight electricity and energy supply as well as energy efficiency as a priority focus.

*Table 4: Existing Wider National Strategies and Policies / Garment Sector Development Strategy*

| Strategies and Policies | Description and Relevance to MGFP |
|---|---|
| **Industrial Development Policy 2015-2025[58], 2015** | The IDP 2015-2025 by the Council of Ministers is prepared in alignment with the Rectangular Strategy as a guide to promote industrial development for sustainable and inclusive economic growth. The IDP sets a target to increase GDP from the industrial sector by 30% by 2025 with manufacturing sector increase by 20% by 2025. IDP mentions that the garment sector plays an important role in the industrial sector with its share at 42.4% as of 2013. |
| **Rectangular Strategy for Growth, Employment, Equity and Efficiency: Building the Foundation Toward Realizing the Cambodia Vision 2050, Phase IV of the Royal Government of Cambodia of the Sixth Legislature of the National Assembly[59], 2018** | The Phase IV Rectangular Strategy identifies "environment and natural resources management and managing impacts of climate change on Cambodia's ecological systems and socio-economic development" as key challenges to be addressed in a collaborative manner. It requires all subsequent strategic plans, action plans, and programs to be sensitive and responsive to all these issues by putting forth actionable proposals.<br><br>Electricity is mentioned as one of the four priority areas. The strategy highlights high electricity price, limited reliability of electricity supply and renewable energy sources not having been included in the energy supply system to their full economic potential as challenges and focus areas to address climate change. |
| **Cambodia Sustainable Development Goals (CSDG) Framework 2016 -2030[60], 2018** | The CSDG framework approved by Council of Ministers, seeks to ensure access to energy and to increase the proportion of renewable energy in the total energy consumption. Related goals:<br>• Goal 7: Ensure access to affordable, reliable, sustainable, and modern energy for all<br>• Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation |
| **National Strategic Development Plan 2019-2023[61], 2019** | The NSDP formulates a roadmap for the implementation of the Rectangular Strategy. It discusses reducing the electricity tariff, expanding supply coverage, and enhancing reliability through sub-stations closer to economic development poles and areas with high economic potential. |
| **Circular Economy Strategy and Action Plan[62], 2021** | The Circular Economy Strategy and Action Plan is a collaboration between the NSCD/MoE and experts at UNDP and the Swedish International Development Agency (SIDA). CE Strategy and Action Plan outlines that more efficient and sustainable use of energy and material resources is key to achieve a prosperous economy, a thriving and inclusive society. The plan involves all relevant stakeholders including public and private sectors to manage and use existing natural resources with sustainability and to |

[58] Council for the Development Cambodia (CDC). (2015). *Cambodia Industrial Development Policy 2015-2025 "Market Orientation and Enabling Environment for Industrial Development".* Retrieved from: Link

[59] Royal Government of Cambodia. (2018, September). *Rectangular Strategy for Growth, Employment, Equity and Efficiency: Building the Foundation Toward Realizing the Cambodia Vision 2050 Phase IV of the Royal Government of Cambodia of the Sixth Legislature of the National Assembly.* Retrieved from: Link

[60] Royal Government of Cambodia. (2018, November 19). *Cambodian Sustainable Development Goal Framework (2016-2030). Open Development Cambodia.* Retrieved from: Link

[61] Ministry of Planning (MoP). (2019). *National Strategic Development Plan.* Retrieved from: Link

[62] Ministry of Environment (MoE). (2021). *Circular Economy Strategy and Action Plan 2021.*

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| | enhance energy efficiency or the usage of renewable energy<br>• Strategic objective 1, Priority Action 1.1: Promote use of sustainable energy and materials and energy efficiency |
| **Cambodia Garment, Footwear and Travel Goods (GFT) Sector Development Strategy[63], 2022 – 2027** | The sector development strategy prepared by the Supreme National Economic Council and recognizing that environmental sustainability is on the rise, especially among major brands and buyers, presents a vision to upgrade the garment sector into an industry that is "environmentally sustainable, resilient, high value-added, focused on high-end and unique products, highly competitive, and supportive of economic diversification". The government set out 5 strategic measures; listed below in more detail are aspects directly relevant to the MGFP:<br>• Strengthen human resources to increase productivity and create career paths for Cambodian workers<br>• Improve working conditions and welfare for workers<br>◦ Improve ventilation and airflow inside workplace facilities<br>• Promote domestic and foreign investment in high value addition<br>◦ Conduct market demand and investment needs study on high price, value addition, and set out the action plans in attracting investors<br>◦ Review feasibility to create a support mechanism to provide financing, technical, and business support to factories and SMEs for planning, management and scale up of operations<br>◦ Examine feasibility of a strategic framework on environmental sustainability to strengthen value chains, reduce environmental impact and to adapt to the evolution of this industry<br>◦ Enhance incentives for investment, technology transfer, renewable energy use, etc., in accordance with the Law on Investment and other relevant regulations<br>◦ Promote reputation as a destination with high compliance, ethics, environmental sustainability, and high value-added products<br>• Attract investment in supporting industry<br>◦ Promote the use of renewable energy with an efficient option and monitor electricity price in a timely manner<br>◦ Promote market diversifications for exports of garments, footwear, and travel goods |

Protecting the environment and addressing climate change are key areas of focus to achieve sustainable development. More than 50% of electricity in Cambodia comes from coal and oil as of 2020.[64] The dependency on fossil fuel will increase to a minimum of 70% by 2030 given the current planning scenario but the government has declared to stop further approval of coal plants and plans to increase usage of hydro and renewable energy.[65]

Climate commitments are also approached as an opportunity for trading carbon credits. The existing strategies and action plans in which the environment and climate change are prioritized are listed below.

[63] Supreme National Economic Council. (2022). *Cambodia Garment, Footwear and Travel Goods (GFT) Sector Development Strategy.*
[64] Ministry of Mines and Energy of Cambodia (MME). (2019, March 20). *Cambodia Basic Energy Plan.* Retrieved from: Link
[65] Nikkei Asia. (2021). *Cambodia Minister Vows No New Coal Plants Beyond Those Approved.* Retrieved from: Link

*Table 5: Existing National Environmental and Climate Change Related Policies*

| Plans and Policies | Description and Relevance to MGFP |
|---|---|
| **National Policy on Green Growth[66] & National Strategic Plan on Green Growth[67], 2013** | The policy is prepared by the National Council on Green Growth at MoE. It aims to develop the economy in balance with environment, society, and culture, create a favorable enabling environment for green growth, manage access to renewable energy and energy efficiency, and access to financing for green growth investment.<br><br>The strategic plan focuses on strengthening green growth by focusing on enhancing green investment, developing green technology and green job opportunity. Green investments include technical and financial investments in all sectors that contribute to pollution reduction and environmental improvement. |
| **Climate Change Strategic Plan for the Manufacturing Industry and Energy[68], 2013** | The plan was developed by the Ministry of Industry, Mines and Energy (MIME) back in 2013 (now Industry is under MISTI). Back in 2011, the industrial sector contributed 20%-30% of GDP, textile and garments had 70% share of the industrial sector. As within the industries the number of SMEs is high, they are vital to the economy but usually also energy inefficient. The strategic plan therefore targets SMEs and assistance will be provided for adopting and transferring green technology to the manufacturing industry and energy sectors. In particular:<br><br>• Incentives to the private sector to invest in energy savings (import and implementation of energy efficiency equipment)<br>• Establishment of information sharing and consultation mechanisms |
| **Cambodia Climate Change Strategic Plan 2014-2023[69] , 2013** | The framework by the National Climate Change Committee aims to create a participatory process among public, private, civil society and development partners to respond to climate change through measures including promoting renewable energy and energy efficiency to reduce GHG emissions and promoting low carbon planning and technologies to support sustainable development. |
| **Cambodia Climate Change Action Plan 2016 – 2018[70] , 2016** | The MoE action plan identifies 17 priority actions that contribute to resiliency of the country to climate change, which include: technology hub for food, energy and water security, GHG inventory system, GHG Emission Reduction Facility, urban development plans and programs addressing climate change, climate change knowledge management system, climate change public awareness raising, mainstreaming climate change at subnational planning, climate change M&E system, developing capacity of climate change national coordinating mechanisms, climate change legal framework and national carbon finance framework. |

[66] Royal Government of Cambodia. (2013, March 01). *National Strategic Plan on Green Growth 2013-2030.* Retrieved from: Link
[67] Ibid.
[68] Ministry of Industry, Mines and Energy (MoIME). (2013). *Climate Change Strategic Plan for the Manufacturing Industry and Energy.* Retrieved from: Link
[69] National Climate Change Committee (NCCC). (2013). *Cambodia Climate Change Strategic Plan 2014-2023.* Retrieved from: Link
[70] Ministry of Environment (MoE). (2016). *Climate Change Action Plan.* Retrieved from: Link

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| **National Environmental Strategy and Action Plan (NESAP) 2016 – 2023[71], 2017** | The NCSD/MoE's NESAP provides a roadmap for the ministries, institutions and concerned stakeholders to formulate strategic plans and action plans for modernizing the management of environmental and natural resources to ensure environmental sustainability in Cambodia. NESAP initiates the development of programs and projects in priority areas such as road, water, and electricity. |
| **Cambodia's Updated Nationally Determined Contribution[72], 2020** | The NCSD/MoE's Cambodia's Updated NDC extends its coverage to include climate change mitigation targets in the agricultural and waste sectors among others, and expands more detailed actions to aspects such as energy efficiency.<br>• Some action plans for EE suggested in NDC include creating public awareness campaigns on EE, enforcing/certifying EE standards on new buildings and those undergoing major renovation, adopt climate-friendly cooling appliances across all public sector buildings<br>• Garment sector specific action plan includes promoting the sustainable sourcing of fuel wood<br>• An increased level of commitment toward reducing GHG emission and efforts to develop a solid framework for MRV are also highlighted<br>An ambitious target has been set in the Forestry and Land Use sector (FOLU) for halving the deforestation rate by 2030, in line with the REDD+ strategy (reduce emission from deforestation and forest degradation, increase forest cover and achieve sustainable development). |

The National Energy Efficiency Policy defines policy targets. The National Energy Efficiency Strategy lays out how to achieve the policy targets and the National Energy Efficiency Action Plan outlines how to implement the strategies proposed. Sustainable finance is a topic that is increasingly discussed in both the public and private sector. On the public sector side, MEF and MoE are actively involved in

*Table 6: Existing Energy and Equipment Related Policies*

| Plans and Policies | Description and Relevance to MGFP |
|---|---|
| **National Policy Strategy and Action Plan on Energy Efficiency[73], 2013** | The National Policy Strategy and Action Plan on Energy Efficiency (in 2013 was under MIME) seeks to improve Cambodia's energy efficiency whilst contributing to reduced greenhouse gas emissions. Five sectors are identified as priority areas:<br>• EE in industry<br>• EE of end user products<br>• EE in buildings<br>• EE of rural electricity generation and distribution<br>• Efficient use of biomass resources for residential and industrial purposes<br>The policy goal is to reduce the future energy demand in Cambodia by 20% and reduce national CO2 emissions by 3 million tons in 2035. |

[71] Asian Development Bank (ADB). (2017). *Cambodia's Road Map for Sustainable Development*. Retrieved from: Link

[72] The National Council of Sustainable Development (NCSD). (2020). *Cambodia's Update National Determined Contribution 2020*. Retrieved from: Link

[73] Ministry of Industry, Mines and Energy (MME). (2013, May 16). *National Policy, Strategy and Action Plan on Energy Efficiency in Cambodia*. Retrieved from: Link

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| **The Energy Efficiency Action Plan for the Industry[74], 2013** | The EE Action Plan for the Industry (in 2013 was under MIME) is part of the National Policy Strategy and Action Plan on EE. Energy savings potential is identified at 20% for the garment industry depending on uptake of modified behavior and the replacement of inefficient equipment.<br>3 strategic objectives set:<br>• Improvement of EE in the industrial sector<br>• Capacity building in the field of Energy Efficiency and Conservation (EE&C) in industry<br>• Increased attention of factory owners/managers to EE<br>The specific action plan based on the strategic objectives is listed below: |
| | Strategic Objective 1: Improvement of EE in the industrial sector<br>• Activity 1: Improve energy data collection and processing by collecting energy consumption and production volumes across the country annually<br>• Activity 2: Promoting good energy management practice in the industrial enterprise by following standard ISO 500001 Energy Management Standard (EnMS)<br>• Activity 3: Promotion of biomass use for decentralized production of energy (thermal or electrical) through gasification or bio digestion<br>• Activity 4: Implementation of voluntary as well as of compulsory standards on energy efficiency in industrial enterprises consuming more than a certain amount (to be determined) of energy per year |
| | Strategic Objective 2: Capacity building in (EE&C) in industry<br>• Activity 1: Support the development of energy service companies (ESCO's)<br>• Activity 2: Technical training for engineers and technicians in the field of energy efficiency, performing energy audits, establishing EnMS, and implementing energy saving measures in the industry<br>• Activity 3: Support the local development and manufacturing of EE equipment (thermal or electrical) through gasification or bio digestion |
| | Strategic Objective 3: Increased attention of factory owners/managers to EE<br>• Activity 1: Organize awareness raising campaigns about EE<br>• Activity 2: Provide financial incentives to interested companies to implement energy efficiency strategies and measures |
| **Law on Standards of Cambodia and Amendment, 2018[75]** | The Law on Standards of Cambodia aims to improve product quality and efficiency, ensure fair and simplified trade, rationalize use, and enhance consumer protection and public welfare. The law covers all activities related to standardization and quality assurance in Cambodia. The law also provides for the establishment of the Institute of Standards of Cambodia (ISC) under MISTI and the procedures for adoption of standards, marks, licensing, system certification, accreditation, and registration of certificate. |

[74] Ibid.

[75] Council for the Development of Cambodia (CDC). (2011, September 19). *Law On Standards of Cambodia.* Retrieved from: Link

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| **General Conditions for Connecting Solar Generation Sources to the Electricity Supply System of National Grid or to Electrical System of a Consumer Connected to the Electricity Supply System, 2018**[76] | The regulation covers two types of solar systems: solar system projects that supply to the national grid, and 'big' or 'bulk' consumers of solar systems that are connected to the grid but do not supply to the grid<br>• Under Article 3 of the regulation:<br>◦ To be connected to the grid, a solar system project must be included in the master plan of the MME, or must be evaluated and approved by the MME<br>• Under Article 4 of the regulation:<br>◦ Project must comply to the technical standard and safety conditions set forth in Article 7 and 8<br>◦ Conditions of investment and business conditions shall be defined in the project implement agreement, which the regulation does not have many details on<br>◦ Solar energy supplied to the national grid must be sold to EDC under a PPA<br>• Under Article 5 of the regulation:<br>◦ Only big consumers (medium voltage consumers above 380 volts up to 22,000 volts) and bulk consumers (high voltage consumers at above 22,000 volts) are allowed to install solar PV system and connect it to their own system and synchronize with the national grid and provide the additional electricity for their own consumption and will be subject to:<br>◦ Two-part tariff system with charges for both capacity and energy<br>◦ The maximum capacity of the solar power projects shall not be more than 50% of the contract demand in Kw<br>◦ The inverters should be programmed that the solar PV project power is consumed by the consumer and not fed into the grid i.e., there is zero export. Export of power under exceptional cases must be allowed with written agreement between EDC and the consumer |
| **Basic Energy Plan for Cambodia (BEPC)**[77]**, 2019** | The BEPC aims for an energy supply that is affordable, accessible, secure, safe, and transparent. The target year of the plan is 2030 and applies a rolling plan method of review every 5 years. The plan suggests short-, medium- and long-term strategies to improve EE across the electricity sector. Targets by 2030 are below:<br>• Basic energy mix: coal/gas 35%, hydro 55%, renewable energy (biomass, solar, and wind) 10%<br>• Export electricity to neighboring countries<br>• Improve the utilization of diverse energy sources |
| **Energy Efficiency and Conservation (EE&C) Master Plan of Cambodia**[78]**, 2020** | The EE&C Master Plan suggests the installment of ESCOs in Cambodia. New EE&C to be formulated in a few years will require energy intensive factories and buildings to have a designated and mandated energy manager. The EE&C Master Plan targets 100 energy managers in Cambodia by 2025. |

[76] Electricity Authority of Cambodia (EAC). (2018). *Regulations on General Conditions for Connecting Solar PV Generation Sources to the Electricity Supply System of National Grid or to the Electrical System of a Consumer Connected to the Electricity Supply System of National Grid.* (2018). Retrieved from: Link; Tilleke & Gibbins. (2018, May 25). *A Break in the Clouds: Regulating Cambodian Solar Energy*. Retrieved from: Link; The Phnom Penh Post. (2018, November 26). *Cambodia's Solar Regulation.* Retrieved from: Link

[77] Ministry of Mines and Energy of Cambodia (MME). (2019, March 20). *Cambodia Basic Energy Plan.* Retrieved from: Link

[78] The Economic Research Institute for ASEAN and East Asia (ERIA). (2020). *Energy Efficiency and Conservation Master Plan of Cambodia*. Retrieved from: Link

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| | It is estimated that of the 100 energy managers, some will be working for ESCOs, engage in EE&C consulting work, and some others will work in energy audit work designated by the General Department of Energy. |
| **Decision on a shift in electricity regulation and pricing structure[79], 2021** | EAC mandated a shift for all medium voltages (MV) consumers starting in Jan 2022 from "average rate billing" to "time of use billing" which changes the billing tariff based on when electricity was used. EAC also mandated all consumers to pay for the installed grid infrastructure by a "maximum power capacity rate". This rate is determined by EDC and based on the contract demand. |

the Climate Change Financing Framework and MoE also in the Cambodia Climate Change Alliance where funding is available to support expenditure and projects aligned with the Climate Change Action Plan. On the private sector side, the Association of Banks in Cambodia (ABC) led the development of the Cambodian Sustainable Finance Principles (CSFP) and Implementation Guidelines for financial institutions.

*Table 7: Existing Sustainable Financing Frameworks and Initiatives*

| Frameworks and Initiatives | Description and Relevance to MGFP |
|---|---|
| **Climate Change Financing Framework (CCFF)[80], 2014** | The CCFF by the MEF and MoE / Department of Climate Change aims to update the existing climate change expenditure, review future climate change funding for the next 5-10 years, prioritize sectoral climate action plans prepared by 8 ministries and the National Committee for Disaster Management (NCDM), assess benefits of climate finance, provide guidance for better climate responsive budgeting and planning, and define the modalities for managing climate finance.<br><br>The sectoral climate action plans include 117 actions with a total expenditure of $843 million over 5 years. 10 action plans involve investment on infrastructure and equal 56% of total expenditure. |
| **Cambodian Sustainable Finance Principles (CSFP)[81], 2016** | An initiative led by the Association of Banks in Cambodia (ABC) with the support from USAID, PACT, Wildlife Conservation Society (WCS) and Mekong Strategic Partners (MSP), the principles support sustainable energy financing by including environmental risk related to climate change, waste management, and national resources in Principle 2. The principles also commit to raising financial awareness and financial institution capacity to develop innovative solution for green economy activities. The capacity building is delivered by development agencies, development financial institutions, industry association, non-governmental organizations, external experts, and banks/MFIs. |

[79] Electricity Authority of Cambodia (EAC). (2021). *Decision on a Shift in Electricity Regulation and Pricing Structure.* Retrieved from: Link

[80] Ministry of Environment (MoE). (2014, November). *Analyzing and Recommendations for a Cambodia Climate Change Financing Framework*. Retrieved from: Link

[81] The Association of Banks in Cambodia. (n.d.). *Cambodian Sustainable Finance Principles.* Retrieved from: Link

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| **Cambodian Sustainable Finance Principles: Implementation Guidelines[82], 2019** | In Principle 6, ABC provides guidelines to financial institutions on the development and implementation of a business strategy that addresses a green economy such as supporting climate change mitigation and adaption projects, resource efficiency and green manufacturing, GHG emission reduction, renewable energy, and green buildings. |
| **Cambodia Climate Change Alliance (CCCA)[83], 2019** | The CCCA is a joint initiative of the RGC (Department of Climate Change within the NCSD at MoE) and development partners (UNDP, the EU, and the Swedish Government) to address climate change in Cambodia. The program is in its third phase currently (2019-2024) with the specific objective to strengthen the implementation of the Cambodia Climate Change Strategic Plan for 2014-2023. In previous phases, the program operated the grant facility for 42 government and NGO projects supporting key aspects of climate change. The maximum amount per grant is USD 100,000 (minimum USD 50,000). |
| **Law on Investment (LOI), 2021[84]** | The Law of Investment drafted by CDC aims to develop a green investment incentive program including:<br>• Tax-related incentives<br>• Investment guarantees<br>• Guidelines on how to register and transfer (acquisition, sales, or merger) investment projects<br>The LOI provides incentives to eligible sectors including the industrial sector, green energy, and technologies contributing to climate change adaptation and mitigation. |

Besides the described policies above, the development sector has also been actively involved in the energy space. ADB and UNDP are working on financing for EE projects and UNIDO is co-implementing an ongoing project that targets resource efficiency and cleaner production. The three ongoing projects are listed in the table below:

*Table 8: Ongoing Energy and Energy Financing Projects*

| Projects | Description and Relevance to MGFP |
|---|---|
| **Energy Efficiency Sector Development Program (EESDP)[85], 2021** | The EESDP is executed by MEF with the support of ADB. The EESDP aligns with the transition toward an EE economy and reduced GHG emissions from the energy sector.<br>The program comprises of 2 components or conditions:<br>• Establishment of policy and regulatory framework for EE<br>• Upon approval, ADB provides a loan for support of public investments at demonstration-scale projects<br>◦ Public buildings (hospital, offices, schools)<br>◦ Streetlights (replace less energy efficient streetlights, greenfield investment on streetlight)<br>Timeline: A loan could be signed at the end of 2022 for this EE program |

[82] The Association of Banks in Cambodia. (2019, February 19). *Implementation Guidelines.* Retrieved from: Link
[83] The Cambodia Climate Change Alliance (CCCA). (2019). *Programs on Climate Change.* Retrieved from: Link
[84] Council for the Development of Cambodia (CDC). (2021). Law on Investment. Retrieved from: Link
[85] KII with ADB; Asian Development Bank. (2021). Proposed Loans Kingdom of Cambodia: Energy Efficiency Sector Development Program. Retrieved from: Link

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| **Green Industry Awards[86], 2021** | The UNIDO/MISTI Green Industry Awards aim to recognize and reward green efforts from companies, spread word on green activities, stimulate and support voluntary adoption of green practices, and raise environmental awareness among industries and the public. Companies with a related project within the last 2 years can apply if they can demonstrate significant leadership in a focused area.<br>3 potential target groups:<br>• Manufacturing Companies<br>• Industrial Supporting Services<br>• Green Start-ups and Innovation<br>2 segments:<br>• Large industrial companies<br>• SMEs (with potentially fewer criteria than large companies)<br>There are 15 selection criteria, divided into 3 groups:<br>**Environmental criteria**<br>• Material Efficiency (SME)<br>• Waste Management and Recycling (SME)<br>• Energy Efficiency and Renewable Energy (SME)<br>• Water Efficiency (SME)<br>• Wastewater Treatment<br>• Emission to Air<br>• Environmental Management Program<br>**Economic criteria**<br>• Innovation<br>• Investment vs Saving (SME)<br>• Relative Investment (SME)<br>• Job Creation (SME)<br>• Personnel (SME)<br>**Social criteria**<br>• Working Place and Industrial Safety (SME)<br>• Gender (SME)<br>• Community (SME)<br>The Award was granted to 32 companies in December 2021. |
| **Energy Efficiency Revolving Fund[87], 2022** | The UNDP Energy Revolving Fund's main objective is to accelerate the implementation of the EE policy:<br>• Seed funding could be sourced from DPs, multilateral institutions such as ADB and combined with a guarantee scheme<br>• Financial institutions are eligible for concessional finance to give loans to SMEs across a wide range of sectors |

[86] KII with UNIDO; *Cambodia Green Industry Award.* (2021). Retrieved from: Link;

[87] KII with UNDP

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|---|---|
| | • Target for funding are SMEs in sectors indicated in the EE policy draft and the NDC which broadly mentions the industrial sector; the garment sector is included but eligibility criteria yet to be defined<br>• The seed fund is estimated to materialize by mid-2022<br>• Fund size will be approximately USD 50-150 million, based on an estimated current USD 672 million gap for mitigation finance in the energy sector alone, USD 79 million in the industry sector<br>• Fund management could lie with a new legal entity like the Credit Guarantee Cooperation of Cambodia, or a special division embedded in existing public units like SME bank or ARDB, hosted by MEF or MME |
| **Low-Carbon Development for Productivity and Climate Change Mitigation through the Transfer of Environmentally Sound Technology (TEST) Methodology Project[88], 2017** | TEST is one of the key projects between MISTI and UNIDO. It is an integrated approach for industries and SMEs with a set of tools to initiate a cycle of continuous improvements within their business operations to manage the transition towards a sustainable production using two methodologies:<br>• Cleaner Production Assessment (CPA)<br>◦ Environmental Management System (EMS ISO14001)<br>◦ Energy Management System (EnMS ISO50001)<br>• Material Flow Cost Accounting (MFCA) (Environmental Accounting ISO 14051)<br>TEST encourages factories to have EnMS compliance since factories can obtain scores on "Energy Efficiency and Renewable Energy" criteria. TEST also focus on encouraging adoption of EMS, EnMS and Environmental Accounting so factories can minimize waste and pollution in water, material, and energy. TEST was implemented in two factories[89] which received technical assistance to implement resource efficiency and cleaner production tools. They have reported a significant decrease of energy intensity of production per piece implementation between 2019 to 2020 compared to 2017 and 2018. This includes production assessment for use / cost of material and utilities (energy, water), support of energy audit, environmental accounting, and management system.[90]<br>The government has launched the second phase of TEST program in July 2021 and onboarded a second batch of 20 garment factories and food processing enterprises.[91] |

### 4.1.2. Upcoming Regulations, Policies, and Instruments

More laws, regulations and policies on environmental and resource efficiency, energy and equipment, investments, and green buildings are under development. This indicates the government's intention to build a strong foundation on the regulatory side to enable and encourage further growth and investment for sustainable development.

[88] United Nations Industrial Development Organization (UNIDO). (2017, January 09). *Test Implementation.* Retrieved from: Link

[89] One of the two factories featured in the source is Sabrina Garment Manufacturing Corp, the other factory is unknown.

[90] KII with UNIDO; United Nations Industrial Development Organization (UNIDO). (n.d.). *Transfer of Environmentally Sound Technologies (TEST).* Retrieved from: Link

[91] Thou, V. (2021, July 01). *UNIDO Eco-Tech Project Extended.* Phnom Penh Post. Retrieved from: Link

*Table 9: Upcoming Environmental and Resource Efficiency Related Policies*

| Projects | Description and Relevance to MGFP |
|---|---|
| **Draft Environmental and Natural Resources Code of Cambodia[92], draft 9.1, 2017** | The drafted Environmental Code by the National Assembly provides rights and incentives to the solar energy sector, including[93]:<br>• Right to connect to the national grid for companies and consumers using solar energy<br>• Requirement to develop regulations on net metering by the public entity regulating production, distribution, and usage of electricity<br>• Establishment of a one-year pilot for a feed-in-tariff system, in which the government offers a fixed rate for solar energy fed into the grid; and up to 20% reduction in profit taxes for any company generating at least 20% of its own energy through sustainable sources<br>The code is currently at version 11.2 of the draft which could not be reviewed; the expected date of passing is still unclear |
| **National Sustainable Consumption and Production Roadmap[94]** | The National Sustainable Consumption and Production (SCP) Roadmap under the NCSD and MoE is an implementation guide for promoting resource efficiency and reducing environmental impact, energy, and waste. |

Medium- and long-term strategies and action plans for the energy sector are in sight with the upcoming National Energy Efficiency Policy and Power Sector Masterplan. The Draft Sub-decree and Prakas for selected appliances as pilot is expected to be issued short-term. ADB is working on an ESCO policy framework, but it currently remains at an unspecified level, requiring further data and discussion on institutional coordination and other aspects including definition of thresholds for EE consumers.[95]

*Table 10: Upcoming Energy and Equipment Related Policies*

| Plans and Policies | Description and Relevance to MGFP |
|---|---|
| **National Energy Efficiency Policy 2021-2030, draft as of July 2021[96]** | The NEEP 2021 by MME with assistance from ADB sets a national target for the reduction of total energy consumption (thermal and electrical) of at least 19% by 2030 vis-a-vis the "Business-as-Usual" (BAU) scenario, from 89,837 GWh to 72,470 GWh. Below are the targets listed by sector:<br>• 20% in the industrial sector, from 38,600 GWh to 30,800 GWh<br>• 34% in the residential sector, from 17,981 GWh to 11,826 GWh<br>• 25% in commercial and public buildings, from 8,552 GWh to 6,431 GWh<br>• 29% in public services, from 42 GWh to 30 GWh<br>• 5% in the transport sector, from 24,662 GWh to 23,383 GWh<br>ADB worked with MME and consulted MEF on this policy. The policy was expected to be approved by end of 2021. |

[92] Ministry of Environment (MoE). (2017). *Draft Environmental and Natural Resources Code of Cambodia.* Retrieved from: Link
[93] Tilleke & Gibbins. (2018). *A Break in the Clouds: Regulating Cambodian Solar Energy.* Retrieved from: Link
[94] KII with MoE
[95] KII with ADB
[96] Royal Government of Cambodia (RGC). (2021, July). National Energy Efficiency Policy Draft; KII with ADB

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|---|---|
| **The Cambodia's Power Sector Development Masterplan**[97] | The Cambodia's Power Sector Development Masterplan is MME's long-term vision to 2040 for the power sector. Power demand is estimated to reach 24,184 GWh in 2025 under a medium-growth scenario. |
| **Sub-decree on Energy Efficiency Standards and Labelling (S&L)**[98] | This MME sub-decree on EE with the assistance from ADB, UNDP and CCCA is based on workshops conducted by the Economic Research Institute of Asia (ERIA) to inform MME on a comprehensive policy and regulatory framework to achieve EE in all sectors for target appliances (lighting, refrigerator, air conditioning, fan, television, water heater, washing machines). Target appliances shall be reviewed with regards to market availability, distribution, power consumption, and market share. Stage 1 of implementation applies to residential appliances and stage 2 to commercial/industrial appliances. Priority is given to residential appliances for a wider target.<br><br>The draft sub-decree energy labelling for refrigerators and air conditioning is in the final stage of issuance. |
| **Prakas for Energy Efficiency**[99] | The Prakas on EE is led by MME with the assistance from ADB, UNDP, and CCCA. It lays out Minimum Energy Performance Standards (MEPS) / Energy Efficiency Standards and penalty for noncompliance. The prioritized equipment will be air conditioners and refrigerators with a target year of 2025.<br><br>The draft sub-decree for MEPS for refrigerators and air conditioning is in the final stage of issuance. This sub-decree would empower MME to issue prakas on MEPS. |
| **Eco-Labelling Policy**[100] | The Eco-Labelling Policy is a joint effort between MISTI and NCSD /MoE, still at an early stage, but the policy analysis is completed. The policy aims to promote awareness and understanding in the marketplace and is applicable to SMEs and the industrial sector. The policy starts with Standards and Labelling (S&L), then MEPS, then eco-labeling within a time span of 10 years.<br><br>The timeline of each step will depend on equipment identified by MISTI. |
| **Solar PV Guidelines**[101] | The Solar PV guideline is in development by MME and UNDP and aims to provide technical guidelines for rooftop solar installation. |

Green buildings offer the potential of energy savings, reduced GHG emission and environmental and natural resource benefits. To achieve the energy savings goals laid out in the national policies, construction laws and green building guidelines are in development, with unclear progress and timeline.

[97] Asian Development Bank (ADB). (2020, June). *Power Development Master Plan, 2020–2040 Demand Forecasts*. Unpublished. This study is being conducted under ADB. Regional: Southeast Asia Energy Sector Development, Investment Planning and Capacity Building Facility.

[98] Kimura, S., Han, P.M., & Leong, S.M. (2020, July 30). *Energy Efficiency and Conservation Master Plan of Cambodia*. Retrieved from: Link

[99] Ministry of Environment (MoE). (2021). *Circular Economy Strategy and Action Plan 2021*; Asian Development Bank. (2021, October). *Proposed Loans Kingdom of Cambodia: Energy Efficiency Sector Development Program*. Retrieved from: Link; United Nations Development Programme. (2020, June 28). *Cambodia's Energy Future*. Retrieved from: Link; KII with ADB

[100] KII with MoE, PwC

[101] KII with UNDP; Switch Garment. (2021). *Impact Assessment of Regulatory Measures to Support Sustainable Energy Investment in the SME Garment Sector – Problem Definition and Regulatory Options Validation*; The National Council for Sustainable Development and Ministry of Environment (NCSD and MOE). (2021). *Circular Economy: Strategy and Action Plan (Draft)*

*Table 11: Upcoming Green Building Related Laws and Policies*

| Laws and Policies | Description and Relevance to MGFP |
|---|---|
| **National Energy Efficiency Green Building Concept Development**[102] | The Green Building Concept Development is placed under NCSD/MoE and the Department of Green Economy. The aim is to develop guidelines and certification standards for constructing green buildings, such as minimum green space in residential and commercial sectors, not yet for the industrial sector. |
| **Guidelines and Certification for Green Building**[103] | The guidelines and certification are implemented by the Department of Green Economy of the NCSD/MoE and funded by the Mekong-ROK Cooperation with fund management by the Mekong Institute (MI).<br>Both residential and commercial buildings are in focus. Three building components are included in the guideline and certification: energy, water, and material. Target beneficiaries would be SMEs working on improvement of the design of their building and residential buildings. |
| **Construction Law**[104] | The Construction Law is under development by the Ministry of Land Management, Urban Planning and Construction (MLMUPC) and UNDP. There is discussion around:<br>• Integrating energy regulations into construction<br>• Requiring minimum efficiency for new and renovated buildings for reduction of energy use and emissions to slow down energy demand and to reduce power cuts |

Further policies are in development to encourage adoption of green initiatives from the private sector.

*Table 12: Upcoming Investment Related Laws, Policies and Programs*

| Laws and Policies | Description and Relevance to MGFP |
|---|---|
| **Sub-decree on Incentive for Green Business**[105] | The sub-decree to be issued by CDC is expected to shape the significance of the LOI's environmental impact and the range of environmentally focused activities and organizations eligible for incentives. The sub-decree is expected for 2022. |
| **Climate Change Tax Policy**[106] | The Climate Change Tax Policy is a joint effort between MEF and UNDP and part of the Cambodia Climate Change Alliance (CCCA) program of UNDP. A sub-decree on carbon tax is in development; the progress on the policy is unclear. |

[102] KII with UNDP; The National Council for Sustainable Development (NCSD). (n.d.). *Cambodia's Commitment to Sustainable Development.* Retrieved from: Link

[103] The National Council of Sustainable Development (NCSD). (n.d.). *Guidelines and Certification for Green Buildings in Cambodia Terms of Reference (TOR).* Retrieved from: Link

[104] Ministry of Land Management, Urban Planning and Construction (MLMUPC). (n.d.). *Law On Construction.* Retrieved from: Link

[105] Delgado, A.L. (2022, January 5). *Cambodia's Updated Investment Law Gives Incentives to Green Business. Southeast Asia Globe.* Retrieved from: Link; McGonigle, A. (2022, January 6). *New Tax Law Introduces Green Incentives for Investments.* Khmer Times. Retrieved from: Link

[106] KII with UNDP

## 4.2. Assessment of the Regulatory Environment for the MGFP

### 4.2.1. Supporting Policies and Developments

The wider national policies and frameworks provide foundational support to the broader context of the MGFP, specifically highlighting the garment sector and electricity as key areas of focus.

- **Industrial Development Policy 2015** supports sustainable growth, and the garment sector is mentioned as key contributor to the economy.
- **Rectangular Strategy Phase IV, Cambodia Sustainable Development Goals, National Strategic Development Plan 2019-2023 and Circular Economy Strategy and Action Plan, 2021** mention the high importance of energy efficiency but also electricity cost, reliability of electricity supply and renewable energy not having been included in the energy supply system to their full economic potential as challenges and address it as development prioritization for sustainable growth.
- **Cambodia Garment, Footwear and Travel Goods (GFT) Sector Development Strategy, 2022 – 2027** aims to upgrade the garment sector into an industry that is "environmentally sustainable, resilient, high value-added, focused on high-end and unique products, highly competitive, and supportive of economic diversification". The strategy also provides measures to promote and incentivize investment in improving productivity, technology transfer, energy efficiency and use of renewable energy.

Environmental policies and strategic directions are also supportive towards green investment especially in the industry sector.

- **Updated Nationally Determined Contribution, 2020** extends the coverage to include climate change mitigation target and contains detailed action plan with regards to EE (enforce/certify EE standards on new buildings/major renovation, adopt climate-friendly cooling appliances across all public sector building, and create public awareness on EE). Garment sector specific action plan includes promoting the sustainable sourcing of fuel wood commitment toward reducing GHG emissions.
- **Climate Change Strategic Plan for the Manufacturing Industry and Energy, 2013** and **National Green Public Procurement and Environmental Labels, 2021** encourage green production for manufacturing and investments for energy savings through tax exemption and duty-free import of production equipment.
- **Resource Efficiency Policy Action Plan 2021-2030, Resource Efficiency and Cleaner Production (RECP) 2021-2031,** and **National Sustainable Consumption and Production Roadmap** promote the use of energy savings and renewable energy for increasing resource efficiency and reducing environmental impact, energy, and waste in the industrial sector.

Energy and equipment related policies are highly supportive of the MGFP and funding programs from development partners support EE pilots. Power sector improvement policies encourage adoption of alternative energy sources and energy efficiency improvements which aligns with the SES component of the MGFP and the MEPS, EnM and BAT elements respectively.

- Renewable Energy Adoption
  - **Tax incentives on solar panels** exempt direct import of solar panels from taxation
- Energy Efficiency Improvement
  - **The Energy Efficiency Action Plan for the Industry, 2013**[107]
    - Support promotion of ISO 500001 EnMS in industrial enterprises

[107] The Action Plan was published in 2013 but implementation seems lagging. However, the plans and strategic directions which have been laid out in the Action Plan are in favor of the MGFP and its goals.

        - Implement both compulsory and voluntary standards on EE in industrial sectors
        - Support development of ESCOs
        - Provide training to engineers and technicians on energy efficiency, energy audits, establishing EMS, and implementing energy saving measures in the industry
        - Organize awareness campaigns about EE
        - Provide financial incentives for energy efficiency strategies and measures
    - **EE&C Master Plan of Cambodia, 2020** targets to develop 100 energy managers by 2025 who will work at ESCOs, engage in EE&C consulting work and in energy audits
    - **National Energy Efficiency Policy, 2021- 2030 (upcoming)** sets a reduction target on energy consumption for industrial sector at 20%
    - **Sub-decree on EE S&L and Prakas on EE (upcoming)**
        - Develop MEPS and S&L standards for selected appliances
        - Pilot launch includes AC and refrigerator
        - Start from residential sector to later include industrial sector
- Sustainable Energy / Environmental Project Investment Incentive
    - **Law on Investment (2022) and Sub-decree on Incentive for Green Business (upcoming)**
        - Provide tax-related incentives, investment guarantees, and guidelines on how to register and transfer investment projects (acquisition, sales, or merger)
        - Eligible sectors: industrial sector, green energy, and technologies contributing to climate change adaption and mitigation
        - The Sub-decree shall shape the significance of the LOI's environmental aspects and eligible range of environmentally focused activities and organization.

### 4.2.2. Unfavorable Regulations

One key regulation with negative impact revolves around solar PV installations. The EAC adopted the Regulation on General Conditions for Connecting Solar Generation Sources to the Electricity Supply System of National Grid or to Electrical System of a Consumer Connected to the Electricity Supply System in 2018 (see Error! Reference source not found.) which mainly serves as a regulatory framework for previously unclear and undefined conditions. However, the regulation disincentivizes the adoption of solar energy by the private sector.[108] It fails to address key concerns such as feed-in tariffs and net metering. For factories that use solar panels, there is a 50% maximum share of solar energy out of contracted demand, a flat electricity fee without the reduced nighttime (off-peak) rate. These regulations reduce the savings effect from installing solar which also means a longer return on investment (6 years or more).

There are also procedural issues with connecting and synchronising with the grid for solar system implementation. To connect to the grid, the solar project must meet the following criteria (see Error! Reference source not found. for more information):

- Be included in the master plan of MME or evaluated and approved by MME (Article 3)
- Comply to the technical standard and safety conditions set forth by EDC (Article 4)
- Only big consumers and bulk consumers area allowed to install solar PV systems and connect and to synchronize with the grid (Article 5)

Another challenge revolves around fiscal incentives with the current Investment Law where a company that is considered Qualified Investment Project (QIP) can import production equipment and construction

[108] Tilleke & Gibbins. (2018). *A Break in the Clouds: Regulating Cambodian Solar Energy.* Retrieved from: Link

materials free of import duty.[109] However, the same incentive is not applicable if a business buys the same equipment in bulk and retails it to supply locally. This means a factory has more incentive to buy the equipment directly from an international seller than buying it locally from a provider unless there is a clear benefit of doing so, i.e., lower price. The incentive also does not apply to turnkey services and solutions provided by third parties or specifically energy efficient equipment.

Compared to other countries in the region, Cambodian is still behind in terms of EE policies in place. While development is ongoing, some critical aspects are still in early-stage studies or pilots that could play a central role in supporting and encouraging the adoption of sustainable energy practices.[110]

- Requirements on having designated energy managers for factories
- Standards & Labelling for other appliances beyond AC and refrigerators
- Regulations around governing the operations and promotion of ESCOs
- Establishment of Building EE code[111]

On the side of supporting measures, the lack of energy price subsidies, lack of affordable financing options or financial support puts a damper on adoption of EE and RE interventions. The new Investment Law with incentives for investments in environmental management, the circular economy or green energy and technologies can be a crucial facilitator of green investments; however, its impact also depends on the details of sub-decree and its implementation. More access to designated (concessional) funding is needed to open the market and encourage the adoption of MGFP by factories. Therefore, financial support or incentives on energy efficiency and renewable energy can support the uptake and contribute to sustainable industrial development aligning with the government vision and policies.

In summary, the current regulatory environment is deemed favorable to the outline and implementation of the MGFP. The policies discussed above illustrate government support toward achieving sustainable development and tackling climate change and serve as foundation for further development of policies that are more specifically related to the MGFP. Its elements including MEPS, EnM, BAT, and SES are mentioned across different policies indicating high level and strategic alignment that in certain areas would profit from more specific elaboration and enactment. Providing fiscal incentives and financial supports can further reduce the investment barrier to accelerate the adoption of the MGFP among Cambodian garment factories.

## 4.3. Key Government Stakeholders

Most relevant government stakeholders in the project context include MISTI, MoE, and MME; mainly MISTI and but also MoE are already collaborating with Switch Garment. The respective ministries play a key role in providing strategic direction, creating an enabling environment, developing targets and measures to achieve those targets. These government stakeholders have mandates directly relevant to the MGFP:

- The Ministry of Industry, Science, Technology and Innovation (MISTI) manages the industry sector and on national and subnational level develops policies and programs to improve the SME, industry, handicrafts and clean water sector, it promotes competitiveness and improves the investment environment.[112] MISTI also has a broad mandate to promote resource efficiency and cleaner production (RECP) in industries.

[109] Council for the Development of Cambodia (CDC). (2022, April 06). *Investment Incentives Granted to a Qualified Investment Project (QIP).* Retrieved from: Link

[110] Switch Garment. (2021). *Output 1: Policy and Regulatory Measures. Policy Scenarios Discussion Paper.*

[111] Shigeru, K., Phoumin, H., & Siew Meng. L. (2020). *Energy Efficiency and Conservation Master Plan of Cambodia. Economic Research Institute for ASEAN and East Asia.* Retrieved from: Link

[112] Ministry of Industry, Science, Technology, and Innovation (MISTI). (2021). *Importance of Resource Efficiency in the Industrial Sector of Cambodia.*

- The Ministry of Environment (MoE)'s main roles and responsibilities are to protect natural resources and to prevent environmental degradation. The National Council for Sustainable Development (NCSD) under MoE has the mandate to prepare, coordinate and monitor the implementation of environmental policies, strategies, legal instruments, and plans for sustainable development. The Department of Climate Change under NCSD, serves as national coordinating mechanism for the development and management of the GHGs inventories, national report and deliver government commitments under United Nations Framework Convention on Climate Change (UNFCCC)[113].

- The Ministry of Mines and Energy (MME) manages the mining and energy sectors including the oil, gas, and electricity supply in Cambodia.

Other key actors relevant to the context of the MGFP include the Electricity Authority of Cambodia (EAC) and Electricité du Cambodge (EDC)[114]:

- EAC is the regulator for power sector and responsible for
    - Granting licenses
    - Approving and enforcing performance standards
    - Determining tariffs, rate, and charges
- EDC is responsible for
    - Generating, transmitting, and distributing electricity throughout Cambodia
    - Facilitating import and export of electricity to and from neighbouring countries
    - Signing agreement for new power projects and power purchase agreements

Support from key stakeholders at government and association level, potentially with a role in the implementation process, adds credibility to the MGFP and ensures the program receives the (institutional) support required.

## 4.4. Potential Roles of Government Ministries

In the context of the development of the MGFP, involvement of MISTI, MoE, and MME ensures government collaboration and alignment on environmental criteria by all relevant ministries to avoid any redundancy or overlapping prakas or sub-decrees.[115] Possible engagement of the three governmental stakeholders may revolve around the following:

- MISTI handling industry sector policies promotes awareness, and endorses the application of MGFP targeted industry sector
- MoE focusing on sustainable development and environmental impact assessment for licensing of factories and other compliance with environmental criteria.
- MME formulating EE regulations including MEPS and Standards & Labelling, related programs, and managing registration and licensing processes for energy managers, and ESCOs

[113] The National Council for Sustainable Development (NCSD). (2019). *Department of Climate Change*. Retrieved from: Link
[114] Open Development. (2017, March 27). *Electricity Infrastructure*. Retrieved from: Link
[115] KII with MoE, UNDP

# 5. Business Environment for Sustainability Interventions

## 5.1. Key Industry Stakeholders of the MGFP

Starting with the government as regulatory authority, several further stakeholders have crucial influence on sustainability progress and thus competitiveness of the garment sector.

### Government

As stated by buyers, a clear vision and strategy by the government for the garment sector is key in keeping Cambodia a competitive supplier country. For the electricity supply, the recent developments from 34% non-renewable energy sources in 2018 to a projected 74% in 2030 with only 26% coming from renewable energy will make it more difficult for factories to improve environmental performance in the buyer rating. The electricity pricing for factories with solar PV and caps on use of solar energy by EDC as well as a lack of PPPA and RECs are another obstacle for increasing their sustainability. While efforts have been made in ongoing discussion with the government from buyer side regarding their sustainability commitments, there is still a need for more initiative in the garment sector with regards to environmental standards and a push for sustainability for Cambodia not to fall behind in the global competition, at least if the intention is to keep and attract buyers above the lowest value segment.[116]

As the preparation and implementation of PPPA in Vietnam took 5 years despite comprehensive support from development partners, a signal for such policy development is already valuable for mid- and long-term planning on buyer side. High end brands like Apple looking to move out of China and deciding to produce in Vietnam because they can achieve 100% RE shows which relevance such regulations can hold.

### Factories

Factories, as outlined in chapter 2.1, face certain barriers when it comes to sustainable investments. Since implementation of sustainability criteria comes with sourcing advantages but usually does not warrant a rise in pricing or any purchase and contract guarantee, investing carries the risk of little return in a sector operating on very tight margins. Where the business case of short-term cost reduction does not apply or convince enough, appeal must lie in the prospects of improving buyer relationships even if currently not backed by guarantees or advance commitments from buyers.

Suppliers already producing for brands with higher sustainability requirements, like adidas and Nike, must show advanced equipment and practices to qualify for contracts, but continuous improvements will likely be required from them to maintain supplier status. Potential for EE improvements and their impact will be highest for those producing or especially those aiming to produce for the mid-value segment and brands with progressing environmental terms, such as H&M, Inditex, Marks and Spencer, New Look, GAP, Uniqlo, or Levi's.

For factories as potential borrowers, it is mainly smaller local factories that face obstacles in accessing finance for related necessary investments. A lack proper financial records can make it difficult to obtain a loan, even more so for still uncommon sustainability projects, and small factories might not have a large and creditworthy enough buyer that could – or is willing and able to – stand in for them. Most importantly, the local financing options with their high interest rates, relatively short tenors and collateral requirements often prove not feasible. The larger, usually foreign-owned factories that are part of a group with headquarters abroad have access to in-group or cheap offshore funds through their parent companies and can forego local financing options.

[116] KII with adidas, H&M, Li & Fung, VFC; UNFCCC Fashion Industry Charter for Climate Change (2021, June 30). *WG 4 Meeting on Promoting Climate Action in Cambodia.*

### TAFTAC

TAFTAC as business association is considered a key supporter for the success of the MGFP and for the general ambitions of the sector towards sustainability. While single factories have been moving forward on their own in terms of production capabilities and sustainability, a comprehensive raising of industry standards relies on TAFTAC support and initiative. Successful examples of greening garment industries in Vietnam and Bangladesh were propelled by active involvement of the respective local industry associations, VITAS and BGMEA.[117]

The TAFTAC partnership in development of the MGFP, their support of SE measures and push for implementation among their members based on the clarification of business benefits is realized as key by the Switch Garment project and a close collaboration has been established since the beginning.

### Brands

Brands are already driving the sustainability performance of Cambodian factories, by their compliance requirements and sourcing incentives for sustainable production. This can only be a selective impact on interested suppliers, but for the time being, their role and power as buyers proves to be the most effective influence for sustainability investments. More directly, they also collaborate with suppliers, sustainability initiatives like the Sustainable Apparel Coalition (SAC) or Apparel Impact Institute (AII) and at times other brands for awareness raising and capacity building for sustainability in factory side as it is in their interest not only to secure capable suppliers but also to deepen relationships to have a perspective for longer-term collaboration.

### Energy Service Providers (ESPs) and Certification Providers

The integration of local ESPs with the garment sector seems limited, presumably also due to direct equipment imports by foreign-owned factories, mainly from China. For execution of the proposed sustainability measures, one barrier is the lack of technical resources and skills – not only on factory side but also in the business environment. In an ESP market survey conducted in 2021 by EMC for the Switch Garment project[118], roughly 90 relevant ESP firms were identified. While a wide variety of technological capabilities exists, firms generally do not have deep experience in energy efficiency, due to lack of demand. While solar installations see better uptake, SE projects beyond LED lighting retrofits or projects implemented with support of development partners and concessional finance are rare.

One main barrier to sustainable energy projects, upfront project costs, could be solved by Energy Service Companies (ESCOs) – companies that also finance or arrange financing for operations and whose payment is directly tied to the energy savings achieved – but ESCOs have yet to emerge in Cambodia and existing firms show little ESCO-readiness based on technical and financial characteristics, experience, capabilities, and attitudes. An energy-as-a-service offer that takes the investment burden off the factories, whether it be through ESCOs or other instruments, could be a key element in increasing sustainability interventions. Overcoming certain concerns on ESP side towards garment factories, such as potential strikes, factory closures, or cultural differences with factory owners, would help increase the appeal of this potential target group for collaboration.

For certification providers, auditing garment factories is generally a large part of their business, whether it be based on custom company guidelines, industry standards or a combination of both. Whereas social compliance has become common for factories, environmental compliance has seen a steady but only slow growth over the recent years in Cambodia;

[117] Emerging Markets Consulting (EMC). (2019, December). *Green Finance in the Textile, Apparel and Footwear Sector in Southeast Asia.*

[118] Emerging Markets Consulting (EMC). (2021). *Market Survey of Energy Product and Service Providers in Cambodia.*

it is not yet a strong business area, if at all. For any audit, certification or training demand, resources must be brought in from Thailand or Vietnam, due to lack of qualified local resources which has proven especially difficult during the pandemic.[119] Currently, companies active in environmental compliance in Cambodia seem to be few - SGS, Intertek, TUV - often via their regional office in Vietnam or Thailand. While certification needs can be addressed by a relatively smaller number of audit providers, more crucial is a sufficient supply in locally available competent energy service providers to support with sustainable energy interventions and also business services that help factories prepare specifically for audits, such as Green Move Consulting; auditors often also offer trainings in the relevant standard for which they provide certifications. The Institute of Standards of Cambodia (ISC) can also play a role in supporting, auditing, and certifying standards such as ISO14001 Environmental Management System (EMS).[120]

### Financial Institutions (FI)[121]

The finance sector plays a crucial role as enabling partner of investments but is currently not yet effective, mainly due to lack of experience and internal assessment capabilities of EE or RE projects. Microfinance Institutions (MFI) lack experience with corporate garment sector clients or SE projects beyond financing distributors of small-scale home solar.[122] Banks are to certain extent involved with the garment sector or larger-scale renewable energy investments, but like MFIs, perceive both the garment and energy sector as high-risk environment. For garment factories, this is due to the high share of short-term contracts in the business aggravated by potential long-term COVID-19 impacts, and for ESPs there are concerns about the technical capabilities of local firms. However, all interviewed FIs express interest in SE initiatives, even more so if specific support can be offered to engage in higher risk projects. Since cost of funds is high for both banks and MFIs at around 3-5% and 7-8% respectively, access to funds at slightly lower cost or paired with a guarantee on defaults can make loans available at easier conditions. According to the Association of Banks in Cambodia (ABC), a challenge is also the lack of a clear national definition of green lending. ABC with its members and the National Bank of Cambodia (NBC) is working a common definition expected for 2022. The Cambodian Sustainable Finance Principles (CSFP), initiated by ABC, have been voluntarily adopted by 47 banks by 2019 and some FIs such as CIMB, Acleda, PPCB, Sathapana, J-Trust, and FTB have prepared an independent department for ESG initiatives to evaluate loans in terms of ESG criteria.[123]

In other garment producing countries, such as Vietnam and Bangladesh, financing offers for green investments – often in the form of blended finance in collaboration with government, DFIs and/or NGOs – have shown to support sustainability development effectively, provided the application process is not a barrier.[124] In Cambodia, actors, such

[119] KII with BV, Cosmo / Control Union, SGS

[120] Institute of Standards of Cambodia. (2016, April 21). *System Certification*. Retrieved at: Link.

[121] The role and opportunities for the finance sector in this project context are covered in more detail in a dedicated consulting project proposing financial instruments and infrastructure suitable to promote sustainable energy practices in the Cambodian garment sector, conducted for the SWITCH Garment project in 2021: Econoler, EMC (2022). *Research to Develop a Financial Instrument to Promote Sustainable Energy Practices in the Garment Sector in Cambodia. Investigation of Finance Strategies.*

[122] This can also be via grant funds, such as the ResponsAbility (EE lending facility) grant of USD 20 million for a green lending program distributed by Prasac MFI launched in 2016 to low-income households and farmers. Other programs were managed by Nexus for Development with their Clean Energy Revolving Fund (CERF) to enable smallholder farmers to switch to clean energy technologies or their Pioneer Facility with working capital loans to SMEs and social enterprises selling clean water and energy technologies to the low-income population (ADB Institute, October 2020: *Energy Efficiency in ASEAN: Trends and Financing Schemes).*

[123] KII with ABC

[124] The Business Standard. (2022, January 30). *Inadequate Policy Support Slowing Down Green Transition*. Retrieved from: Link; Emerging Markets Consulting. (2019). *Green Finance in the Textile, Apparel and Footwear Sector in South Asia and Southeast Asia*. In Bangladesh, the government or government agencies and state banks offer low-cost long-term finance, security finance, risk sharing and partly grants, sometimes in collaboration with DFIs to facilitate installation of energy efficiency and conservation equipment. This is complemented by fiscal incentives such as tax reductions and is backed by increasingly strict national environmental regulations. In Vietnam, multi-party initiatives by VITAS, the banking association and local or international banks, partly with NGOs, support the greening of the sector with credit lines at preferential conditions.

as Mekong Strategic Partners (MSP) setting up a Green Financing Institution (GFI) through a mandate with the Green Climate Fund (GCF) are interested in entering the space with long-term debt financing for green projects at concessional rates.

From government side in Cambodia, the Credit Guarantee Corporation of Cambodia Plc. (CGCC), a state-owned enterprise operating under the guidance of the Ministry of Economy and Finance (MEF) provides the Business Recovery Guarantee Scheme (BRGS) since March 2021, a credit guarantee given to participating FIs for loans to locally owned businesses. This credit support is to improve businesses' access to finance and to contribute to overall economic recovery during the COVID-19 pandemic. While garment or ESP are not priority sectors, businesses can still apply for loans. The credit assessment is conducted by the collaborating FIs, both banks and MFIs. Another scheme has been added in late 2021, the Co-Financing Guarantee Scheme (CFGS) that is specifically designed for loans disbursed with help from SME Bank of Cambodia. The government provides funding to SME Bank for onward lending and risk sharing with participating FIs.

### Development Financial Institutions (DFI)

For DFIs, involvement often depends on a certain market size and investment potential. With the direct or indirect beneficiaries and impact at hand – not only garment factories, but also ESPS and last but not least familiarization of local FIs with green investments – the appeal lies not only in the estimated market potential of USD 168 million investment in SE interventions, including solar PV, over 150 average factories but also the potential broader effects that carry on from the project.

AFD has been funding the Cambodian Garment Training Centre (CGTC) for worker skill improvement run by TAFTAC from 2012 and a project in childcare support for female garment workers. Proparco, the private sector development arm of the Agence Française de Développement (AFD), shows strong interest in the MGFP and its impact, in line with renewable energy being a focus of the institution. Proparco works with debt, equity, and guarantee tools; their current Proparco program in Cambodia ARIZ is a silent guarantee for banks which covers the loss for the bank up to 50% of loans disbursed, to a maximum of EUR 2 million. While garment factories are not yet covered under this scheme, the sector falls under the 4 priority areas agriculture, tourism, export, and industry. EE and RE are of high interest and prospects for such projects might come under a new credit line to be launched in 2022– a collaboration with banks for on lending with loan size per bank of USD 15 million allowing banks to offer loans for SE projects.[125] Due to ongoing negotiations in September 2021, no further details could be disclosed. For any parties involved, however, social, and environmental compliance criteria need to be fulfilled, such as labour conditions, rightful land securement without deforestation.[126]

After the completion of a scoping study in fall 2021, UNDP is in the process of setting up a revolving fund with the main objective being acceleration of EE policy implementation through investments of the private sector in EE measures. ADB would be eager to offer financing to the private sector via such a revolving fund and investigates its opportunities under their Sector Development Program (SDP) that is being brought on the way after their work on the EE policy draft with MME. After discussion with key stakeholders including the private sector, the draft for the EE revolving fund was completed by UNDP and handed over for discussion with the energy policy team at MEF. Target for funding are SMEs in sectors indicated in the EE policy draft and the NDC which broadly includes industry. The study proposes fund management by a new legal entity, similar to CGCC, or embedded as special division in existing public units like SME bank or ARDB, hosted by potentially MEF or MME. Seed funding could be sourced from DPs, multilateral institutions such as ADB or WB and credit could be given to EE project owners directly or preferably via partnering FIs, potentially combined

[125] Extension of a previous credit line for improved access to electricity and water, to be extended by EE / RE targets.
[126] KII with AFD Finance, AFD Garment, Proparco

with a guarantee scheme. The seed fund is estimated to materialize by mid-2022 with a dimension of approximately USD 50-150 million, based on an estimated USD 672 million gap for mitigation finance in the energy sector alone, USD 79 million in the industry sector.[127]

As largest development institution that focuses exclusively on the private sector, IFC runs trade finance programs that can bridge the gap between the factories' investment in material for production and the payment made by brands for the order, often allowing generous payment terms up to around 3 months after delivery.

IFC's Global Trade Finance Program (GTFP) offers risk mitigation in the form of partial or full guarantees for confirming banks, covering payment risk on banks in emerging markets for trade related transactions in the private sector. In the fiscal year 2020, GTFP has supported over USD 3 billion in trade in International Development Association (IDA) countries. Better financing conditions may be available for equipment and projects that have climate change benefits as defined by the Climate Smart Trade initiative. This covers RE projects including PV solar panels and solar hot water, EE goods such as EE light bulbs, LED lights and EE Replacement Goods including but not limited to air conditioners, boilers, compressors, electric motors, manufacturing devices, ventilation systems. Proof that the financed good qualifies under international protocols may be necessary.[128]

The IFC Global Trade Supplier Finance (GTSF) program provides short-term financing to suppliers with interest rates based on a combination of their buyers' credit rating and the suppliers' performance on environmental and social standards, giving them access to finance at better terms and incentives to improve their sustainability conditions. IFC works with buyers across industries that source in emerging markets like Bangladesh, Vietnam, Cambodia, Sri Lanka and provides this finance directly via web-based supplier finance platforms or in collaboration with financial institutions. Launched in 2012, the program's volume has exceeded $1.5 billion per year during IFC's financial year 2020 ending on June 30; in Cambodia, the annual financing amounts to around USD 200 million and financing has included equipment upgrades. For the garment sector, Nike, Puma and Levi Strauss & Co. are among the supported supply chain communities that saw increased demand for the program during the pandemic.[129] Such sort-term financing is especially crucial in garment production where factories finance the large cost item material at their own risk in advance.

Besides the more traditional instruments such as debt financing, grants and revolving funds, effective instruments in ASEAN have been loan guarantees, green bonds, specialized funds and blended finance, also utilizing public besides development finance, such as with the ADB initiative Southeast Asia Department Innovation Hub.[130]

### Development Partners

Various development organizations have been involved with the Cambodian garment sector or energy supply, planning and efficiency endeavors in Cambodia over a considerable time and a wide array of projects, whether it be for social compliance and worker empowerment like AFD or ILO BFC for industry development like UNIDO, policy work like ADB, Geres for sustainable energy development, GIZ with their Fabric Asia program, and others.

With their different focuses and perspectives, they have been promoting sustainability in Cambodia in the garment sector in partnership with the

[127] KII with ADB, UNDP; Ministry of Environment (MoE). (2020). *Cambodia's Updated Nationally Determined Contribution.* Retrieved from: Link

[128] International Finance Corporation (IFC). (n.d.). *Global Trade Finance Program.* Retrieved from: Link; International Finance Corporation (IFC). (n.d.). *GTFP Climate Smart Trade.* Retrieved from: Link

[129] KII with IFC; Infor. (2020, October 22). *IFC Surpasses $1.5 Billion in Annual Digital Trade Financing on Infor Nexus Digital Commerce Network.* Retrieved from: Link; Levi Strauss & Co. (2021, July 19). *Supporting Supplier Sustainability with the IFC.* Retrieved from: Link

[130] Asian Development Bank (ADB). (2021, July). *Financing Clean Energy in Developing Asia.* Retrieved from: Link

government or in multi stakeholder collaborations such as UNIDO in its support of MISTI in the development of the Resource Efficiency and Cleaner Production Strategy and Action Plan for Industry and SME 2021 – 2030 through a consultation process with the private sector development partners, industrial associations, UN agencies, academic institutions, financial institutions, such as PwC, local energy consultancy companies like Green Move Consulting and brands such as VFC.[131]

IFC's support to the industry includes engagement through the Better Work program with the ILO that piloted in Cambodia with Better Factories Cambodia (BFC) in 2001. BFC with the goal to improve working conditions by establishing factory assessments by the ILO as a legal requirement for garment exporting factories has been a longstanding and trusted actor, well connected with TAFTAC and its member factories, with brands and collaborating with the Ministries of Labor and Vocational Training (MoLVT) and Commerce (MoC) with plans to eventually transfer the inspection process entirely to MOLVT.[132] As IFC states, analyses based on BFC data show that factories that increased compliance with labor standards have seen significant productivity gains, higher profitability and improved employee retention all of which help "boost the garment sector's competitiveness and sustainability, strengthen its position in global supply chains and further climb to the next level of the value chain ladder".[133]

ILO's Regional Office has emphasized the relevance of environmental sustainability in the new program Decent Work in Garment Supply Chains Asia (Bangladesh, Cambodia, Indonesia, Vietnam) which includes four focus areas as outcomes: Social dialogue, gender equality, productivity and competitiveness and last but not least environmental sustainability through strengthening policy and regulatory guidance as well as tools and knowledge to support eco-innovation and the Just Transition. The project is being implemented by ILO since 2018 with financial support from the Government of Sweden (SIDA). The goal is to link the strength of ILO in social compliance work to environmental compliance in policy work through strengthening regulations, increasing monitoring and enforcement as well as identifying best practices and pathways to enhancement in the four countries. For regulations, Environmental Impact Assessment and Environmental Management are the key systems for strengthening with a focus on support for smaller companies. Workshops are planned to start in Bangladesh and Vietnam before rollout to other countries.[134]

The FABRIC Asia program of GIZ Promoting Sustainability in the Textile and Garment Industry in Asia (2019 to 2023) is active in Bangladesh, Cambodia, Myanmar, Pakistan, Vietnam, and China and cooperates with the private sector, the international buyers. While it also aims at employees and socially responsible working conditions another focus is on solutions in energy, chemicals and (waste) water management to improve resource efficiency and reduce environmental impact of production. Trainings on digital climate protection provide practical methods for factories to calculate and measure GHG emissions.[135] Efforts for recycling and better fabric waste management are being made in Cambodia in collaboration with research institutes and brands such as H&M and VFC.[136]

## 5.2. Assessment of the MGFP by Stakeholders

The synthesized assessment of the MGFP by stakeholders is based on interviews and insights

[131] KII with PwC, VFC; LinkedIn. (2021, September). *Green Move Consulting.* Retrieved from: Link

[132] KII with ILO BFC; Better Work (n.d.). *Better Factories Cambodia.* Retrieved from: Link

[133] Haider, H. (2021, February 25). *Better Factories Cambodia Expands to Include Travel Goods and Bags. Khmer Times.* Retrieved from: Link

[134] KII with ILO Regional Office

[135] GIZ. (2021, December). *Improving Production Conditions in the Textile and Garment Industry in Asia.* Retrieved from: Link; GIZ. (2021, May). *Promoting Sustainability in the Textile and Garment Industry in Asia (FABRIC).* Retrieved from: Link

[136] Fibre2Fashion. (2021, October 19). *Consortium comprising GIZ, Others to Address Textile Waste in Cambodia.* Retrieved from: Link

from brands and buyers, development partners, FIs and DFIs, ESPs and factories, also via TAFTAC. Overall agreement among stakeholders is that it is key to convert the factories' potential perception of any standard or program being an external demand and constraint into a more benefit focused view of it being a worthwhile effort for cost savings, increased productivity, competitiveness, and ultimately profit. The MGFP discussed in the KIIs is deemed achievable depending on the specific modus of implementation in depth, compliance, and timeline, especially in combination with supporting policies as envisioned such as technical extension, linking to finance and potentially fiscal incentives.

As the ILO Regional Office put it, the MGFP can be the realistic pathway to bring the sector forward and create necessary momentum, raising sector wide performance while not requiring unrealistically high international standards such as advanced Higg Index scores throughout the industry.[137]

### 5.2.1. General Concept, Impact and Target Group

From a development partner perspective, a local initiative is attributed a positive effect, but it is known that international buyers are oriented towards international certifications, mainly the Higg Index. Confirming this from the brand and buyer side – the vital perspective on that matter – a local standard would create an indirect benefit to factories in terms of competitiveness: Sustainability conscious brands operate mainly based on internationally accepted standards or they company-own sustainability criteria to evaluate suppliers and to allocate sourcing. In this context, a local label would not act as a replacement in the process but if it contributes to factory and sector capacities in sustainability management and increase the factories' Higg Index score it is seen as relevant and adding business value for factories. Local standards or programs like the MGFP can then increase factories' competitiveness via the respective Higg Index scores in several steps:

- Raising awareness for sustainable production as valuable business opportunity
    - Including compelling scenario analysis to illustrate its impact, showing reduction of energy costs and other business benefits
- Increasing capabilities on factory side for better sustainability management
- Reduce energy consumption and increase EE and SE practices in line with the Higg criteria

Unanimously considered crucial from private sector side for the structure and formulation of the MGFP is consideration of SBTi target indicators (reduction of absolute emissions or emission intensity in Scope 3, i.e., suppliers in the value chain) and even more so the practically mandatory Higg Index with its evaluation and performance levels to avoid burdening factories with an additional compliance system. The motivation behind this now globally established index was synchronization and standardization for factories aiming to improve their sustainability performance. If the MGFP is built in line with the existing evaluation procedures and performance levels, synergies apply, and the direct benefit should become clearer to factories. With better Higg Index performance come concrete benefits in sourcing. These can range from – most commonly – higher volume (GAP, Li & Fung, VFC) to longer contracts up to 5 years or higher value contracts for higher profit on factory side (H&M).

The MGFP will not be of equal relevance to all garment producers in Cambodia. Factories that prefer to cater to local buyers that refrain from any sustainability

[137] KII with ILO Regional Office. With their current project on Environmental Regulatory Systems in the Garment Sector, ILO focuses on 4 key garment producing countries including Cambodia. In contrast to other multi stakeholder initiatives, ILO intends to focus on smaller factories and build relevant capacities there. This is in line with research in Asia by the Textile Eco-Innovation Research Network (TERN) that has shown that smaller, less advanced factories are at higher risk for scaling down and losing direct business or business as subcontractors of larger firms. Supporting best practice environmental regulations involves environmental impact assessment (EIA) and environmental management system, overcoming weaknesses in implementation and monitoring.

standards will try to forego abiding by anything more than the current minimal local environmental compliance criteria that currently focuses more on pollution aspects, especially wastewater treatment and protection of natural waters.[138] A sensible approach for the MGFP can be targeting exporting factories that face increasing compliance requirements from their international buyers; those should have most inherent interest in implementing measures to improve their standing as suppliers. As a first step, putting (mandatory) measurement systems in place is considered a key step by development partners for sustainability developments: Not only for meaningful "before and after" insights but also for comprehensive tracking of sector performance and as reference for improvements along the spectrum of lower-end manufacturing to high end factories that already have advanced systems in place with the medium value segment in-between as the main target group for interventions of the MGFP. Interest is also growing for GHG emissions reporting; if both can be combined in a simple mechanism, streamlining could prove beneficial with regards to the longer-term perspective and eventually establishing an MRV system. Currently, comprehensive energy consumption and efficiency data are not yet available since neither precise measuring equipment nor skilled staff are on site at most factories, also due to cost. Sub-metering would only be accessible at premium factories that have ISO norms such as ISO 140001 in place; the overwhelming majority can only conduct simple overall electric metering and does not follow any ISO guidelines.[139]

The implementation of social compliance via the BFC program through ILO with support from IFC can be an orientation for the introduction of the MGFP. Through mandatory enrollment for exporting factories in the assessment system that evaluates and monitors compliance with ILO core labor standards and national labor laws in the garment sector, brands found it easier to source from Cambodia and BFC improved the positioning of the entire industry within the global competition. Buyers were assured of a compliance system in place that is regularly updated and that indicates breaches or declining standards via the compliance score; the system was made meaningful enough for brands and achievable enough for factories. Such an implementation would mean engaging all factories in the beginning via an onboarding process that is mandatory for existing or registering exporting producers to establish a measuring and monitoring system of key indicators in place for standardized documentation. This would initially focus on recording comprehensive data to capture the status quo and document all future progress made on business and on sector level, only targeting investments as a next step – from potentially mandatory basic measures to more advanced options, allowing for a more voluntary participation due to the cost factor of interventions. However, as experience with social compliance has shown, the mandatory nature of national labor laws is considered a crucial driver in actual realization of improved standards and positioning of the sector. A certain, to be defined, minimum standard that is legally formalized and enforced appears advisable to achieve similar results.

### 5.2.2. Credibility and Timeframe

While collective action from many actors – government, TAFTAC, buyers, factories – is seen as prerequisite to effectively advance sustainable energy practices in the garment sector, there is consensus among KIIs from the development and private sector that a clear authority which is to implement, monitor and control standards and compliance is crucial for success and credibility of the MGFP. Depending on stakeholder category, the preference for governance differs. Generally acknowledged is that the government is to be involved in a key role whether it be focused on providing a clear direction and sustainability targets or additionally engaged in the more practical implementation.

[138] KII with JLC (2019)
[139] KII with ADB, CGTI

- NCSD / MoE deems a joint implementation by MISTI, MME, and MoE as best choice to ensure governmental collaboration on environmental criteria at all relevant ministries.

- Development partners consider implementation and monitoring a challenge but see the government involved in a key role, potentially spread over different ministries, to award the MGFP formal local endorsement and legitimation – combined with further supportive measures in the form of garment industry development and investments.

- Especially brands and buyers describe the ideal scenario as the government providing a clear vision with targets and TAFTAC as industry association as credible and catalysing force in implementation: TAFTAC has the most direct connection to factories and credibly represents their members' best interest which makes them best positioned to convey the business benefits to factories, supported by a concise concept explanation. This would ideally be complemented by a private sector third-party if not for (co-)implementation, then for monitoring and ongoing assessments, in light of capacity constraints at the government level.[140]

H&M brings into play BFC as potential collaboration partner in implementation. As known and respected actor, they have established excellent connections to brands and factories and have an infrastructure in place for their work. While BFC sees the work more as to be focused on social compliance, environmental sustainability is becoming increasingly important also for ILO, as confirmed by the regional office with their current project work on environmental regulatory systems in Bangladesh, Cambodia, Indonesia, and Vietnam. Generally, for potential implementation leads and actors, their capacities also need to be considered in terms of available or to be provided manpower and sufficient background and knowledge.

Imaginable from NCSD / MoE side is also an integration of the MGFP into the environmental impact assessment (EIA) for licensing new factories in order to inform investors early about requirements and benefits. This could include establishing a process including environmental criteria from or even before business set up and licensing. The NCSD strives to continually strengthen its processes, and a collaboration with the Switch Garment project is well considered for a revision of current standards with and opportunity for the MGFP to provide guidance already in the licensing process. With the EIA department moving from its placement under the General Directorate of Environmental Protection to ministry level, it also holds a stronger position to independently certify and issue licenses upon compliance with environmental criteria.[141]

A step-by-step introduction as foreseen by the project with initial awareness raising in the first two years, a period of voluntary compliance in the third to sixth year with an eventual transition to (basic) mandatory compliance between the sixth and eighth year of implementation appears a realistic and sufficient timeline, allowing for communication and capacity building in the initial phases. Priority for compliance can also be given to larger factories as top energy and resource consumers and as those generally with more means to implement sustainability measures.[142] A pilot can also be used as roll out measure with voluntary participation of select factories and clear implementations plans for objective performance improvements.[143] The Switch Garment is already conducting energy audits in collaborating factories as a baseline measurement. Regardless of any pilot, a visible success of factories engaging with the MGFP interventions in relevant competitions that are become increasingly popular, such as the Green Industry Award, can further make the efforts and benefits more visible, provide proof of concept, ideally in connection to the sourcing advantages of these suppliers with international buyers.

[140] KII with adidas, H&M, Puma, SGS, VFC
[141] KII with MoE
[142] KII with CCDE, UNIDO; SWITCH Garment. (2021). Output 1: Policy and Regulatory Measures. Policy Scenarios Discussion Paper.
[143] KII with AFD Garment

Granting enough time for developing domestic capacity organically is preferable to only bringing in experts from abroad for a quick implementation; domestic expertise will be key in keeping the knowledge and standards long-term and also for further incremental raising of standards. These professionals will not only benefit the garment sector but also the general sustainability transition towards higher EE and RE usage, in energy and other sectors.[144]

### 5.2.3. Priority Compliance Areas

The MGFP focuses on the predominant CMT manufacturing in Cambodia that unlike textile production does not involve substantial washing or dyeing. Generally, waste and wastewater with their respective treatment are often pointed to as requiring most attention due their heavy environmental impact but due to the nature of CMT production, the MGFP will focus on energy efficiency and use of renewable energy.

Before equipment retrofits come into play, minor less cost intensive measures can have high impact, considering the status quo with many energy inefficient factories showing large potential for efficiency improvements on a small scale:

- UNIDO case studies have shown the considerable impact of easy, inexpensive fixes to existing systems (better maintenance, prevention of leakage, improvement of insulation, small but crucial repairs) with high, quick returns. Investments such as skylights can reduce energy consumption long-term in a different way than retrofits (see exemplary data in the Annex Chapter 9). Considering energy efficiency when building and planning is usually more efficient than retrofitting, for instance, avoiding oversizing of equipment which can have a negative effect even if energy effective equipment is installed.[145]
- Similarly, Li & Fung sets priority on finetuning the use and operations of existing equipment which can be as simple as checking AC schedules and default modes to prevent excessive or unnecessary settings or installing sensors on lighting which can result in 10-15% energy savings. Only then is the next step identification of equipment replacements for more energy efficient options that require investments. Options for renewable energy sources are the final stage in the screening which reflects priority of energy efficiency over renewable energy.

While some sustainability efforts require investments, they are always considered a good ROI. For H&M, smaller measures, such as improvements to energy efficient lighting or sewing machines, are changes with quick ROI of a few months that aim to 'keep the buyer', especially buyers like H&M that require continuous performance improvements, whereas investments the scale of solar PV are aimed at 'attracting new buyers' with a substantial investment and ROI timeline of around 5 to 6 years.

As a standardized approach, the MGFP is deemed to cover the central areas around energy consumption and energy efficiency. In terms of perceived priority and achievability, a rough order emerged over the interviews of Minimum Energy Performance Standards (MEPS) and Best Available Technologies (BAT), followed by Energy Management (EnM) and Sustainable Energy Sources (SES). The argument behind these priorities was to start with the easier measures and to proceed to the more complex or cost intensive ones with sufficient timelines for adaptation and adjustments for the garment factories.

More details are given below for the respective core compliance areas.

#### Minimum Energy Performance Standards (MEPS)

Considered a familiar concept that is easy to understand for its technical simplicity in implementation and its obvious, immediate benefits. Generally, from the supply side for equipment, advances have been made in recent years in global labeling standards and

[144] KII with ILO Regional Office
[145] KII with CCDE, UNIDO

efficiency of appliances, such as globally standardized boilers, making advanced technology more available and accessible, also to factories operating in Cambodia.[146] When it comes to CMT production, most often cited for impact are the main energy consumption areas AC and ventilation, but also compressors, with mentions for pumping, sewing, lighting. Boilers are considered the most demanding item in this compliance area. While all retrofits will lead to eventual cost savings, boilers might achieve the highest impact but will likely also be the biggest initial investment by unit.[147] Currently used boilers operate to a good share at a poor efficiency of below 40%; especially for them an investment in a highly efficient boiler would have a quick ROI and at the same time reduce wood consumption.[148]

### Best Available Technologies (BAT)

While closely linked and overlapping with MEPS, BATs in their execution are seen as more difficult in that they involve the entire system and process, with a rating based on actual emissions which emphasizes the crucial role of monitoring capacities in-house and monitoring for compliance. In contrast to equipment standards, BAT not only require a certain technology standard but also appropriate management, maintenance and reporting by skilled staff which requires initial and ongoing training. This makes effective implementation dependent not only on a company's willingness and resources to provide internal or external capacities, but also on the local availability of such skilled professionals.

### Energy Management (EnM)

'Energy Management' is part of the broader 'Environmental Management' but for the MGFP, energy will be in focus to reduce the scope of compliance. With both MEPS and BAT, the pace of change is heavily dependent on the uptake of new equipment; this is less the case for energy management, but its implementation can be complex. This compliance area is considered challenging due to the current lack of ability in most factories to put the necessary measuring equipment and procedures in place, requiring a designated skilled specialist – internal or external – capable of implementing and executing the required monitoring and documentation. As this is a generally rare resource in Cambodia, capacity building is needed to better enable compliance for this area. Together with necessary measuring tools and equipment to facilitate sub-metering, cost can also be a factor – the larger and more advanced the factory, the more likely it is that financial and human resources are available, along with an environmental sustainability plan and strategy. Energy Management could be targeted at larger factories first and then trickle down or start with a longer voluntary basis.

ISO 50001 as Energy Management Standard has a narrower focus than the Environmental Management Standard of ISO 14001 and is thus considered a first, more basic step that could serve as minimum requirement. Currently, more than 80% of factories are estimated to not follow any ISO norms at all, based on a training needs assessment conducted by CGTI. ISO 14001 is deemed difficult for factories to achieve but it is also acknowledged that specific ISO norms might not be the key focus for buyers in their requirements unless they are part of their specified criteria or local regulations require them.[149] ISO 14001 is a reference already in the existing Higg Index framework and evaluation: "A facility is advised to follow an internationally recognized EMS standard, for example ISO 14001." World Bank or IFC standards are also mentioned, but the ISO norm is currently the most explicitly indicated in the Higg evaluation.

### Sustainable Energy Sources (SES)

In the Cambodian context, this area is perceived as facing certain obstacles. In the energy mix, there is still a high reliance on fossil fuels and imported

[146] KII with UNDP
[147] KII with UNIDO, UNDP, H&M
[148] Buysman, E. (2018). *Feasibility Study of a Credit-Line Program for Energy Efficiency Projects in Cambodia.* In. Phnom Penh, Cambodia: GERES Cambodia
[149] KII with H&M, JLC (2019), UNDP

electricity from neighboring countries. Combined with high electricity prices and an unreliable supply to end users, especially during dry season, the high potential for renewable energy is apparent, especially for solar PV due to the fact of solar irradiation in Cambodia being one of the best in Southeast Asia year-round. Research by EMC found that rooftop solar can provide economically viable returns for newly constructed residential homes and commercial use in hotels and factories.[150]

However, for **solar PV**, unfavorable policies and regulations are in place and it remains unclear, if and when these could change: Currently in place is a 50% maximum share of self-generated solar energy out of total subscribed electricity demand, a lack of net-metering and change in electricity fee after solar installation combined with a capacity demand charge. On the regulatory side, higher certainty about current and upcoming regulations would provide more investment security. Besides these constraints, the lack of quality standards or certification for solar systems, installation, and maintenance would ideally be addressed from public side. Consistent standards enforced by the General Department of Energy (GDE) would professionalize the sustainable energy sector and boost confidence in its services. Solutions for off-grid solar OPEX models operated by the large established suppliers are becoming more popular but usually come with a minimum installed capacity of around 200kW. Factories also often face additional costs for required initial rooftop strengthening which alters the ROI calculation and has even ended certain projects entirely.[151]

**Solar hot water** in a tropical country like Cambodia requires a relatively higher investment, is more complex and intense to install, operate and maintain to provide the required water quality. The solar option therefore appears less promising in competition against the widely used, already installed boilers running on cheap biomass. Mixing solar hot water with boilers could be an option for which the economic benefits would need to be proven.[152]

For **biomass**, the key issue is the lack of a certification and traceability system for green biomass to ensure sustainable sources. Deforestation is a sensitive issue in Cambodia but for fuel wood, preference is high for natural forest wood that burns well and is cheap, whereas regenerative forest wood can have lesser combustive qualities at a higher price. In the end, the overall cost is assessed to be approximately equal between both options, plantation wood only requiring larger volumes and a certain effort in procurement and handling. According to a study from 2018 and also based on data provided by factories, it is estimated that about 75% forest wood and 25% plantation wood making the lack of certification a key issue.[153] Notably, biomass boilers are considered carbon neutral in the Higg Index evaluation and in that respect might be less in focus.[154] However, a certified source of fuel and specifically of wood as biomass is of relevance to some buyers, e.g., GAP and H&M.

As alternative biomass, rice husk can be difficult to handle in operations or maintenance and with an underdeveloped supply chain, seasonal production, and uncertainty about its cost competitiveness with wood it currently appears not as viable alternative.[155] Generally, different types of biomasses often require their own design at least of the boiler chamber which makes switching more complex. Another issue is fabric incineration in boilers. An average factory could potentially save up to USD 50,000 by burning fabric making it an incentive for cost savings; some factories

[150] Roosmalen, M. (2020). *Policy Memo: Policy Agenda to Promote Behind-the-Meter Solar System in Cambodia.*
[151] KII with UNDP; Emerging Markets Consulting (EMC). (2021). *Market Survey of Energy Product and Service Providers in Cambodia.*
[152] KII with CCDE, UNIDO, UNDP
[153] Buysman, E. (2018). *Feasibility Study of a Credit-Line Program for Energy Efficiency Projects in Cambodia.* In. Phnom Penh, Cambodia: GERES Cambodia
[154] KII with GAP, H&M, UNDP
[155] KII with Green Move; Buysman, E. (2018). *Feasibility Study of a Credit-Line Program for Energy Efficiency Projects in Cambodia.* In. Phnom Penh, Cambodia: GERES Cambodia

might have suitable well-maintained boilers for such use. However, certain brands like H&M ban fabric waste incineration, also because it is not aligned with the circular economy concept. Legal regulations prohibiting burning of (mixed) fabrics have also increased due to concerns about emitted toxins and hazardous pollutants.[156]

As mid- to long-term goal and strategic outlook for beyond 2030 partly brought forward from brands is an eventual switch to electric boilers; latest then, (green) electricity becomes even more important in the mix. However, consideration of steam needs also plays a role for actual feasibility – smaller-scale, decentralized steam consumption is more adequate, efficient, and affordable for a switch than large scale needs.[157]

For the future, Renewable Energy Certificates (REC) and carbon trade are expected to become essential tools in this context. A REC framework is considered necessary which emphasizes the relevance of green electricity in the grid but also opens potential for businesses to monetize their carbon savings. Important would be an internationally agreed upon standard for carbon credits; for instance, with REDD+, one example for a forest carbon credit initiative, there can be problems with the concept (linkage to forest without addressing root causes of deforestation or the different nature of carbon sequestered by trees vs fossil fuels etc.). In general, carbon credits are not required for what cannot be decarbonized but should in any case be considered the last resort after energy efficiency measures and DPPAs.[158]

### 5.2.4. Potential Areas of Resistance and Counterstrategies

While pending regulations and resulting uncertainties for planning are a barrier to change in their own right, the following challenges and potential areas of resistance emerge based on implicit and explicit comments in KIIs, with potential impact on implementation results of interventions:

- For the completely unwilling, any standard as such can create opposition. For those who are oriented towards the Higg Index, any potentially separate, additional procedures will seem a burden.
    - The MGFP should be consistent with documentation and evaluation processes for the Higg Index, to draw on synergies and point out the specific business benefits more easily to factories as advancing in the Higg Index evaluation in order to attract more sustainably minded buyers that often offer more profitable and longer-term contracts against higher environmental standards and efforts. Also, implementation of interventions should not disrupt manufacturing operations.
- Despite the high electricity prices in Cambodia, the share of energy cost out of all production cost is comparatively small in the predominant CMT production. An increase in profit is usually aimed for by increasing material or labor efficiency, rather than decreasing energy consumption.
    - Where cost savings are not the most immediate business case, prospects of more valuable contracts from increasingly environmentally conscious buyers need to be the motivational driver. The positive impact of an investment needs to be demonstrated to factories in a clear enough way and if possible, even be linked to specific advantages or commitments on buyer side.
- The lack of skilled specialists in the factories – either as internal resource or external service – could be a bottleneck to improved sustainability practices unless technical extension can build up skills quickly.

[156] KII with CGTI, H&M
[157] KII with Geres, H&M
[158] KII with H&M, Li & Fung; Kolinjivadi, V. (2015, December 23). *The Problem with REDD+. Post Carbon Institute's Resilience Program.* Retrieved from: Link

- Technical assistance (TA) as foreseen supporting measure for introduction of the MGFP can be a counter measure, not only related to the energy service provider (ESP) sector directly for installation and maintenance, but also to skills within the factory and in the financial sector for appropriate assessment of green financing request from factory or ESP side, depending on CAPEX or OPEX models of sustainability measures. Key is a substantial enough training according to the respective needs to ensure proper and sustained implementation of sustainable energy interventions.

- Complex measures requiring ongoing attention, such as Energy Management systems, face higher potential resistance than simple retrofits that are completed after purchase and installation with only comparatively minor attention required for proper operations and maintenance.
  - Since allocating additional staff and labor is a barrier, this issue could be solved with ESCO model like services or extended services of local ESPs – sufficient technical resources provided. Alternatively, existing staff would need specific training.

- The financial upside of illegal biomass might still outweigh sustainability considerations, at least in the short term, as long as monitoring is lacking, and a sustainable sourcing certification is not in place or ad hoc solutions like the wood recognition scanner by H&M is only accessible to select suppliers.
  - A choice can be made as to whether this is an acceptable compromise for the time being in comparison to other impactful measures, also considering that wood biomass counts as neutral in the Higg Index and wood certification is not equally important to all buyers. Wood could more strongly come into focus at a later stage, potentially when solutions or certificates are more readily available.

- A lack of cashflow and financial buffer might make it difficult especially for smaller factories to cope with sustainability standards if they require advanced technology or more sizeable investments. For solar PV, the current laws and regulations and the corresponding longer ROI timespan hamper a more widespread uptake of renewable energy among factories, especially in light of common short-term business planning of internationally owned factories. Limited access to finance or lack of ESCO business models in Cambodia also make it harder for those willing to implement sustainability measures.
  - A start with smaller, less cost-intensive SE measures can ease the way and act as proof of commitment. With the high impact of solar PV on carbon footprint of production, it can be a key investment to attract new buyers whereas smaller measures with usually quicker returns are made for incremental improvements to keep fulfilling buyer requirements.
  - Support with access to finance can be crucial to enable suppliers to get on the sustainability track, especially for those factories without financing through a larger parent company or ways of accessing cheaper offshore funds.

### 5.2.5. Supporting Measures and Incentives

A holistic approach as planned and in implementation by the Switch Garment project is promising for enabling real uptake, as in offering the whole 'suite' with dialogue, opportunity assessment and energy audit, capacity building and linking to finance with the finance sector part of the collaborative action.[159] Combining this with clear targets and stepwise compliance would enable effective change and impact. The envisioned complementary measurements of technical extension and fiscal

[159] KII with ILO Regional Office

incentives find general agreement from DPs, public and private side; access to finance is also considered a crucial element as lack of finance can be a barrier to sustainable investments, especially for smaller to medium size factories.

Technical assistance (TA) is deemed most essential due to current lack of technical capabilities around SE practices and lack of local staff with sufficient expertise. Training efforts are already in place in the context of Higg Index evaluations but on a select and small scale, whether it be by organizations such as the Sustainable Apparel Coalition (SAC) or consulting and audit providers, mostly in collaboration with brands supporting their suppliers. Ensuring enough skilled staff is crucial since even equipment focused interventions require appropriate operations and maintenance, whether on-site by designated factory staff or via external business services. Skilled local sustainability professionals would be an asset not only for the garment sector but also other industries and the general energy efficiency efforts in Cambodia.

Not only for direct project implementation but also for enabling business services, TA is considered crucial and explicitly requested by FIs; lack of familiarity with green investment projects and lack of understanding of technologies, equipment and potential energy savings result in difficulties assessing loan applications and thus prevent broader scale emanation of green financing. Capacity building on government side as training of trainers (ToT) could be the long-term approach for an eventual hand over of TA to public entities. TA programs should ideally be conceptualized when the most common weaknesses and knowledge gaps are known in order to start with the basic, easier to address changes and have a clear outline of more advanced interventions and all parties involved.

Fiscal incentives such as reduction or exemption of import taxes on energy efficient equipment, like they are already in place for solar panels, are deemed an effective tool – to be discussed with MEF. Or similarly, an investment incentive program with preferential access to tax exemptions or incentives that could apply to those having improved sustainability performance through a certificate or documented changes to energy performance. The initial government stance at NCSD / MoE was a suggestion of (initial) shared funding between development partners such as EU SWITCH-Asia or UNIDO and the government – public budget permitting – to support the targeted goals.[160] The planned Law on Investment can be another crucial catalyzer but can only be expected for the mid-term perspective, potentially coinciding with the MGFP progressing from voluntary to more mandatory implementation, at least for certain minimum standards.

Another barrier to implementation of energy efficiency and sustainability interventions can also be a lack of proper incentives to the financial service providers as enablers; measures beyond much needed capacity building can trigger higher involvement and thus financial policy frameworks should complement regulations on environmental sustainability.[161] As a first step in Cambodia, the MoU between NBC, ABC, CAM and MoE to support sustainable finance and the MoU between NBC, ABC and the American Chamber of Commerce to drive the implementation of Cambodia Sustainable Finance Principle (CSFP) in the business community are preparing the basis and also help address the still existing need for a common understanding of green and sustainable finance in order to grow the landscape of green lending.[162]

### 5.2.6. Potential to Mobilize Finance

#### Brands and buyers

While Li & Fung cautions that brands and buyers should not be counted on for any (substantial) monetary support of factories for sustainability efforts, a few initiatives are reported from brand side:

[160] KII with ILO Regional Office, MoE, UNIDO, UNDP
[161] Asian Development Bank (ADB). (2020, October). *Energy Efficiency in ASEAN: Trends and Financing Schemes.* Retrieved from: Link
[162] KII with ABC, NBC

- GAP has an upcoming program with GAP funds supporting investments in RE projects for factories that show strong initiative and performance. Evaluating pilot countries based on current national regulations, this project is planned to start in Vietnam, China, and India.

- H&M has launched a Green Investment Fund at the end of 2021 to mobilize finance within the company to work with suppliers. The form of investment – co-financing, acting as guarantor or lending to factories – will be determined on a case-by-case basis and is aimed less at the larger top performers, more the 'middle level' of suppliers that show high sustainability commitment and improvement but face financing limits. Out of the 14 production countries H&M is working in, Turkey and India were chosen as main roll out countries. While in principle factories in Cambodia are also eligible as long as they show enough commitment, the sheer proportion of factory numbers will make this less likely in the near future – H&M works with 25 factories in Cambodia vs around 1,000 in India.

If not direct finance support for investments, other means of support can be in sponsoring trainings or capacity building programs for sustainability minded suppliers or EE and SE assessments as starting point for the most effective measures as Puma appears to do. Other supportive measures can be quick payment modalities to improve cashflow on factory side, as VFC has implemented as default measure and especially reinforced during times of the pandemic.

### DFI related instruments

From the perspective of DFIs, the Switch Garment project and the role of the MGFP are of interest for mobilizing finance and for potentially getting involved.

**Proparco** could get involved further in the garment and SE sector, sufficient market size and suitable projects allowing, either through direct financing or through collaborating FIs that have a strong enough financial statement and ideally are familiar with the sector in question. For larger endeavors above USD 50 million, co-financing with another DFI has been a preferred mechanism. Proparco can consider technical assistance as part of the project support, such as covering a share of factory expenses required to reach certain required performance standards. Precondition is a careful screening of factories and ESPs; social and ecological criteria need to be ensured, for instance compliance with labor laws or confirmation that current land use did not require eviction of households or deforestation. Proparco usually works with collateralized loans, but equipment can be considered as form of collateral; their portfolio guarantee tool can come into play for financing. As part of the credit assessment, the MGFP can mean a better chance to access financing, provided it proves a suitable and appropriate tool for raising the environmental performance of factories.[163] If the MGFP is led by the government or in a form of public private partnership (PPP), **AFD** is also a potential funder due to their interest and previous work in the garment sector.[164]

**Mekong Strategic Partners (MSP)** is already active in green financing in Cambodia and is currently setting up a Green Financing Institution (GFI) capitalizing on USD 100 million of Green Climate Fund (GCF) resources for long-term debt financing for sustainable projects in Cambodia. In the four key sectors eligible for funding – RE, EE, Sustainable Agriculture and Water Infrastructure – a partnership is foreseen with Switch Garment to finance ESPs or eventually ESCOs for their services to the garment sector. The largest gap in financing has been identified as the project bracket from USD 50,000 to 300,000, loans that fall in-between small scale, commonly MFI served projects and larger investments, commonly financed directly by large solar PV providers or through group or offshore financing when it comes to garment sector clients. While the credit assessment process and criteria have not been defined in detail, a standard

[163] KII with Proparco
[164] KII with AFD Finance

such as the MGFP can be a useful instrument for prequalifying applications. Since the GCF provides the funds, the screening is also subject to IFC criteria, meaning the investment must demonstrate GHG emissions reduction or climate benefits for EE section projects.

Once the **UNDP** EE Revolving Fund materializes – planned for mid-2022 – and with potential funding from ADB in distribution by partnering FIs, the MGFP can be of positive impact for mobilizing finance for factories as standards can enhance attractiveness and effectiveness of the business case as bankable project. For the fund, a strong project pipeline in the target industries is also important as it makes the case for feasibility of the fund; the MGFP would feed into the market and needs in that regard. ADB under the Energy Efficiency (EE) Sector Development Plan (SDP) will not lend money directly to the private sector, but if the EE revolving fund is established, loans could be extended via the fund. However, specific details, processes and eligibility or selection criteria have yet to be established.[165]

**3i**, an Australian Aid program that invests in infrastructure including water and energy, is also interested in getting more involved in energy efficiency projects, the right opportunities provided.[166]

The **IFC** programs Global Trade Supplier Finance (GTSF) for short-term financing and improved cashflow or the Global Trade Finance Program (GTFP) with special conditions for financing sustainable projects could be applicable for financing and scaling up finance, for instance with a guarantee structure for funding of the MGFP interventions. However, while IFC offers these programs in Cambodia and engages in the garment sector via support of the ILO initiative Better Factories Cambodia, reservations remain due to concerns about working conditions not yet fulfilling all necessary IFC criteria and standards.

Generally, for implementing financing instruments in collaboration with the private sector, certain implementation mechanisms can be beneficial. For instance, in the case of a guarantee structure as insurance against factories defaulting on loans, it should be ensured that banks feel and take certain risks rather than getting negligent; a first loss guarantee could be a good middle ground. Bundling of projects can also help mitigate risks by diversification as it is less likely all projects will fail. This can be an efficient approach for management of risk and effort, with only slightly higher prices allowing for certain share of default which is especially suitable for a country like Cambodia with only limited possibilities of financial auditing of companies. Such mechanisms can not only improve access to finance but also support development of ESCO type business models since they reduce the uncertainty and perceived risk with regards to factory solvency.

### Mobilizing finance in the garment sector in other countries[167]

#### Bangladesh

As an example, for a multi-partner financing initiative in garment producing country Bangladesh, PaCT (Partnership for Cleaner Textile) launched in 2013 to facilitate eco-friendly textile production by supporting the entire textile value chain – spinning, weaving, wet processing, and garment factories in adopting Cleaner Production (CP) practices. Led by IFC, the initiative is working with global apparel brands, such as Puma, Levi's and Gap, technology suppliers, textile factories, government, BGMEA (Bangladesh Garment Manufacturers and Exporters Association) as well as financial institutions. PaCT's integrated finance approach supports FIs in evaluating resource efficiency measures and developing suitable (blended) finance products for better access of factories to funding. Examples of existing partners are

[165] KII with ADB, UNDP

[166] KII with 3i

[167] This section only list select individual examples and does not aim to provide a comprehensive overview of financing projects and possibilities.

BRAC Bank Ltd. and IDLC Finance Ltd. with tailored loan products that include technical and advisory assistance. Since inception, PaCT has supported 381 factories with on-site assessments and advice on sustainability solutions, with investments of USD 110 million made, energy savings of 3.2 million MWh per year achieved and 618,779 tons CO2 eq/year of GHG avoided, besides reduction of water and wastewater. Typical investments to implement equipment upgrades and new machinery are in the range of USD 100,000 to USD 250,000 or up to USD 1.5 to 2 million with flexible tenors and often short payback periods due to substantial savings achieved.[168] Only the conditions to obtaining such funding can be restrictive, especially for smaller or medium sized factories. Factories also wish for better incentives for these costly interventions.[169]

PaCT's advocacy also helped creating a USD 200 million Green Transformation Fund (GTF) in 2016 that the government of Bangladesh uses to offer concessional financing for environmental sustainability measures in the textile industry. The fund is handled by Bangladesh Bank that offers loans to scheduled banks for on-lending to borrowers, mainly for technology and machinery to increase sustainability in water and waste management, energy efficiency, renewable energies and also for improvements of the work environment. Involved banks must have appropriate capacity for loan appraisals (including environmental and social assessment) and adequate internal audits and controls.[170]

### Vietnam

A renewable energy pilot in Vietnam's apparel sector by Apparel Impact Institute (Aii), the Clean Energy Investment Accelerator (CEIA), IDH – The Sustainable Trade Initiative together with major brands and select suppliers introduces an aggregated procurement approach to increase benefits and thus facilitate greater use of rooftop solar in the garment industry. Emitting one joint RFP for several manufacturers and using a standardized approach for site evaluation means time and cost savings for factories; it also opens renewable energy options to suppliers that might have been too small or under-resourced to negotiate and obtain suitable power purchase agreements (PPA) on their own. Solar vendors only need to negotiate once for several pre-vetted customer sites and have access to better financing options through economies of scale. Best practices of this pilot are to be shared to enable further replication in Vietnam and other countries.[171]

### Other examples

IFC is also involved in Puma's Forever Better Vendor Financing Program that helps suppliers bridge the gap between producing and receiving payment by selling their invoices to a funding partner, such as HSBC, BNP Paribas, Standard Chartered or the International Finance Corporation (IFC) and receive their payment within 5 days. While in the year of launch in 2016 only about USD 100 million were financed through this program, the amounts rose to about USD 200 million in 2019 and sharply increased to USD 580 million in 2020. In the first six months of 2021, financing volumes reached USD 322 million. If the supplier is rated "A" in Puma's sustainability audits, it will get more favorable terms on these transactions, providing incentives for further sustainability improvements. In 2021, the program was expanded with insurance partner Chubb to better terms for product liability insurance.[172]

To overcome obstacles in in sustainability financing, some more advanced economies have adopted

[168] Building on the success of PaCT, this program has been scaled all over the world. PaCT Partnership for Cleaner Textile. PaCT (n.d.), *Doing More with Less.* Retrieved from: Link

[169] The Business Standard. (2022, January 30). *Inadequate Policy Support Slowing Down Green Transition.* Retrieved from: Link

[170] Leathergoods And Footwear Manufacturers & Exporters Association of Bangladesh. (n.d.). *Bangladesh Bank to Set up $200 M Green Transformation Fund.* Retrieved from: Link

[171] Apparel Impact Institute. (n.d). *Renewable Energy Pilot Launch in Vietnam's Apparel Sector.* Retrieved from: Link

[172] Catchup. (2021, November 11). *Forever Better Finance and Insurance.* Retrieved from: Link

financing schemes targeted towards energy efficiency, e.g., Thailand provides grants, loans, equity, and guarantees for implementing EE projects as well as capacity building for local banks that issue soft loans with minimum interest rates for EE projects. In Malaysia, the Energy Performance Contracting (EPC) fund grants loans with interest rebates and provides loan guarantees to eligible EE projects in the building sectors to help overcome capital shortage faced by the ESCOs.[173]

# 6. Impact Assessment Model

## 6.1. Key Messages

Energy consumption for garment manufacturing represents a key cost item. While not representing the largest share in production cost, challenges emerge in relation to price volatility and policy risk in relation to the possible introduction of measures to reduce air pollution and greenhouse gas (GHG) emissions

We have analyzed the likely outcomes of (i) implementing retrofits that would improve energy efficiency and (ii) increase generation and use of renewable energy from solar PV.

We find that the adoption of energy efficiency equipment reduces energy consumption and costs (on average by 18.8% in 2030, across 12 products, when the full ambition is reached), and results in higher profit, with a short payback time of 3 years. Similar results emerge for solar PV, with cost reductions of 6.3% when 40% of electricity needs are produced with on-site solar PV, but higher savings could be achieved if the ambition were to be higher (e.g. we forecast a 22.1% cost saving when each factory invests in 850 kW of power generation capacity, regardless of the size of the factory). When solar PV capacity is purchased and installed on-site, the payback time is 7 years. On the other hand, when relying on a Power Purchase Agreement (PPA) for the use of renewable energy the cost of energy increases by 3.8%. Overall, solar PV shows a mixed picture, with benefits being accrued with the purchase of solar PV infrastructure and with larger installations (e.g. if only 10% of electricity consumption would come from solar PV, the cost of energy would increase by 12.7% with the purchase of solar infrastructure and by 15.2% with a PPA, as opposed to observing a cost reduction as mentioned above), as a result of the current electricity pricing mechanism. This is a disincentive for smaller investments, which would result in higher electricity spending.

[173] Asian Development Bank. (2020, October). *Energy Efficiency in ASEAN: Trends and Financing Schemes*. Retrieved from: Link

As a result of reduced energy costs (both from efficiency improvements and solar PV) the unit and total cost of production decline by 1.1% on average across all products analyzed. This results in higher profit, with a considerable average increase for companies that operate with a margin in the range of 1-2% (i.e. high value brand products by 2035 could see an increase of profit of 92.2%, 100.9% for medium brand value, and 74.2% for low brand value products, the ones with the lowest energy cost per unit produced); for companies that operate with a higher margin, in the range of 30%, the increase in profit is smaller (i.e. high value brand products by 2035 could see an increase of profit of 3.3%, 0.8% for medium brand value, and 1.8% for low brand value products). These values could be even larger if the retrofits result in an improved working environment that stimulates labor productivity and reduces waste/rework. On the other hand, we did not consider these outcomes in the quantitative analysis performed.

Having reviewed the outcomes of investments, and their economic viability, it is worth mentioning that the annual cash flow of factories can be considerably impacted by the interventions analyzed, in the year of the investment. Specifically, retrofits do not impact cash flow considerably, because the savings are larger than the investment, and the investment is phased over 8 years. Solar PV is assumed to be implemented as a 1-time investment, and it is a large investment, implying that the net cash flow is negative in the year of the investment, but turns positive and higher from the year in which solar PV is operational (i.e. the year after the investment is made). Considering all products, and the same ambition for solar PV across all products/factories (40% of electricity needs), the cumulative investment in PV reaches $ 3.5 Million while the investment of energy efficiency $2.27 million. To put these values into context, they represent about 10% of the profit estimated for the period 2022 – 2032, next 10 years.

These results show that the economic competitiveness of factories will increase, i.e. cost reduction will result in higher profits and profit margins. Two possible outcomes are envisaged: (1) factories reduce prices to become more cost competitive and gain market share (this could be envisaged especially for low value brands and products) or (2) resources are used to invest and increase production quality, migrating to higher quality products and brands, and better contracts. Either way, this would be an improvement for the garment sector of Cambodia.

Worth mentioning, reduced reliance on carbon intensive fuels will reduce the vulnerability of factories to volatile fossil fuel prices, and to the potential introduction of carbon taxes either in Cambodia or internationally. This will increase economic resilience, and generate a competitive advantage for Cambodian factories, and possibly for the whole garment sector if the standard is mandated at national level, in relation to international competitors.

If we were to expand these results to the garment sector, comprising approximately 600 factories, and considering 20 factories for high value production, 150 for medium value, and 400 for low value (570 factories in total), 1.9 million tons of GHG emissions could be saved each year, or approximately 12% of annual emissions at the national level (and 54.3 million tons cumulatively by 2050). As a result of investments in solar PV, 5,600 jobs could be created to manufacture and install the new power generation capacity, and 200 jobs for operation and maintenance.

Given the positive outcomes emerging from the improvement of energy efficiency and the expansion of power generation from solar PV, investments in these areas should be promoted and phased in over time. Our scenarios consider 2030 as the target for full adoption, to account for the lifetime of equipment and support a gradual but steady transition. Incentives could be introduced to reduce the capital cost of investments, for those factories lacking resources of access to capital, while at the same time bottlenecks should be removed to unlock virtuous investment, especially considering the short payback time and high internal rate of return (IRR) of many retrofit options. The introduction of concessional loans and tax rebates are examples of the former, while modification of the current solar power tariff would be an example of the latter.

## 6.2. Scenario Assumptions

### 6.2.1. Factory Profiles

The factory characterization presented in Error! Reference source not found. was used to customize and parametrize the models for the 12 products considered. We represent three types of value additions, considering four products for each high, medium and low value brands. We also consider that factories producing high value products are normally larger in size (3,000 workers), and factories producing low value products are normally smaller (750 workers). Finally, for the extrapolation of model outcomes to the garment sector, we consider 20 factories for high value production, 150 for medium value, and 400 for low value (570 factories in total).

*Table 13: Overview of Factory Archetypes and Profiles Utilized for Model Parametrization*

| Value Addition | Main Brands (Examples) | Factory Size | Product 1 Summer | Product 2 Summer | Product 1 Winter | Product 2 Winter |
|---|---|---|---|---|---|---|
| **High** | Adidas, Nike, Puma | Ø 3.000 Workers | Sportswear Functional T-Shirt<br>Share: 65% | Sportswear Short Pants<br>Share: 35% | Sportswear Knit Light Sweater<br>Share: 50% | Sportswear Long Pants<br>Share: 50% |
| **Medium** | H&M, M&S, A&F, GAP, Zara | Ø 1.500 Workers | Woven Pants light<br>Share: 40% | Woven Blouse<br>Share: 60% | Woven Pants warm<br>Share: 60% | Woven Jacket<br>Share: 40% |
| **Low** | Walmart, Lidl, Target, Primark, Costco, Auchan | Ø 750 Workers | Women's panties<br>Share: 70% | Women's bra<br>Share: 30% | Women's nightgown<br>Share: 50% | Women's pajama<br>Share: 50% |

### 6.2.2. Ambition for Energy Efficiency and Renewable Energy

Several scenarios have been created to assess the outcomes of improved energy efficiency and renewable energy generation on the economic viability of the garment sector of Cambodia.

First, a Business as Usual (BAU) scenario was created, assuming that historical trends will continue. This implies the no changes are expected in energy use for unit of production, and that carbon taxation will not be introduced.

Second, an energy efficiency (EE) scenario was created. This scenario assumes that all equipment for (i) compressed air, (ii) lighting, (iii) sewing, (iv) steam (from biomass, electricity and liquid fuel), (v) ventilation is upgraded by 2030. An incremental, linear effort is assumed, considering that current equipment will be progressively replaced, depending on vintage of the current stock (i.e. the older equipment will be replaced first, and the one purchased more recently will be replaced just before 2030). The energy efficiency improvement assumed is as follows: compressed air (24%), lighting (40%), sewing (50%), steam from biomass (42%), electricity (0%) and liquid fuel (0%), ventilation (24%).

Third, the expansion of renewable energy generation from solar PV is assumed in the "Solar PV" scenario. Solar PV is introduced in one year, 2030. Two main

outcomes emerge. On the one hand, the purchase of electricity from the grid will decline; on the other hand, the unit price of electricity purchased from the grid will increase (as per national law). Further, we assume that, for the portion represented by solar PV, two business models are considered: (a) purchase of solar panels and inverters by the factory or purchase of electricity from an energy service company. The difference is purely economic, with the capital cost being sustained by the garment factory in the first option and by the energy service company in the latter. Finally, it is assumed that 40% of the electricity required will be supplied using solar PV capacity, with the same value used for each and all products. Alternative simulations have been tested, considering both 10% of the electricity needs being produced with solar PV, and a fixed investment of 800 kW of solar PV by each factory (a small amount for large, high value factories, and a large amount for small, low value factories.

Fourth, the energy efficiency and solar PV investments are combined. The two business models for solar PV are considered separately: one scenario uses the power purchase option for solar PV; the other scenario considers instead full investment by the factory.

This gives us 6 scenarios simulated with the model, and presented in the next sections:

1. Business As Usual (BAU)

2. Energy efficiency (EE), with linear effort and the standard reached by 2030

3. Solar PV (with power purchase agreement), with installation in 2030

4. Solar PV (with full capital cost for panels and inverter), with installation in 2030

5. Energy efficiency + Solar PV (with power purchase agreement)

6. Energy efficiency + Solar PV (with full capital cost for panels)

The following sections provide an overview of the results generated with the model, by product, brand value and across the whole garment sector. Results for scenarios 2, 4 and 6 are presented next, representing extreme assumptions (i.e. full cost for solar PV, resulting in the worst short term performance, by 2030) and hence providing information on the best and worst possible outcomes among the scenarios generated.

## 6.3. Summary of Results

The improvement of energy efficiency and the increase of power generation from solar PV generate several outcomes for garment manufacturing. The outcomes presume that all factory types across high, medium, and low value segments adopt the respective energy efficiency or renewable energy measures and throughout the same timeframe.

First, energy consumption and energy costs decline when energy efficiency improves. Error! Reference source not found. shows that, across all products, the improvement of energy efficiency results in a reduction of energy costs of 18.8% by 2030, when the full ambition for energy efficiency is reached.

Second, adding solar PV has mixed economic outcomes, depending on the amount of solar PV installed or purchased. Overall, as shown in Error! Reference source not found., energy costs decline on average by 6.3% when solar PV is considered, despite the higher electricity costs for electricity purchased from the grid. This brings the energy cost (both total and per unit of production) lower by 2031, to a level that is 23.5% smaller than in the BAU case, for all measures of EE and solar PV combined. The cost reduction of 6.3% emerges when 40% of electricity needs are produced with on-site solar PV. On the other hand, when relying on a Power Purchase Agreement (PPA) for the use of renewable energy the cost of energy increases by 3.8%. Further, when the ambition is reduced to 10% of the electricity needs, the cost of energy would increase by 12.7% with the purchase of solar infrastructure and by 15.2% with a PPA, as opposed to observing a cost reduction as mentioned above. This is due to the current electricity pricing mechanism, which represents a disincentive for smaller investments and small factories since they may have less cash available or face difficulties accessing financing due to their low value of production and low profit margin.

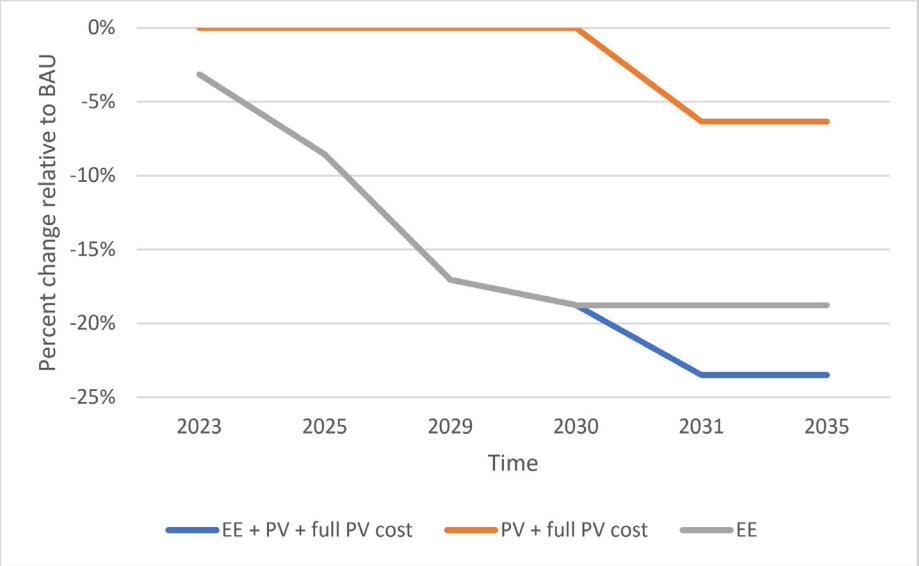


*Figure 2: Unit Energy Cost, Average Change Relative to BAU, Across All Products*

As a result of reduced energy costs (both from efficiency improvements and solar PV) the unit and total cost of production decline. Error! Reference source not found. shows that production costs would decline by 0.9% as a result of energy efficiency improvement, and by 0.3% when considering solar PV investments. Overall, the combined reduction of production costs reaches 1.1% across all products, after 2030. This reduction is smaller than the energy cost reduction, given that energy is only one of the components making up production costs.

*Table 14: Unit Production Cost, Average Change Relative to BAU, Across All Products*

| | 2023 | 2025 | 2029 | 2030 | 2031 | 2035 |
|---|---|---|---|---|---|---|
| **Scenario 6** | -0.1% | -0.4% | -0.8% | -0.9% | -1.1% | -1.1% |
| **Scenario 4** | 0.0% | 0.0% | 0.0% | 0.0% | -0.3% | -0.3% |
| **Scenario 2** | -0.1% | -0.4% | -0.8% | -0.9% | -0.9% | -0.9% |

Overall, the outcome for the operating result (i.e. profit before taxes) and value added (i.e. profit after taxes) are positive, with an average payback time (across all products and all investments) of less than 3 years for energy efficiency and 7 years for the purchase of solar PV infrastructure.

The annual profit for all products, assuming that all the investments simulated are accounted for in the balance sheet in the year in which they occur (i.e. amortization is not considered) declines in the year of the investment, to then increase and more than offset the short-term decline (Figure 3). In the case of energy efficiency, a decline is observed in 2023, in the range of 6.1%. The value turns positive at 17.2% by 2025, 60.1% higher by 2030 and 71.2% higher by 2035. Solar power adds a small, but yet positive impact in the longer term (+24%), but also a much larger investment in the short term. When all investments are sustained by factories, the profit after taxes in the year 2030 is expected to be 220% less than in the BAU case, or negative (i.e. net loss for that specific year). The large change in profit after taxes forecasted post 2030, in spite of a small change in production cost, highlights the small profit margin that characterizes the garment sector in Cambodia. To present differences among products, the average increase is high for companies that operate with a margin in

the range of 1-2% (i.e. high value brand products by 2035 could see an increase of profit of 92.2%, 100.9% for medium brand value, and 74.2% for low brand value products, the ones with the lowest energy cost per unit produced); for companies that operate with a higher margin, in the range of 30%, the increase in profit is smaller (i.e. high value brand products by 2035 could see an increase of profit of 3.3%, 0.8% for medium brand value, and 1.8% for low brand value products). These values could be even larger if the retrofits result in an improved working environment that stimulates labor productivity and reduces waste/rework. On the other hand, we did not consider these *outcomes in the quantitative analysis performed*.

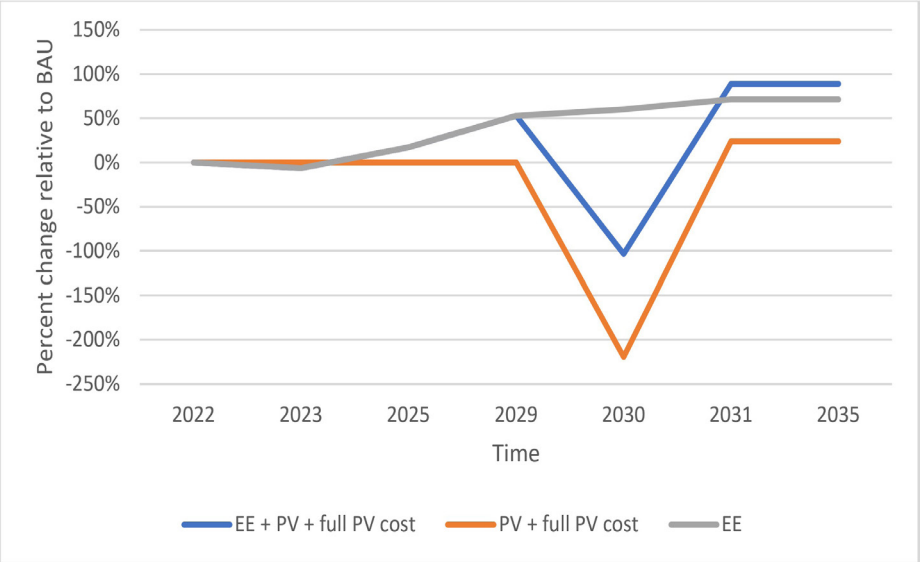


*Figure 3: Profit, Average Change Relative to BAU, Across All Products for Companies with Small Profit Margin (1-2%)*

Having reviewed the outcomes of investments, and their economic viability, it is worth mentioning that the annual cash flow of factories can be considerably impacted by the interventions analyzed (when considering that investments are not amortized over a period of time, and that solar PV infrastructure is acquired, instead of relying on power purchase agreements). This was mentioned earlier in relation to the impact of solar PV investment in the year 2030 and Figure 4 presents a comparison between energy efficiency and solar PV. Considering all products, and the same investment in solar PV across all products/factories, the cumulative investment in PV reaches $3.5 Million while the investment of energy efficiency $2.27 Million. The main difference, as shown in the figure is that the energy efficiency investment accumulates over a period of 8 years, while the one for PV takes place in a single year.

The average investment per factory is estimated at $1.5 Million for energy efficiency and $2.4 Million for solar PV in the case of high value factories (resulting in a total of $78 Million for 20 high value factories in the country); $480,000 for energy efficiency and $700,000 for solar PV in the case of medium value factories (resulting in a total of $177 Million for 150 medium value factories in the country); $235,000 for energy efficiency and $342,000 for solar PV in the case of low value factories (resulting in a total of $230 Million for 400 low value factories in the country). The total investment required countrywide may then reach $485 Million by 2030.

The cost by technology is similar across energy service and related equipment. We find that the highest cost item is represented by sewing (representing 33% of the total retrofit cost); the lowest cost is found for compressed air (3% of the total cost). The other options are comparable, with 15% of the cost for lighting, 13% for ventilation, and 12% for each of the three steam options (biomass, electricity and liquid fuel).

Worth considering, emissions decline when energy efficiency and solar PV are introduced. The contribution of energy efficiency is 26.6% by 2030, while solar power reduces emissions by 7.7% for the

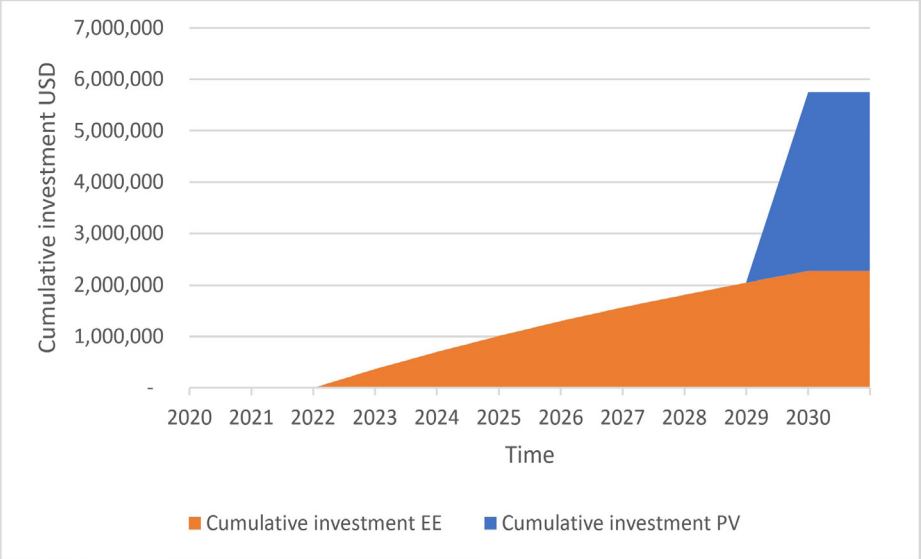


*Figure 4: Cumulative Investment, Energy Efficiency and Solar PV, Across All Products*

amount considered (40% of electricity needs being supplied by solar PV). Overall, when both investments are considered, emissions decline by 32.3% in 2030, which is a considerable amount when taking into account that economic profitability also increases as a result of the same investments.

*Table 15: Energy Emissions, Average Change Relative to BAU, Across All Products*

| | 2023 | 2025 | 2029 | 2030 | 2031 | 2035 |
|---|---|---|---|---|---|---|
| **Scenario 6** | -4.5% | -12.2% | -24.1% | -26.6% | -32.3% | -32.3% |
| **Scenario 4** | 0.0% | 0.0% | 0.0% | 0.0% | -7.7% | -7.7% |
| **Scenario 2** | -4.5% | -12.2% | -24.1% | -26.6% | -26.6% | -26.6% |

If we were to expand these results to the garment sector, comprising approximately 600 factories, and considering 20 factories for high value production, 150 for medium value, and 400 for low value (570 factories in total), 1.9 million tons of GHG emissions could be saved each year, or approximately 12% of annual emissions at the national level (and 54.3 million tons cumulatively by 2050). As a result of investments in solar PV, 5,600 jobs could be created to manufacture and install the new power generation capacity, and 200 jobs for operation and maintenance.

Importantly, the reduction of emissions reduces the prominence of climate policy risk: the introduction of carbon pricing measures. If we were to consider the introduction of carbon pricing in the range of $30/ton of GHG, a value aligned with the global social cost of carbon and with the ambition of several countries, without changing the current level of consumption and with the energy sources currently used, most products would incur losses and would not be economically viable in Cambodia. This is due to the low profit margin characterizing most products nowadays. Specifically, only two products (1, sportswear functional T-shirt and 7, woven pants) would still be profitable with a carbon tax of $30/ton, due to their profitability and relatively small energy use. Among all others, the lower value products are the ones most impacted. On the other hand, the introduction of energy efficiency improvement and solar PV makes so that, even with the carbon tax implemented, all products are economically viable and generate profits.

As indicated above, when it comes to a move to action, different business models could be considered. In the context of energy efficiency, a phase-in of new equipment has been considered over the course of the next 8 years. In relation to solar PV, the possibility to invest in power generation capacity, or the purchase of electricity via a power purchase agreement have been analyzed instead. The differences for Solar PV are important: a power purchase agreement eliminates the short-term investment, but reduces the medium- and long-term cost saving for electricity consumption (i.e. the levelized cost of on-site power generation is lower than the price paid to an energy service company, and this in turn is lower than the market price of electricity from the grid). Specifically, the power purchase agreement would result in an average reduction of profit of 14.4% after 2030 when considering 40% solar PV use, as opposed to an increase of 24% when the full investment is implemented by the factory.

Further, the introduction of solar PV and the adoption of energy efficiency are expected to create additional jobs. On the side of solar PV, literature shows that solar PV is more labor intensive than hydropower and thermal power generation.[174] When considering coal specifically, as a proxy for thermal power generation, manufacturing is 1.3 jobs/MW more labor intensive for solar PV, construction and installation is 1.8 jobs/MW more labor intensive and operations & maintenance (O&M) is 0.54 jobs/MW more labor intensive. Even when considering only O&M, if production capacity is purchased from abroad, investments in solar PV are going to generate more local jobs. From our analysis, when considering 40% of electricity consumption being provided by solar PV and scaling up the analysis to 570 garment factories in the country, 5,600 jobs could be created to manufacture and install the new power generation capacity, and 200 jobs for operation and maintenance.

Finally, the reduction in the use of fossil fuels and biomass, via energy efficiency and renewable energy, also supports households and the government. This is due to the improvement of air quality, via the reduction of air pollution. With the current level of energy consumption and fuel mix, the garment sector is generating societal costs for health, and these costs are estimated to be higher than the economic benefit created (e.g. USD 2.6 million for the three factories considered across all 12 products, as compared to USD 1.9 million in profits). Specifically, in the BAU scenario the health cost caused by PM2.5, nitrogen oxides and ammonia is larger than the profit generated by garment factories by 30%, with the cost assumptions utilized (Gilmore, et al., 2019). On the other hand, if we improve energy efficiency and increase the use of renewable energy, the cost of air pollution may decline considerably (e.g. down to USD 1.88 million for the three factories analyzed), resulting in the garment sector generating a net economic benefit when considering the increase in profit resulting from retrofits and solar PV. In fact, when retrofits and solar PV are combined, health costs decline by 26%, to represent approximately 50% of the profit of the factories and products considered. Concluding, implementing retrofits and increasing the use of renewable energy is positive for factories, as well as beneficial for society. The results present above highlight the incentive for investing in energy efficiency and renewable energy, and for promoting the adoption of a harmonized standard: on the one hand, the investments analyzed generate higher profitability, already in the short term; on the other hand, the investments analyzed reduce the risk of future climate action (either in Cambodia or internationally, see the EU Carbon Borden Adjustment Measure, CBAM) by reducing emissions. Further, advantages emerge at the societal level also, with a reduction of air pollution and related health cost for both households and government. The implications of this scenario are not negligible, because economic resilience results in job creation (as opposed to job losses) and improved competitiveness of the garment sector in Cambodia (as opposed to outsourcing and migration of the sector to neighboring countries that have higher access to renewable energy and energy efficient equipment).

The following tables present results by product, with

[174] Rutovitz, J., Dominish, E. and Downes, J. 2015. Calculating global energy sector jobs: 2015 methodology. Prepared for Greenpeace International by the Institute for Sustainable Futures, University of Technology Sydney.

the aggregation by brand value being the following: product 1-4 (high brand value), product 5-8 (medium brand value), product 9-12 (low brand value).

Error! Reference source not found. highlights the contribution of energy efficiency and solar PV to profit. In this respect, retrofits offer a stronger contribution to cost reduction and hence profit increase. Products 1, 5 and 10 are clear examples, with retrofits resulting in 3x more profit than solar PV. Energy and production cost reductions are identical for all products, as presented in the following two tables, as a result of the use of the same level of ambition for all factories. For this reason, only the results for Product 1 are presented. Similar results are observed for emissions, with no change across products, but with a larger contribution to emission reduction from retrofits than solar PV. Table 8 presents instead the results for air pollution, where a clear difference is visible for energy efficiency (affecting all energy use) and solar PV (affecting only air pollution from power generation).

*Table 16: Profit Relative to BAU, by Product and Scenario, Factories with Low Profit Margin (1-2%)*

| Time (Year) | 2022 | 2023 | 2025 | 2029 | 2030 | 2031 | 2035 |
|---|---|---|---|---|---|---|---|
| **Product 1 - sportswear functional t-shirt** | | | | | | | |
| Scenario 6 | 0.0% | -6.3% | 24.3% | 71.0% | -134.2% | 116.9% | 116.9% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -288.0% | 31.5% | 31.5% |
| Scenario 2 | 0.0% | -6.3% | 24.3% | 71.0% | 80.4% | 93.4% | 93.4% |
| **Product 2 - sportswear short pants** | | | | | | | |
| Scenario 6 | 0.0% | -9.8% | 16.8% | 57.4% | -121.1% | 101.7% | 101.7% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -250.6% | 27.4% | 27.4% |
| Scenario 2 | 0.0% | -9.8% | 16.8% | 57.4% | 65.7% | 81.3% | 81.3% |
| **Product 3 - sportswear knit light sweater** | | | | | | | |
| Scenario 6 | 0.0% | -6.5% | 13.1% | 43.1% | -88.6% | 75.1% | 75.1% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -184.9% | 20.2% | 20.2% |
| Scenario 2 | 0.0% | -6.5% | 13.1% | 43.1% | 49.2% | 60.0% | 60.0% |
| **Product 4 - sportswear long pants** | | | | | | | |
| Scenario 6 | 0.0% | -4.5% | 15.1% | 45.1% | -86.6% | 75.1% | 75.1% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -184.9% | 20.2% | 20.2% |
| Scenario 2 | 0.0% | -4.5% | 15.1% | 45.1% | 51.2% | 60.0% | 60.0% |
| **Product 5 - woven pants light** | | | | | | | |
| Scenario 6 | 0.0% | -4.8% | 23.4% | 66.6% | -123.1% | 108.1% | 108.1% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -266.1% | 29.1% | 29.1% |
| Scenario 2 | 0.0% | -4.8% | 23.4% | 66.6% | 75.3% | 86.3% | 86.3% |
| **Product 6 - woven blouse** | | | | | | | |
| Scenario 6 | 0.0% | -7.5% | 16.5% | 53.2% | -106.1% | 90.8% | 90.8% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -223.7% | 24.5% | 24.5% |
| Scenario 2 | 0.0% | -7.5% | 16.5% | 53.2% | 60.7% | 72.6% | 72.6% |
| **Product 7 - woven pants warm** | | | | | | | |
| Scenario 6 | 0.0% | -9.2% | 17.4% | 58.0% | -120.5% | 101.7% | 101.7% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -250.6% | 27.4% | 27.4% |
| Scenario 2 | 0.0% | -9.2% | 17.4% | 58.0% | 66.3% | 81.3% | 81.3% |
| **Product 8 - woven jacket** | | | | | | | |
| Scenario 6 | 0.0% | -6.3% | 20.6% | 61.7% | -118.9% | 103.0% | 103.0% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -253.6% | 27.8% | 27.8% |
| Scenario 2 | 0.0% | -6.3% | 20.6% | 61.7% | 70.1% | 82.3% | 82.3% |
| **Product 9 - men underwear** | | | | | | | |
| Scenario 6 | 0.0% | -3.2% | 7.8% | 24.6% | -49.1% | 42.0% | 42.0% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -103.5% | 11.3% | 11.3% |
| Scenario 2 | 0.0% | -3.2% | 7.8% | 24.6% | 28.0% | 33.6% | 33.6% |
| **Product 10 - simple women panties** | | | | | | | |
| Scenario 6 | 0.0% | -6.2% | 22.6% | 66.7% | -126.9% | 110.4% | 110.4% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -271.8% | 29.8% | 29.8% |
| Scenario 2 | 0.0% | -6.2% | 22.6% | 66.7% | 75.6% | 88.2% | 88.2% |
| **Product 11 - simple women bra** | | | | | | | |
| Scenario 6 | 0.0% | -5.4% | 16.9% | 50.8% | -98.3% | 85.0% | 85.0% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -209.3% | 22.9% | 22.9% |
| Scenario 2 | 0.0% | -5.4% | 16.9% | 50.8% | 57.7% | 67.9% | 67.9% |
| **Product 12 - women pyjamas** | | | | | | | |
| Scenario 6 | 0.0% | -3.5% | 12.0% | 35.7% | -68.6% | 59.5% | 59.5% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -146.5% | 16.0% | 16.0% |

*Table 17: Unit Production Cost Relative to BAU, by Product and Scenario*

| Time (Year) | 2022 | 2023 | 2025 | 2029 | 2030 | 2031 | 2035 |
|---|---|---|---|---|---|---|---|
| **Product 1 - sportswear functional t-shirt** | | | | | | | |
| Scenario 6 | 0.0% | -0.1% | -0.3% | -0.7% | -0.8% | -1.0% | -1.0% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -0.3% | -0.3% |
| Scenario 2 | 0.0% | -0.1% | -0.3% | -0.7% | -0.8% | -0.8% | -0.8% |

*Table 18: Unit Energy Cost Relative to BAU, by Product and Scenario*

| Time (Year) | 2022 | 2023 | 2025 | 2029 | 2030 | 2031 | 2035 |
|---|---|---|---|---|---|---|---|
| **Product 1 - sportswear functional t-shirt** | | | | | | | |
| Scenario 6 | -3.1% | -8.6% | -17.0% | -18.8% | -23.5% | -23.5% | -3.1% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | -6.3% | -6.3% | 0.0% |
| Scenario 2 | -3.1% | -8.6% | -17.0% | -18.8% | -18.8% | -18.8% | -3.1% |

*Table 19: GHG Emissions Relative to BAU, by Product and Scenario*

| Time (Year) | 2022 | 2023 | 2025 | 2029 | 2030 | 2031 | 2035 |
|---|---|---|---|---|---|---|---|
| **Product 1 - sportswear functional t-shirt** | | | | | | | |
| Scenario 6 | 0.0% | -4.5% | -12.2% | -24.1% | -26.6% | -32.3% | -32.3% |
| Scenario 4 | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | -7.7% | -7.7% |
| Scenario 2 | 0.0% | -4.5% | -12.2% | -24.1% | -26.6% | -26.6% | -26.6% |

*Table 20: Air Pollution from Energy Use and Power Generation by Pollutant (unit tonne/year)*

| Time (Year) | 2022 | 2023 | 2025 | 2029 | 2030 | 2031 | 2035 | Reduction |
|---|---|---|---|---|---|---|---|---|
| **Direct energy consumption** | | | | | | | | |
| black carbon emissions | | | | | | | | |
| Scenario 6 | 19.14 | 18.23 | 16.67 | 14.25 | 13.76 | 13.76 | 13.76 | *28%* |
| Scenario 4 | 19.14 | 19.14 | 19.14 | 19.14 | 19.14 | 19.14 | 19.14 | 0% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Scenario 1 | 19.14 | 19.14 | 19.14 | 19.14 | 19.14 | 19.14 | 19.14 | |
| ch4 emissions | | | | | | | | |
| Scenario 6 | 14.18 | 13.49 | 12.29 | 10.44 | 10.06 | 10.06 | 10.06 | *29%* |
| Scenario 4 | 14.18 | 14.18 | 14.18 | 14.18 | 14.18 | 14.18 | 14.18 | *0%* |
| Scenario 1 | 14.18 | 14.18 | 14.18 | 14.18 | 14.18 | 14.18 | 14.18 | |
| co emissions | | | | | | | | |
| Scenario 6 | 270.22 | 257.02 | 234.20 | 199.09 | 191.93 | 191.93 | 191.93 | *29%* |
| Scenario 4 | 270.22 | 270.22 | 270.22 | 270.22 | 270.22 | 270.22 | 270.22 | *0%* |
| Scenario 1 | 270.22 | 270.22 | 270.22 | 270.22 | 270.22 | 270.22 | 270.22 | |
| co2 emissions | | | | | | | | |
| Scenario 6 | 58,225 | 55,631 | 51,149 | 44,249 | 42,843 | 42,843 | 42,843 | *26%* |
| Scenario 4 | 58,225 | 58,225 | 58,225 | 58,225 | 58,225 | 58,225 | 58,225 | *0%* |
| Scenario 1 | 58,225 | 58,225 | 58,225 | 58,225 | 58,225 | 58,225 | 58,225 | |
| n2o emissions | | | | | | | | |
| Scenario 6 | 1.98 | 1.89 | 1.73 | 1.48 | 1.43 | 1.43 | 1.43 | *28%* |
| Scenario 4 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | *0%* |
| Scenario 1 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | 1.98 | |
| nh3 emissions | | | | | | | | |
| Scenario 6 | 17.19 | 16.34 | 14.86 | 12.58 | 12.11 | 12.11 | 12.11 | *30%* |
| Scenario 4 | 17.19 | 17.19 | 17.19 | 17.19 | 17.19 | 17.19 | 17.19 | *0%* |
| Scenario 1 | 17.19 | 17.19 | 17.19 | 17.19 | 17.19 | 17.19 | 17.19 | |
| nmvoc emissions | | | | | | | | |
| Scenario 6 | 141.40 | 134.45 | 122.45 | 103.97 | 100.20 | 100.20 | 100.20 | *29%* |
| Scenario 4 | 141.40 | 141.40 | 141.40 | 141.40 | 141.40 | 141.40 | 141.40 | *0%* |
| Scenario 1 | 141.40 | 141.40 | 141.40 | 141.40 | 141.40 | 141.40 | 141.40 | |
| nox emissions | | | | | | | | |
| Scenario 6 | 85.31 | 83.20 | 79.56 | 73.95 | 72.81 | 72.81 | 72.81 | *15%* |
| Scenario 4 | 85.31 | 85.31 | 85.31 | 85.31 | 85.31 | 85.31 | 85.31 | *0%* |
| Scenario 1 | 85.31 | 85.31 | 85.31 | 85.31 | 85.31 | 85.31 | 85.31 | |
| organic carbon emissions | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Scenario 6 | 33.74 | 32.07 | 29.19 | 24.75 | 23.85 | 23.85 | 23.85 | *29%* |
| Scenario 4 | 33.74 | 33.74 | 33.74 | 33.74 | 33.74 | 33.74 | 33.74 | *0%* |
| Scenario 1 | 33.74 | 33.74 | 33.74 | 33.74 | 33.74 | 33.74 | 33.74 | |
| pm10 emissions | | | | | | | | |
| Scenario 6 | 68.08 | 64.77 | 59.05 | 50.24 | 48.44 | 48.44 | 48.44 | *29%* |
| Scenario 4 | 68.08 | 68.08 | 68.08 | 68.08 | 68.08 | 68.08 | 68.08 | *0%* |
| Scenario 1 | 68.08 | 68.08 | 68.08 | 68.08 | 68.08 | 68.08 | 68.08 | |
| pm2.5 emissions | | | | | | | | |
| Scenario 6 | 66.69 | 63.44 | 57.84 | 49.22 | 47.46 | 47.46 | 47.46 | *29%* |
| Scenario 4 | 66.69 | 66.69 | 66.69 | 66.69 | 66.69 | 66.69 | 66.69 | *0%* |
| Scenario 1 | 66.69 | 66.69 | 66.69 | 66.69 | 66.69 | 66.69 | 66.69 | |
| **Power generation** | | | | | | | | |
| ammonia emissions | | | | | | | | |
| Scenario 6 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | *55%* |
| Scenario 4 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | *40%* |
| Scenario 1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | |
| black carbon emissions | | | | | | | | |
| Scenario 6 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 | 0.03 | 0.03 | *55%* |
| Scenario 4 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.04 | 0.04 | *40%* |
| Scenario 1 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | |
| ch4 emissions | | | | | | | | |
| Scenario 6 | 0.20 | 0.19 | 0.18 | 0.16 | 0.15 | 0.09 | 0.09 | *55%* |
| Scenario 4 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.12 | 0.12 | *40%* |
| Scenario 1 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | |
| co emissions | | | | | | | | |
| Scenario 6 | 1.02 | 0.98 | 0.90 | 0.79 | 0.76 | 0.46 | 0.46 | *55%* |
| Scenario 4 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 0.61 | 0.61 | *40%* |
| Scenario 1 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | |
| co2 emissions | | | | | | | | |
| Scenario 6 | 5,240 | 5,018 | 4,632 | 4,030 | 3,905 | 2,343 | 2,343 | *55%* |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Scenario 4 | 5,240 | 5,240 | 5,240 | 5,240 | 5,240 | 3,144 | 3,144 | *40%* |
| Scenario 1 | 5,240 | 5,240 | 5,240 | 5,240 | 5,240 | 5,240 | 5,240 | |
| n2o emissions | | | | | | | | |
| Scenario 6 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | *55%* |
| Scenario 4 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.02 | 0.02 | *40%* |
| Scenario 1 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | |
| nmvoc emissions | | | | | | | | |
| Scenario 6 | 0.16 | 0.15 | 0.14 | 0.12 | 0.12 | 0.07 | 0.07 | *55%* |
| Scenario 4 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.09 | 0.09 | *40%* |
| Scenario 1 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | |
| nox emissions | | | | | | | | |
| Scenario 6 | 9.61 | 9.21 | 8.50 | 7.39 | 7.17 | 4.30 | 4.30 | *55%* |
| Scenario 4 | 9.61 | 9.61 | 9.61 | 9.61 | 9.61 | 5.77 | 5.77 | *40%* |
| Scenario 1 | 9.61 | 9.61 | 9.61 | 9.61 | 9.61 | 9.61 | 9.61 | |
| organic carbon emissions | | | | | | | | |
| Scenario 6 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | *55%* |
| Scenario 4 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | *40%* |
| Scenario 1 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | |
| pm10 emissions | | | | | | | | |
| Scenario 6 | 1.71 | 1.63 | 1.51 | 1.31 | 1.27 | 0.76 | 0.76 | *55%* |
| Scenario 4 | 1.71 | 1.71 | 1.71 | 1.71 | 1.71 | 1.02 | 1.02 | *40%* |
| Scenario 1 | 1.71 | 1.71 | 1.71 | 1.71 | 1.71 | 1.71 | 1.71 | |
| pm2.5 emissions | | | | | | | | |
| Scenario 6 | 1.31 | 1.25 | 1.16 | 1.00 | 0.97 | 0.58 | 0.58 | *55%* |
| Scenario 4 | 1.31 | 1.31 | 1.31 | 1.31 | 1.31 | 0.78 | 0.78 | *40%* |
| Scenario 1 | 1.31 | 1.31 | 1.31 | 1.31 | 1.31 | 1.31 | 1.31 | |
| so2 emissions | | | | | | | | |
| Scenario 6 | 3.86 | 3.70 | 3.41 | 2.97 | 2.88 | 1.73 | 1.73 | *55%* |
| Scenario 4 | 3.86 | 3.86 | 3.86 | 3.86 | 3.86 | 2.32 | 2.32 | *40%* |
| Scenario 1 | 3.86 | 3.86 | 3.86 | 3.86 | 3.86 | 3.86 | 3.86 | |

# 7. Implementation and Governance

This section describes an outline of the advised implementation approach, including institutional arrangements, involved actors (public and private) and processes. The guiding principle will be the strategic role of TAFTAC for the introduction and implementation of the MGFP. Successful implementation of initiatives such as the MGFP – even when conceptualized as an industry program, leading to a potential proposition for government policy only later – needs to ensure political support, institutional will and capacity of all involved actors, sufficient administrative and financial resources, clear assignment of roles, cooperation of actors across functions and suitable complementary measures where necessary.[175]

Key requirement in such a process is effective and ongoing communication with all relevant stakeholders on the relevance of sustainable production along with the specific objectives and benefits of the proposed interventions. To the extent possible, conflicting objectives of other policies or opposing economic incentives that pose a barrier to sustainable practices should be eliminated.[176] For any remaining barriers or disincentives, negotiations and advocacy in favor of sustainability goals would be part of the process to increase the prospects of uptake of interventions.

As an example from abroad, the Malaysian Green Building Index (GBI) was developed in 2009 by industry experts, the Malaysia Institute of Architects or Pertubuhan Akitek Malaysia (PAM) and the Association of Consulting Engineers Malaysia (ACEM), with the goal to improve sustainability in the property industry and to raise awareness about environmental issues among industry players, such as developers, architects, engineers, planners, designers, contractors and also the public. Based on six criteria, buildings are awarded Platinum, Gold, Silver or Certified status that require recurring assessments in three-year intervals.[177] The accreditation process itself is structured in a tier system of facilitators (who enable performance of applicants for certification), certifiers (who assess submissions) and the accreditation panel as an independent regulatory body, consisting of senior building professionals reviewing and awarding the GBI status.[178] The index is designed specifically for the country's hot and humid climate, as well as Malaysia's socio-economic context. The organization also trains GBI facilitators and certifiers on the tool.[179] From its inception, the GBI has received support of key stakeholders, also due to the strategic communication approach of the implementation committee that included awareness and relationship building with all relevant decision makers, including on government side:[180]

- Concept presentation and discussion with key stakeholders, such as the Building Industry Presidents Council (BIPC), Pusat Tenaga Malaysia (PTM) Green Energy Office, International Real Estate Federation FIABCI Malaysia and representatives of other green building standards, such as Green Mark from Singapore and others

- Introduction of the concept at national and international forums, such as the Green Design Forum, World Class Sustainable Cities, Building

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[178] GBI Organization. (n.d.). *Green Building Index.* Retrieved from: Link; Wei, K. (2021, September 29). *What is the Green Building Index and the Key Criteria for GBI?.* Retrieved from: Link

[179] Yuen, J. (2020, May 4). *Green Building Developments and Opportunities: Malaysia.* Retrieved from: Link

[180] Lop, N., Ahmad, A., & Zulkipli, N. (2016). *The Implementation of Green Building in Malaysian Construction Industry: Determination of Key Success Factor.* Retrieved from: Link

Trade Show

- Launch of the GBI website
- Discussion with universities during the development stage and later briefing of staff and students from the School of Architecture on the GBI for inclusion into the curriculum
- Information and training sessions for architects and engineers
- Collaboration with the Malaysian Industrial Development Authority (MIDA) on capacity building for professionals in the industry, including training of GBI facilitators
- Collaboration with relevant national authorities, such as the Ministry of Energy and Natural Resources of Malaysia, as well as local and regional authorities with formation of working groups for implementation, incentive development, and inclusion into relevant policies
- Public awareness campaign with full page advertisements in nationwide Malaysian media outlet with support announcements of numerous bodies and agencies from private and public side[181]

In Malaysia, the government plays a key supporting role in promoting green building solutions with initiatives such as energy audits on government buildings or green tax incentives and tax deductions for buildings awarded the GBI certificate.[182] Even with such a comprehensive approach, research has shown that the level of sustainability awareness and practices in Malaysian construction still leaves room for improvement after the establishment of the GBI. This emphasizes the importance of ongoing communication even after implementation; it is also leading some to the conclusion that sustained long-term impact of such a tool requires further support by the public hand, potentially also in the form of a progressively mandatory program or system.[183]

In Cambodia, the concept of starting an initiative via an industry association and taking it through implementation and establishment within the sector before arriving at a more formal status of ministerial policy has already proven successful in certain sectors. For instance, when a regulatory framework was initially lacking for the life insurance market, companies came together to form an association based on the existing business case, proceeding with advocacy at the MEF to jointly develop formal regulations to make the market feasible. While this was a directly revenue driven initiative, the mechanism of going from an industry program to a more formal framework could also be a successful long-term strategy in the context of the Cambodian garment sector, based on the objectives of maintaining and improving competitiveness and resilience of this key industry.

### Stakeholders and Actors

Starting with the key stakeholders of the MGFP, the following table gives an overview of relevant actors, their general role in relation to the garment sector, and their potential role in the implementation of the MGFP. The stakeholder involvement can be directly related to implementation of the MGFP through development, preparation, and execution of processes or more indirect, related to supporting measures, such as investment incentives, regulations (on electricity tariffs and solar PV), suitable financial products, or buyer involvement. Buyers can play an essential role, especially to address the 'chicken egg' issue between factories taking the first step of investing in sustainability and buyers requiring sustainability from suppliers before onboarding.

[181] Mun, A. D. (2009, April 23). *The Development of GBI Malaysia (GBI).* Retrieved from: Link
[182] Yuen, J. (2020, May 4). *Green Building Developments and Opportunities: Malaysia.* Retrieved from: Link
[183] Bahaudin, A. Y., Elias, E. M., Nawi, M. N., Zainuddin, N., & Nadarajan, S. (2017, June). *Construction Sustainability & Awareness amongst Contractors in the Northern Region of Malaysia.* Retrieved from: Link

*Table 21: Involvement of Stakeholders in Implementation of the MGFP*

| Actor | Stakeholder Role | Involvement in Implementation | |
|---|---|---|---|
| **GOVERNMENT** | | | |
| **Ministry of Industry, Science, Technology and Innovation (MISTI)** | Key ministry for the garment sector, improving investment environment and competitiveness, holding the mandate to promote RECP in industries. Key ministerial partner for Switch Garment. | • Endorsement of MGFP<br>• Promotion, awareness raising<br>• Eventual development of sub-decree, prakas or circular after MGFP introduction phase, based on results and insights | Direct |
| **Department of Green Economy (DGE)** | The second government partner for Switch Garment and host agency for GGGI, located in the General Secretariat for Sustainable Development attached to the Ministry of Environment. | • Facilitation of policy initiatives under Switch Garment that are out of the MISTI scope and linked to policy mandates under other ministries<br>• Collaboration with the steering committee and Technical Working Groups under the National Council for Sustainable Development | Direct |
| **Ministry of Environment (MoE)** | NCSD under MoE with mandate for implementation of environmental policies. Department of Climate Change under NCSD manages the GHG inventories and government commitment under the UNFCCC framework | • Endorsement of MGFP<br>• Support of financial incentives (advocacy, co-financing)<br>• Integration of MGFP into the EIA process for licensing of factories as long-term perspective, making it a requirement for factory approval and subject to control of compliance along with other environmental criteria | Direct |
| **Ministry of Economy and Finance (MEF)** | Financial regulations, including investment incentives | • Law on Investment – implementation and detailing of upcoming sub-decree<br>• Potential tax incentives for EE / RE measures such as EE equipment | Indirect |
| **Ministry of Mines and Energy (MME)** | Management of the mining and energy sectors including electricity supply | • Formulating EE regulations including MEPS and Standards & Labelling<br>• Managing future registration and licensing processes for energy managers and ESCOs | Indirect |
| **Electricity Authority of Cambodia (EAC)** | Government agency for managing and administering the provision of electric power | • Discussion of the systems of tariffs and fees | Indirect |

| | | | |
|---|---|---|---|
| **Electricite du Cambodge (EDC)** | Generation, transmission, and distribution of electricity | • Discussion of the percentage of contracted energy that can be supplied by solar PV installations | Indirect |
| **DEVELOPMENT PARTNERS** | | | |
| **Switch Garment (GGGI, TAFTAC, Geres)** | Implementation of the 4-year EU SWITCH-Asia programme in the Cambodian garment sector | • Development of MGFP<br>• Definition of compliance criteria and timelines<br>• Close consultation with MISTI, MoE and other stakeholders to drive the initiative forward | Direct |
| **Other DPs in the field, such as GIZ, UNIDO, BFC** | Initiatives for sector development and sustainability in the garment sector | • Collaboration on insight generation and implementation initiatives for overlapping areas of interest and action | Indirect |
| **PRIVATE SECTOR** | | | |
| **TAFTAC / CGTI** | Business association of the garment industry with associated training institution | • Co-development of MGFP<br>• Endorsement, promotion of MGFP among factories for competitiveness<br>• Implementation lead in introduction and ongoing execution and monitoring<br>• Training for MGFP by CGTI based on current factory capacities<br>• MGFP as part of registration process for TAFTAC membership | Direct |
| **Buyers with sustainability goals and interest in long-term supplier relations** | Key stakeholder group with decisive influence on supplier practices, especially larger sustainability minded brands with a higher contract volume | • Drivers of behaviour change through buyer power<br>• Potential commitment to purchase and sourcing agreements with factories involved in the MGFP program | Indirect |
| **Monitoring / Verification Agency** | Neutral third party for assessment of factory data | • Partner for measuring, monitoring, and reporting of factory performance - potentially in a set up like the Higg Index: verification of self-reported factory data, considering scarce resources of experts<br>• Collaboration with government for eventual transition to public lead | Direct |
| **Energy Service Providers (ESP)** | Local providers of technical services to the garment factories | • Supply of EE equipment and solar PV, maintenance, general expertise on sustainable practices<br>• Potentially offering savings-based contracts if support (financial, guarantees) is made available | Indirect |

| | | | |
|---|---|---|---|
| **Financial Institutions (FI)** | Local providers of financing, such as banks and MFIs, but also specialized entities, such as MSP, with green funds for SE interventions | • Offering financing mechanisms, potentially supported by funds or guarantees considering the perceived high-risk environment of the garment sector for long-term lending | Indirect |

Ideally, this can even mean certain purchase commitments.

The future working groups mentioned in the recent Garment Sector Strategy issued by the Supreme National Economic Council, especially the Inter-Institutional Working Group in Charge of Coordinating the Strategy Implementation and the possible Advisory Working Group on Garment, Footwear and Travel Goods Sector (with representatives from the private sector and development partners) – would be additional stakeholders to involve.[184]

A dedicated steering committee for implementation could be established from the key stakeholder groups to oversee the implementation process, again with TAFTAC in a strategic role. The main stakeholders to consider are TAFTAC, government representatives, especially from MISTI and MoE, development partners active in the field and buyers. The committee can be active when setting up the MGFP or continue its work in ongoing collaboration, and alignment throughout the implementation stages. This would bundle efficient and impactful collaboration through the following roles and responsibilities:

- Direct alignment of mutual objectives and strategic approach
- Communication with key stakeholder groups
    - Introduction and discussion of concept in respective industry gatherings, forums etc
- Direct advocacy for needs and objectives with the government
- Coordination of training and capacity building for different actor groups
- Connection and matchmaking between relevant actors
    - Financial institutions, buyers, ESPs, factories
- Regular internal alignment with the respective represented groups

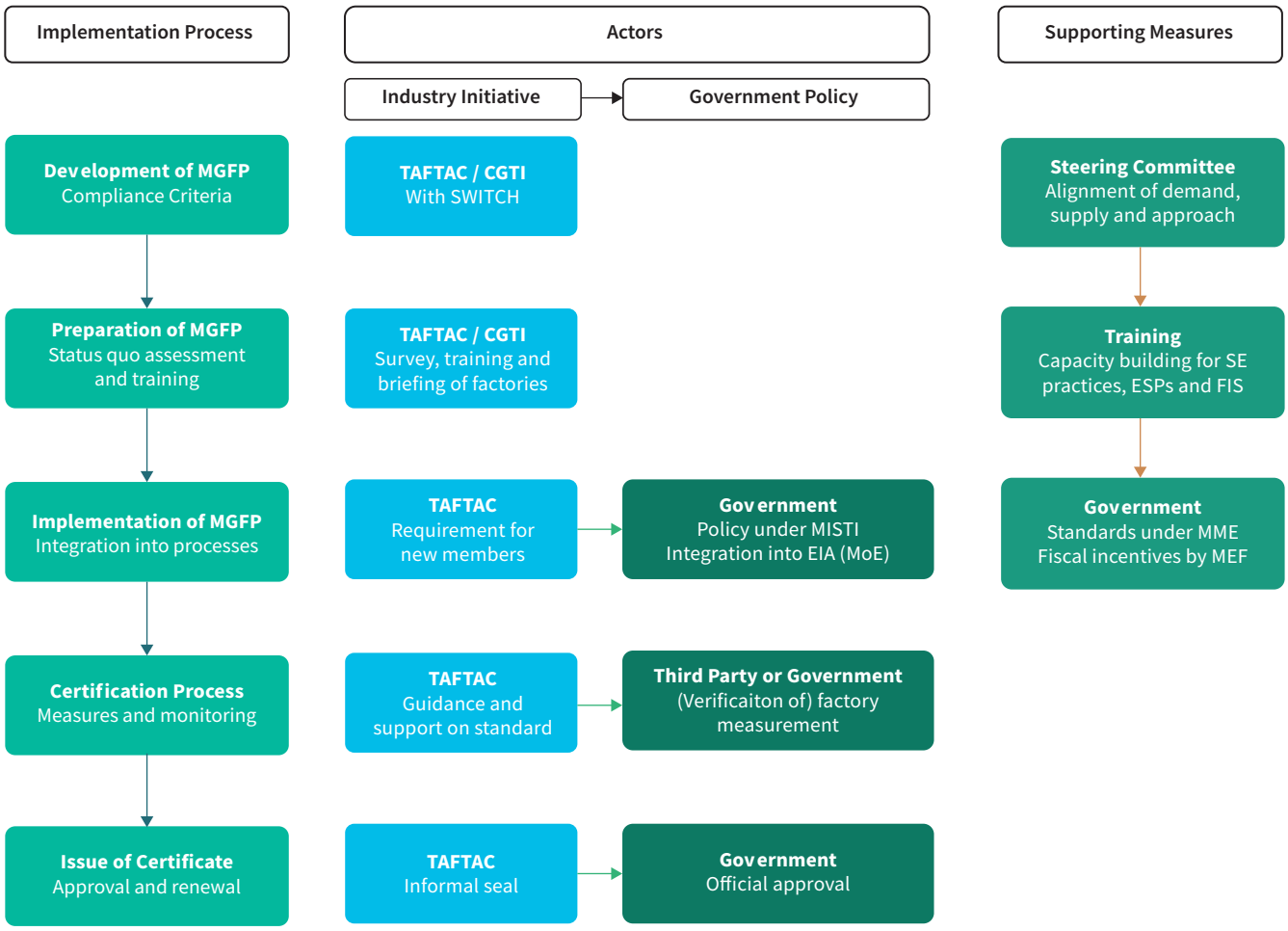
A strategy to effectively support uptake could be a collaboration with an entity like the Clean Energy Investment Accelerator (CEIA), a public-private partnership led by Allotrope Partners, World Resources Institute, and the U.S. National Renewable Energy Laboratory working to address barriers to clean energy investments in emerging markets. The CEIA model brings together the private and public sector through enabling large scale buyers to aggregate RE demand, using financial tools to unlock access to finance and working with governments to strengthen policy frameworks to increase clean energy investment. CEIA is active in Vietnam, Indonesia, the Philippines, Mexico, and Colombia. In Vietnam, CEIA has provided technical support for over 20 MW of RE projects with garment companies and other big commercial and industrial actors.[185]

### Implementation Process

The implementation process of the MGFP itself, including shifting roles for implementing actors, could follow the scheme below. The outline presumes that the MGFP will be introduced as an industry initiative first, eventually leading to a potential proposition

[184] Supreme National Economic Council. (2022). *Cambodia Garment, Footwear and Travel Goods (GFT) Sector Development Strategy.*
[185] Clean Energy Investment Accelerator. (n.d). *About the CEIA.* Retrieved from: Link

for a policy under MISTI, the key ministerial partner for the Switch Garment project. Any eventual policy instruments will be rooted in intra-ministerial measures under MISTI, such as Sub-decrees, Prakas, or Circulars.[186] For sustainability, TAFTAC as a key actor leading implementation of the MGFP could utilize membership fees to support the ongoing additional effort for the initiative. Membership is mandatory for exporting factories, and the sustainable energy interventions would concern and address TAFTAC members as key target group.




## Supporting Measures

Key for successful implementation of the MGFP is capacity building regarding technical knowledge and expertise on SE interventions for various actor groups, such as factories, ESPs, FIs, relevant ministries as described in chapter 5.2.5. TAFTAC and its training institute CGTI will play a key role; expertise on sustainable energy practices as internal factory resource but also as external expertise is a major potential bottleneck to be resolved so that factories are in the position to improve their environmental performance. Sufficient supplies of sustainable equipment need to be ensured, same as knowledge on the side of financial institutions for improving access to finance. For the latter, knowledge on sustainable energy projects and their evaluation is key but also higher familiarity with garment factories and ESPs to create a basis for expanding business in these sectors. Covering all needs for capacity building to better connect supply, demand and financing will be a crucial step to create momentum. Besides a collaboration with FIs interested in green lending and potentially active already on a small scale,

[186] Switch Garment. (2021). *Output 1: Policy and Regulatory Measures. Policy Scenarios Discussion Paper.*

another key collaboration partner and accelerator are financial entities such as MSP that are setting up dedicated green funding mechanisms applicable to SE interventions. Such capacity building also has spillover effects beyond the project and the garment sector, with positive impact on green financing and the overall economy in Cambodia. From the government side, fiscal benefits can further support uptake, whether through accelerated depreciation, tax reductions and exemptions for green technologies, including EE equipment, or other measures (see chapter 5.2.5). While the model shows feasible ROI prospects for certain sustainability measures, some factories will still not be in the position to finance interventions by their own means, especially for more substantial investment with longer ROI.

A regulatory framework for sustainability practices in the garment sector with a certain binding effect is a factor that financial institutions and other actors of the business environment appreciate before getting involved. However, with regards to voluntary or mandatory measures, this will not only be a matter of time – allowing for ample opportunities for awareness building and trainings – but also depend on decision by TAFTAC for initial requirements to their members as the implementation lead for the MGFP. Further, these investment decisions take place in a wider context which can include potential fluctuation or downturn of demand overseas as well as supply issues, increasing minimum wages and labor compliance costs. Eventually, the upcoming laws and regulations that target energy efficiency and sustainable energy, such as MEPS and S&L, will set the regulatory framework including potential energy efficiency standards.

## 8. Monitoring, Reporting and Verification (MRV) Framework

Going from the baseline evaluations of sustainability and energy performance of select factories conducted by the Switch Garment project, continuous data collection will not only enable tracking of factory and sector progress out of interest for the private and public side but can also illustrate the business case for further investments. Therefore, consistent and correct reporting of suitable indicators are key for the long-term implementation and success of the MGFP. Depending on the implementation design or stages, the responsible contacts can be at TAFTAC, factories together with third parties or government actors. The outline of the relevant indicators and timescales are outlined in the approach below.

First, the adoption of equipment should be tracked. This is essential for all monitoring, reporting and verification of the investment implemented. Energy efficient lighting, steam units, sewing machines, ventilation and compressed air units, as well as solar PV installations should be tracked over time. The adoption of efficient equipment is directly connected to energy consumption. The adoption of solar PV is directly connected to the amount of electricity purchased from the grid. Data collection on larger equipment should be trivial, with this information being already included in balance sheets and being required for asset depreciation and import duty exemptions.

- Indicators: energy efficient units purchased and installed in a given year, total units installed over time. Includes lighting and steam units, sewing machines, ventilation and compressed air units, as well as solar PV installations.

Second, corresponding changes to energy consumption should be monitored. The adoption of energy efficient equipment is expected to reduce energy consumption (total and per unit of production). Energy consumption can be measured

using energy purchase bills, for liquid fuels, electricity and biomass. It is expected that reductions in energy purchases will emerge over time, as more efficient equipment is installed, replacing older equipment.

- Indicators: energy consumption per year, including liquid fuels (e.g. liters/year), electricity (e.g. kWh/year) and biomass (e.g. M3/year).

Third, estimations of changes in energy intensity should be performed. This pertains the estimation of energy consumption per unit produced (e.g. kWh per t-shirt produced), or energy consumption per unit of revenue (e.g. kWh per $ of revenue). This is important to benchmark factories regardless of their size and location, and to support the identification of investments that can further improve energy efficiency and reduce the cost of energy consumption. The same can be estimated for electricity purchase (as opposed to consumption) in the case of solar PV installations.

- Indicators: energy consumption per unit of production (e.g. Joule/product, liters/product for liquid fuel use, kWh/product for electricity use, M3/product for biomass use. Also energy consumption per USD or Riel of revenue.

Fourth, economic performance should be monitored, including unit production cost and profit margin per unit produced. These indicators are already available from balance sheets and from TAFTAC surveys. It is expected that, in the face of unchanged market conditions, the profitability of production will increase, with a cost reduction ranging between 2% and 5%. These results would emerge directly from the reduction of energy use, or the switch to more efficient and affordable energy sources, as indicated above. These indicators are also important to benchmark the garment sector of Cambodia with the performance of other markets in the region.

- Indicators: USD per unit of production, by product. Profit margin (%) by product.

Fifth and final, the generation of air emissions should be tracked, in relation to the future risk of climate and air pollution policy implementation. While GHG and air emissions are difficult to track on site, calculations could be made based on energy consumption by energy source and the emission intensity of the energy consumed. This would allow factories to assess and monitor the risk of climate policy (i.e. carbon pricing) for the profitability of operations. It is worth noting that carbon pricing could emerge both as a national policy and/or as a charge introduced by international clients.

- Indicators: GHG emissions, total and per unit of production, by product.

Concerning the timescale to consider, all the

indicators listed above should be collected on an annual basis. Further, if production changes depending on the season (e.g. summer versus winter production), all indicators should be estimated by product, and hence by season.

# 9. Annex

## 9.1. Methodology

### 9.1.1. Research Methods

Secondary research for the project was based on online sources of newspapers, journals, websites of governments, non-profit and non-governmental organizations, and companies, webinar notes of relevant events and other sources as necessary and available, such as documents shared by experts and key informants. Extensive primary research was conducted among stakeholders through semi-structured key informant interviews (KII) through both in person and virtual meetings. A list of KIIs conducted for this research in 2021 and 2022 is given

*Table 22: List of KIIs Conducted in 2021 / 2022*

| No | Category | Name of Organization | Contact | Position | Date |
|---|---|---|---|---|---|
| 1 | Association | TAFTAC / CGTI | Andrew Tey | Institute Director | Oct and Nov 2021 |
| 2 | Brand / Buyer | Adidas | • Tracy Nilsson | Senior Director Global Environment and Social Environmental Affairs | Aug 2021 |
| | | | • Vinh Dang | Head of Responsible Sourcing | |
| | | | • Sheila Shek | Head of Responsible Sourcing | |
| | | | • Mandy Lam | Head of Responsible Sourcing | |
| 3 | Brand / Buyer | GAP Inc | Aaron Tam | Sr. Manager, Environmental Capability Building | Jul 2021 |
| 4 | Brand / Buyer | H&M | Pete Ford | Program Specialist Environment – Cambodia, Vietnam, Myanmar | Jul 2021 |
| 5 | Brand / Buyer | Li & Fung | Jonathan Salomon | Senior Sustainability Manager | Jul 2021 |
| 6 | Brand / Buyer | Puma | Nguyen Tram | Environmental Sustainability Manager | Nov 2021 |
| 7 | Brand / Buyer | VFC | • Joyce Tsoi | Senior Manager, Supply Chain Sustainability, Global (HK) | Jul 2021 |
| | | | • Seng Sokunthea | Sustainable Operations Manager for Social and Environmental Compliance, Cambodia | |

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|---|---|---|---|---|---|
| 8 | Certification Provider | Bureau Veritas | • Vathanak Sim | BD Manager | Aug 2021 |
| | | | • Diogo Begonha | Manager | |
| 9 | Certification Provider | COSMO & Control Union | Max Gridling | Founder of COSMO and Managing Director of Control Union | Sep 2021 |
| 10 | Certification Provider | SGS | • Khontar Isariyapa | Project Manger | Sep 2021 |
| | | | • Oaiphol Wansonkran | Manager | |
| 11 | Development Partner | 3i | Kvammen Morten | Finance Consultant | Aug 2021 |
| 12 | Development Partner | ADB | Joao Aleduia | Regional Clean Energy Specialist and Coordinator | Oct 2021 |
| 13 | Development Partner | AFD Energy | Huy Seav Er | Energy Project Officer | May 2021 |
| 14 | Development Partner | AFD Finance | • Huy Seav Er | Energy Project Officer | Sep 2021 |
| | | | • Driancourt Capucine | Project Officer, Financial Systems, Microfinance, Green finance | |
| 15 | Development Partner | AFD Garment | Malika Ok | Project Officer | Sep 2021 |
| 16 | Development Partner | Geres | Aude Petelot | Sustainable Energy Expert | Aug 2021 |
| 17 | Development Partner | GIZ | Trang Nguyen | Technical Advisor GIZ PDP Program | May 2021 |
| 18 | Development Partner | IFC | Asad Yaqub | Resident Representative | Nov 2021 |
| 19 | Development Partner | ILO | • Laurel Hoffner | Consultant | Jun 2021 |
| | | | • Samantha Sharpe | Research Director at Institute for Sustainable Futures | |
| 20 | Development Partner | ILO-BFC | Sara Park | Program Manager | Aug 2021 |
| 21 | Development Partner | UNDP | • Butchaiah Gadde | Project Manager for Sustainable Energy Solutions (SES) | May 2021 |
| | | | • Vuthy Va | Energy Officer | |
| 22 | Development Partner | UNIDO | Dr. Rey Sopheak | Lecturer and Researcher at ITC, National Consultant | May 2021 |

| | | | | | |
|---|---|---|---|---|---|
| 23 | Energy Consultancy Service | CCDE | Ngovveng Chheng | Energy Specialist | May 2021 |
| 24 | Energy Consultancy Service | Green Move | Sophanna Nun | Director | May 2021 |
| 25 | Energy Service Provider | ATS Cambodia | Raphael Bevillard | Technical Manager | Aug 2021 |
| 26 | Energy Service Provider | Bright & Eternity | Kep Kem | Founder | Sep 2021 |
| 27 | Energy Service Provider | Comin Asia / Comin Khmer | Rogier van Mansvelt | Renewable Energy Engineer | Aug 2021 |
| 28 | Energy Service Provider | IMB Cambodia | Kong Pharith | Founder | Aug 2021 |
| 29 | Energy Service Provider | KamWorks Solar | • William Haines | Assistant Project Manager | Aug 2021 |
| | | | • Jake Davies | Sales Engineer | |
| 30 | Energy Service Provider | Lotus Green Team | Sean Huong | Project Director | Sep 2021 |
| 31 | Energy Service Provider | NRG Solar | Daniel Pacheco | CEO | Aug 2021 |
| 32 | Energy Service Provider | OS Sewing Machine | Ms. Kanha | Founder | Aug 2021 |
| 33 | Energy Service Provider | Paragon Lighting | N/A | Technical Team<br>Sales Representative in Vietnam | Aug 2021 |
| 34 | Energy Service Provider | PowerCom Cambodia | • Khoun Seng | Sales Supervisor | Aug 2021 |
| | | | • Mr. Veasna | Technical Manager | |
| 35 | Energy Service Provider | Sam Hak Cooling System | • Ms. Keang | Owner | Aug 2021 |
| | | | • Mr. Jiang | Technical Manager | |
| 36 | Energy Service Provider | Sitong Boiler | Ms. Yoyo | Sales Representative | Sep 2021 |
| 37 | Energy Service Provider | Sok Enterprise | Sok Vannak | Founder | Sep 2021 |
| 38 | Energy Service Provider | Soma Energy | • Sarath Oum | COO | Aug 2021 |
| | | | • Mr. Adisorn Masaw | CEO | |
| | | | • Mr. LEUK Dana | Business Development Director | |

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|---|---|---|---|---|---|
| 39 | Energy Service Provider | Spirax Sarco | William Hein | Sales Manager | Aug 2021 |
| 40 | Energy Service Provider | Total Solar | Richard Pullen | Sales Director, Cambodia & India | Sep 2021 |
| 41 | Energy Service Provider | VRK Corporation | Yim Keokalyan | Founder | Sep 2021 |
| 42 | Energy Service Provider | X'pan Trading. Ltd. (Tajima Cambodia) | Mr. Hong | Sales Representative | Sep 2021 |
| 43 | Energy Service Provider | Yuanda Boiler | Chris Fu | Sales Executive | Sep 2021 |
| 44 | Financial Services | Association of Banks in Cambodia (ABC) | • Chan Sochinda | Head of Regional Partnership | Sep 2021 |
| | | | • Heng Koy | General Manager | |
| 45 | Financial Services | Acleda Bank | Svay Hay | Head of Strategic Planning Division | Sep 2021 |
| 46 | Financial Services | BRED Bank | • Sopha Min | Deputy CEO | Sep 2021 |
| | | | • Soksan Ngoun | Senior Relationship Manager | |
| 47 | Financial Services | CBC | Sothearoath Oeur | Chief Executive Officer | Sep 2021 |
| 48 | Financial Services | CGCC | Keet Loong Wong | Chief Executive Officer | Sep 2021 |
| 49 | Financial Services | Chamroeun MFI | Yannick Milev | CEO | Aug 2021 |
| 50 | Financial Services | CMA | • Pheakyny Vong | Head of Financial Inclusion and Social Impact | Sep 2021 |
| | | | • Vandy Phal | Executive Director | |
| | | | • Kosal Heang | Financial Inclusion Department Team | |
| 51 | Financial Services | FTB | • Channarith Mean | CBO | Aug 2021 |
| | | | • Sotiara Nou | Head of Financial Institution & Corporate Banking Department | |
| 52 | Financial Services | LOLC Cambodia Plc | • Svoeuy Sodyna | Chief Risk Officer | Aug 2021 |
| | | | • Sok Sophal | Deputy CEO | |
| | | | • Sok Voeun | CEO | |

| | | | | | |
|---|---|---|---|---|---|
| 53 | Financial Services | MSP | • Mark Selby | Senior Investment Analyst | Jul 2021 |
| | | | • Olivia Snow | Senior Financial Analyst | |
| 54 | Financial Services | Phillip Bank | Teong Hoon Ong | Member of the Board of Directors | Aug 2021 |
| 55 | Financial Services | SBI Lyhour Bank | Ly Sopheap | Deputy CEO | Aug 2021 |
| 56 | TAFTAC Factories | TAFTAC / Gladpeer Garments Factory | Albert Tan | Treasurer TAFTAC<br>General Manager of Administrative Services Gladpeer Garments Factory | Dec 2021 |
| 57 | Government / Public Institution | National Bank of Cambodia (NBC) | Pheakdey Men | Director, Macro-Surveillance & Supervisory Data-Management Department | Sep 2021 |
| 58 | Government / Public Institution | Ministry of Environment | Lina NGIN | Deputy Secretary General, General Secretariat of Sustainable Development | Jul 2021 |
| 59 | Other | PwC | • Pradeep Singhvi | Associate Director - Energy | Oct 2021 |
| | | | • Neeraj Ramchandran | Project Lead/Manger - Clean Energy and Climate Change | |

*Table 23: List of KIIs Conducted in 2019*

| No | Category | Name of Organization | Contact | Position |
|---|---|---|---|---|
| 1 | Brand / Buyer | JLC Sourcing | Martijn van Rijnsoever | Head of Organization (Cambodia) |
| 2 | Brand / Buyer | Li & Fung | Jonathan Salomon | Senior Sustainability Manager |
| 3 | Development Partner | IFC | Tuyen D. Nguyen | IFC Asia Regional Lead Manufacturing |
| 4 | EE Service Provider Association | Impactiva | • Mathieu Vassal | VP of Business Development |
| | | | • Ed Gribbin | Chief Engagement Officer |
| 5 | Industry Expert | Sedex | Tristan Edmondson | Head of Responsible Sourcing |
| 6 | Social Sustainability Expert | Raoul Wallenberg Institute | Jonah Wigerhaell | Senior Program Officer |

below, grouped by types of stakeholders. Additionally, we also drew on KIIs conducted for a research project on green investments in the garment sector in Cambodia from 2019; these KIIs are listed separately below.

One objective for primary research was first hand insight generation from industry stakeholders to draw out the picture of the Cambodian garment sector in its current state, its development prospects, opportunities and challenges in light of global industry trends and the general question of competitiveness of the industry: How it is currently positioned against peer producer countries and how its competitiveness can be maintained and improved, with focus on the role of sustainability in sourcing decision making. The resulting analysis is the foundation of the qualitative assessment on key report subjects and also gives context to the model results.

Another objective for the KIIs was data collection for the impact assessment model. The model required detailed input on production cost and efficiency, related information on technologies and their energy consumption and emissions among others. The goal was to gather these records through garment owners and TAFTAC members. The challenges encountered are further described in the following section.

### 9.1.2. Challenges and Limitations

Data availability for modelling, especially factory level information, was very limited. Through contacts at TAFTAC, some KIIs with TAFTAC board members and CGTI experts could be scheduled to obtain qualitative and quantitative insights directly from experts and data on an anonymized or averaged level through already conducted factory surveys. Where reasonable and permissible, averages or ranges as well as extrapolations were used after alignment with the Switch garment team. For data gathered in secondary research, adjusted data were used where specific data for Cambodia and its garment sector was not available. The table below shows an overview of experienced data challenges, strategies to address these challenges and their impact on modeling and insight generation.

*Table 24: Overview of Challenges, Coping Strategies and Impact on Analysis*

| Data / Insights | Challenge | Coping Strategies | Consequences |
|---|---|---|---|
| **Factory data on production indicators for modeling** | • General factory data on broad scale was not available for the desired complete picture of production – an aggregate overview was not available and direct data collection via survey was not an option due to both time constraints on factory management side but also hesitation from managers to share production data in detail<br>• Detailed disaggregation was therefore also difficult for factory subsegments (value segments, size, production type)<br>• Detail energy consumption data on factory side was not yet available on broader scale, disaggregated by factory subsegments | • The Factory Characterization Study conducted by TAFTAC/ CGTI was used to create factory profiles of factory archetypes to use in modelling<br>• Data was obtained from CGTI experts on production, such as material use, SMV per product, FOB price etc.<br>• Switch Garment audit data was used to approximate the production and energy consumption data for the model, based on factory and product characteristics<br>• Extrapolations based on small numbers where feasible | • The anticipated data challenges were addressed with alternative data sources in close collaboration and alignment with the Switch Garment project team<br>• The generally scarce data situation for the garment sector was thus approximated based on available sample data, expert insights, informed assumptions, and extrapolations to arrive at a sound enough data base for reliable modelling |

| | | | |
|---|---|---|---|
| **Interviews with TAFTAC board members for feedback on the MGFP** | Input and insights from factory owner and manager side were difficult to come by due to complications scheduling interviews | • An in-depth interview with one TAFTAC board member combined with CGTI insights on the garment sector, garment production and challenges provided the basis for the factory perspective<br>• Another brief opportunity for feedback from factory side was the consultation workshop | The factory perspective in the analysis is based on the select few direct sources from TAFTAC / CGTI side but also on reflections on sector characteristics and challenges as shared by other stakeholders, such as development partners closely collaborating with garment producers |
| **Effects of energy efficiency measures on productivity and defects** | • Reliable data backed by literature review could not be secured<br>• The effects can also vary based on operator skills and maintenance | A reverse approach by going through specialized service providers or brand measures that focus on process and productivity improvements failed for their lack of detailed insight on simultaneous effects on energy and environment[187] | This aspect was therefore not included in the model |

Quantification of competitiveness and its development as an impact of SE measures is only possible for aspects examined in modeling, such as costs and revenues, and based on the different product types and value segments. As the various purchase decision drivers and the role of specific sustainability factors were not quantified by buyers, these could not be included in the model but only from a qualitative perspective.

While the model indicates changes of profitability resulting from the adoption of technology, how this may increase access to market and revenue as well as competitiveness on an individual factory or sector level depends on the strategic approach the factory owners decide to take: Whether prices are reduced for current buyers to increase market share or investments are made for higher quality production to progress to a higher value segment of buyers.

Assessment of large-scale trends or developments and their long-term implications, such as automation of garment production or re- and near-shoring, are based on a qualitative assessment through secondary and primary research. This was outside of the model scope due to not only the long-term timeframe but even more so dependency on a multitude of factors.

## 9.2. Model Documentation

The creation of customized simulation models, one for each product and then grouped by brand value, is based on the identification of causality in the definition of profitability and impacts of economic activity. System Dynamics (SD) was used as the underlying methodology to capture the stock and

[187] Impactiva is a consultancy that supports manufacturers with lean management principles to improve quality, efficiency, and productivity which often along the way results in reduction of waste and increase in sustainability. Via focus on product quality, reduction of defective products and increase of output for the same input of labor, energy, water leads to higher sustainability, competitiveness and better sourcing agreements – but the focus for measurement is rather on the lean management principles. (KII with Impactiva, 2019)

flow dynamics introduced by policy intervention.

The use of a systemic approach was chosen for this assessment because:

1. Integration: this approach allows to integrate indicators of different nature (e.g. jobs, energy consumption, emissions, units of equipment installed) in the economic assessment of the performance of a product or factory;

2. Forecast of trends over time: this approach supports the use of stocks and flows, representing accumulations and their flows, allowing to carry out an assessment that is time-explicit.

3. Speed of analysis and customization: the software used, called Vensim, allows to create new simulations in seconds, it offers transparency and advanced features to investigate the model and its results.

SD is a methodology designed to investigate how different parts of a system interact with one another. As a result, it is well suited, and commonly used, to assess how social, economic and environmental indicators interact in determining the performance of a system, or a sector. In fact, the use of SD allows for the seamless integration of social, economic and environmental indicators in a single framework of analysis through the use of stocks and flows (and hence allows for the direct integration of natural capital in socio-economic models). Further, an SD model can be fully customized to a local context, and in our case to different products and factories.

SD allows for the creation of time-based simulations that forecast scenario outcomes on social, economic and environmental indicators (including selected SDGs), informing both policy formulation and evaluation (e.g. through the anticipation of synergies and tradeoffs -or side effects- over time). When integrated models are built with SD, it is possible to assess whether policy interventions, through "what if" scenarios, leads to the desired outcomes or also generate the emergence of side effects (e.g. economic growth is accompanied by increasing stress to the environment).

The models created for each product include several indicators, grouped as follows: (1) production costs and revenues, (2) GHG impacts of production, and (3) costs and benefits of improving energy efficiency and expanding renewable energy generation with solar PV. These variables of the model are used to estimate additional indicators, such as productivity (e.g. for labor, energy, emissions).

### 9.2.1. Overview

Twelve simulations models have been created for this study, one for each of the following products and brand value: high value brands (sportswear functional t-shirt, sportswear short pants, sportswear knit light sweater, sportswear long pants), medium value brands (woven pants light, woven blouse, woven pants warm, woven jacket), low value brands (men underwear, simple women panties, simple women bra, women pyjama).

The models simulate from the year 2020 until 2060 and include the introduction of new equipment for (i) compressed air, (ii) lighting, (iii) sewing, (iv) steam (from biomass, electricity and liquid fuel), (v) ventilation as well as (vi) renewable energy generation from solar PV. The introduction of efficient equipment can be introduced at any point in time. The simulation results presented in this report assume a gradual uptake or new technology, between 2022 and 2030. Solar PV is instead introduced in one year, in 2030. This allows for a comparison of the introduction of different investments at different points in time, both for energy consumption and emissions and for the balance sheet and profitability of factories.

Several indicators have been identified for inclusion in the simulation models. These are primarily reflecting production revenues and costs, as well as their environmental impacts and contribution to socio-economic development. At the firm-level, emphasis is put on (a) required investments, (b) policy-induced avoided costs and (c) added benefits. Value added (i.e. profit) is estimated with two methods: (a) a conventional one, considering revenues, costs and income taxation and (b) one in which the cost of GHG emissions is also considered approximating

the introduction of a carbon tax at national or international level.

The presentation of the model starts with (1) revenues and costs (capital and operation and maintenance, labor, energy, water) and (2) environmental impacts (GHG emissions). It then continues with (3) the estimation of energy consumption by energy services, and related stock upgrades in the alternative scenarios. Key equations are presented, describing how productivity indicators are estimated (e.g. using both economic value addition and resource use).

### 9.2.2. Revenues and Profitability

The profitability of an industrial sub-sector is estimated in the model as GDP, representing the value addition of the sector. GDP is estimated considering two main elements: the operational results of the sector and taxation. The equation used for the calculation of the garment sector GDP is formulated as:

*Value added (GDP) = operating results * (1 - TAX RATE)*

Figure 5 provides an overview of the variables used for the calculation of the variable 'value added (with valuation of emissions)' in form of a *tree diagram*, or causes tree. A causes tree shows the variables used for the calculation of the indicator selected. The indicator of interest is the first on the right, and its causes are presented on the left. This tree diagram illustrates the variables used for the calculation of GDP, and further provides insight into the variables that are used to estimate the cost of carbon. The operational results, being the taxable income (estimated using revenues and costs), and the tax rate are used to calculate the value added by product, and emissions from energy and the social cost of carbon are used to estimate the valuation of emissions. Value added considering the valuation of emissions is calculated by subtracting the cost of carbon from value added.

Further, the diagram indicates the **revenues**, which are estimated using production and a market price. A switch hereby allows to choose between two different sales prices.

### 9.2.3. Cost of Operation

**Production costs** on the other hand are estimated as the sum fabric costs, basic trim costs, logistics costs and CMT costs, whereby CMT includes the cost of labor, waste management, energy and other costs. The causes tree illustrating the variables used to calculate the costs of production is presented in Figure 6.

**Costs related to basic trimming, fabric use and logistics** are calculated by multiplying the total production quantity by a respective unit cost. The

*Figure 5: Causes tree GDP garment sector*

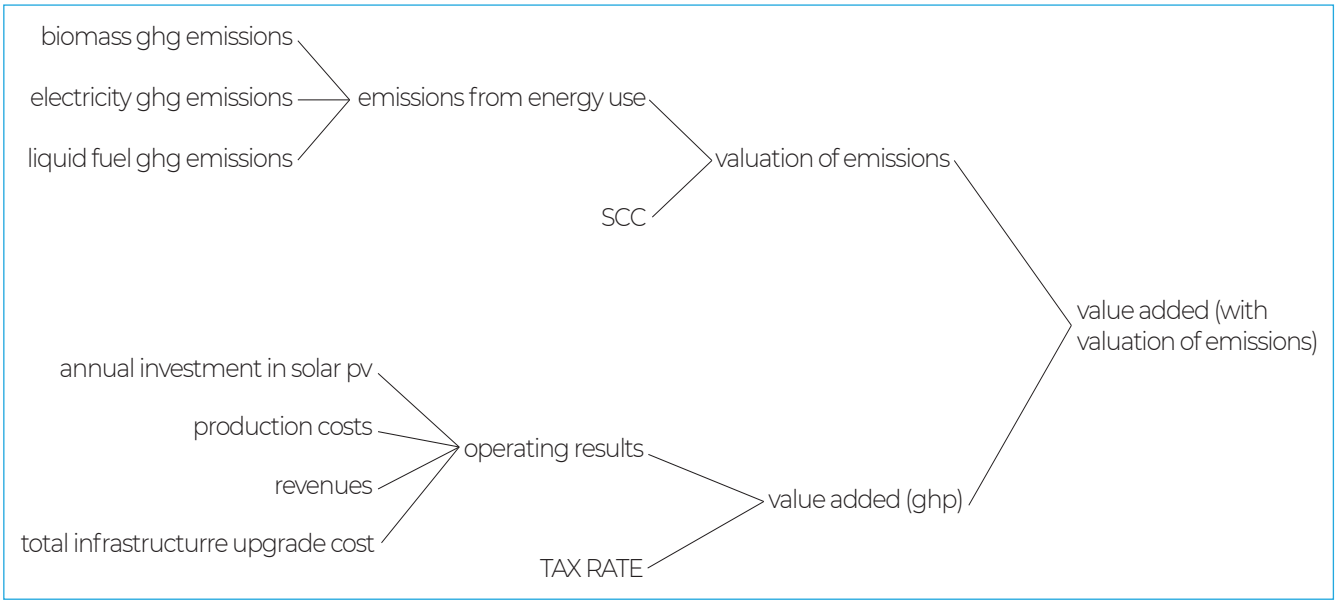
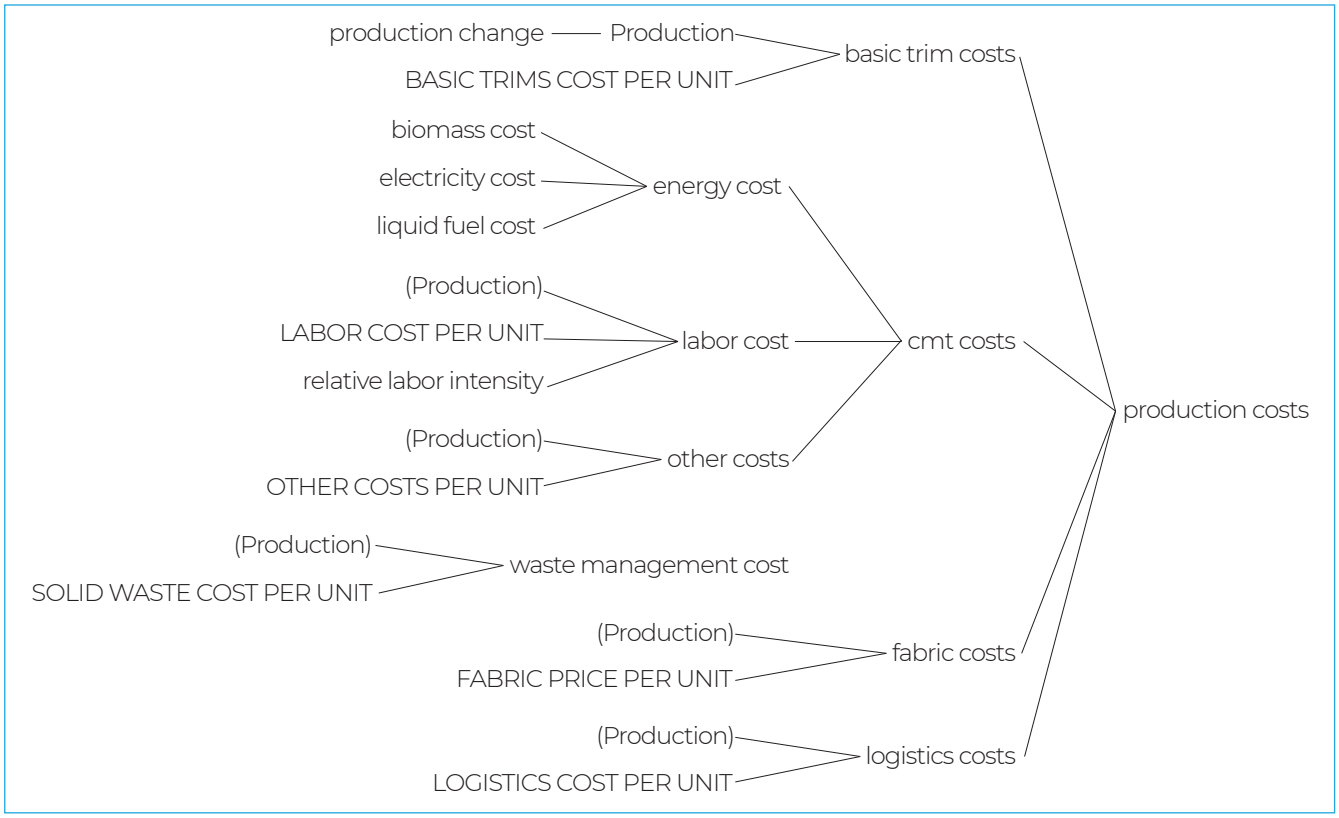


*Figure 6: Causes tree production costs garment*




equations for calculating these costs are presented below.

*Fabric costs = Production * FABRIC PRICE PER UNIT*

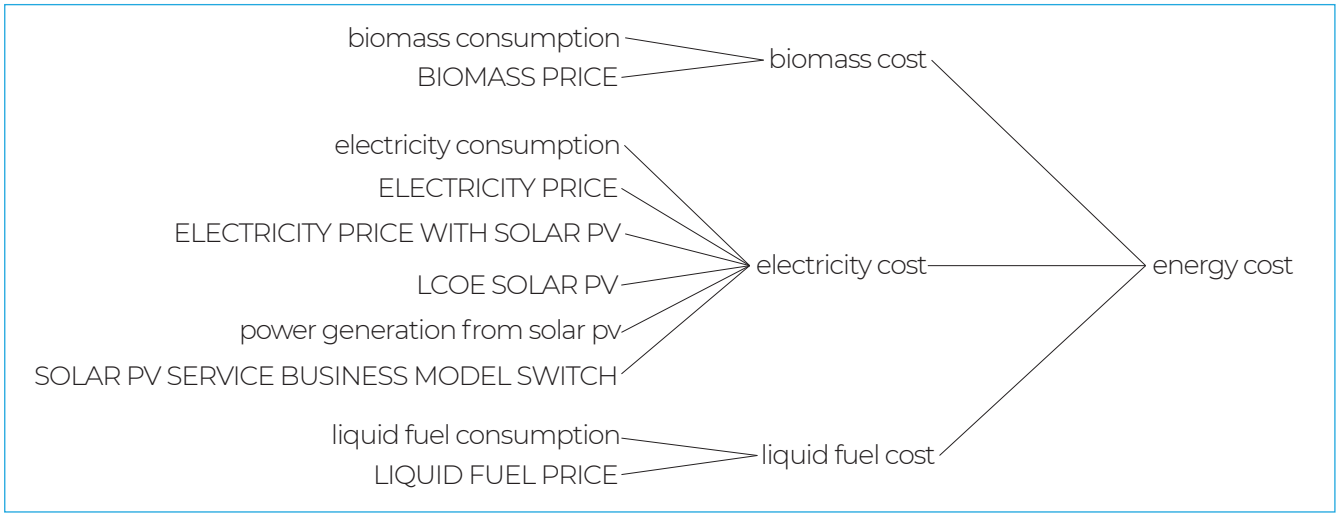
*Basic trim costs = Production * BASIC TRIMS COST PER UNIT*

*Logistics costs = Production * LOGISTICS COST PER UNIT*

**CMT costs**, as displayed in Figure 6, are calculated as the sum of energy cost, labor cost, waste management cost and other cost.

The model considers three different energy sources, biomass, liquid fuels and electricity. Energy costs are the sum of costs for those three fuels, all of which are calculated based on the respective energy use per product (by fuel source) and the cost of energy. The causes tree for the cost of energy is presented in Figure 7.

*Figure 7: Causes tree for energy cost*



While the cost of biomass and liquid fuels is calculated based on energy use and related cost, the cost of electricity is subject to different policy interventions, specifically the establishment of on-site solar PV capacity, which will affect cost. The equation used for the calculation of electricity cost is presented below.

*Electricity cost =*

*IF THEN ELSE(power generation from solar pv = 0, electricity consumption * ELECTRICITY PRICE, IF THEN ELSE(SOLAR PV SERVICE BUSINESS MODEL SWITCH = 0, electricity consumption * ELECTRICITY PRICE WITH SOLAR PV, electricity consumption * ELECTRICITY PRICE WITH SOLAR PV + power generation from solar pv * LCOE SOLAR PV))*

The equation for electricity cost uses two nested IF THEN ELSE functions. The first IF THEN ELSE function is used to assess whether power generation from solar is active, whereby value bigger than zero indicates that electricity is generated from solar. If there is no solar PV generation, electricity consumption is multiplied by the grid electricity price. In case that electricity is generated using solar PV, the second IF THEN ELSE function allows to distinguish between two different business models using a switch, whereby (i) a switch value of zero calculates the cost of electricity based on electricity purchased from the grid at an adjusted price that the utility charges when their customer uses solar power, or (ii) a switch value of one ("1") calculates the cost of electricity using the same approach as in the previous case with the difference that it adds the cost of buying electricity from solar PV when a power purchase agreement is signed with an energy service company as opposed to buying solar panels and producing on-site.

The **cost of labor** depends, in addition to production and the average labor cost per unit, on the relative labor intensity per product. Relative labor intensity is an index that is calculated based on the current and initial labor intensity at any point in time. This index is used to account for changes in labor intensity by product and hence related labor cost.

*Labor cost = Production * LABOR COST PER UNIT * relative labor intensity*

**Waste management and other costs** are calculated by multiplying total production by a respective per unit cost.

### 9.2.4. Energy Use

As indicated above, the model considers the use of biomass, liquid fuels and electricity for the production of each of the products considered. Biomass and liquid fuels are used for steam production and their consumption is calculated based on the historical energy intensity (by fuel) for each product, total production and an efficiency multiplier that allows for simulating different policy scenarios. The causes tree of the demand for liquid fuels is presented in Figure 8.

*Figure 8: Causes tree for liquid fuels*

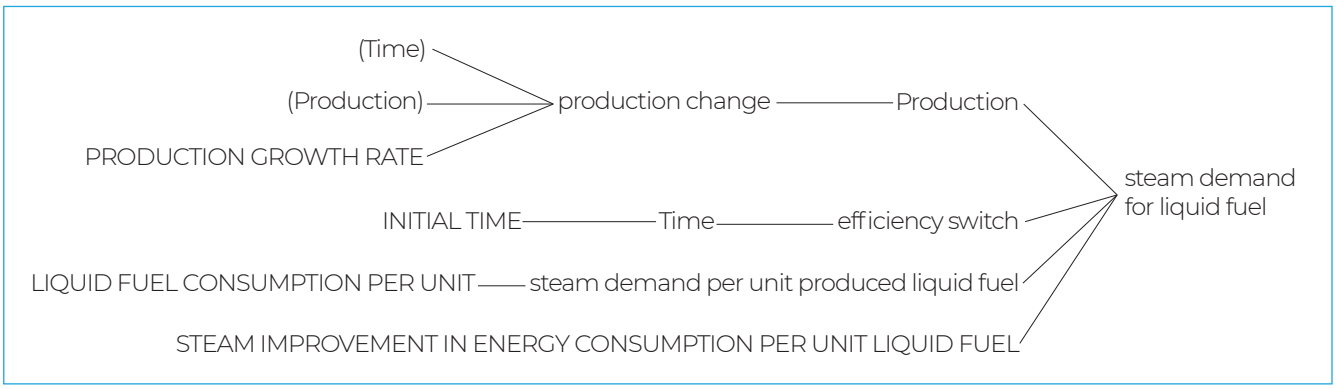


Figure 9 provides an overview of the variables used for determining total electricity demand and the actual amount of grid electricity that is consumed by type of product. While total on-site electricity consumption is the sum of electricity use for AC ventilation, lighting, compressed air, sewing and steam production, the net amount of electricity consumed from the grid is calculated as the difference between the electricity demand from all sources and the amount of electricity produced by on-site solar PV. Electricity consumption from the grid is hence calculated using the following equation:

*Electricity consumption =*

*electricity consumption v2 - power generation from solar PV*

### 9.2.5. GHG Emissions

The model estimates total sub-sectoral GHG emissions from energy and land use. The variables used to determine total sectoral GHG emissions are presented in Figure 10.

*Figure 9: Causes tree energy consumption garment*

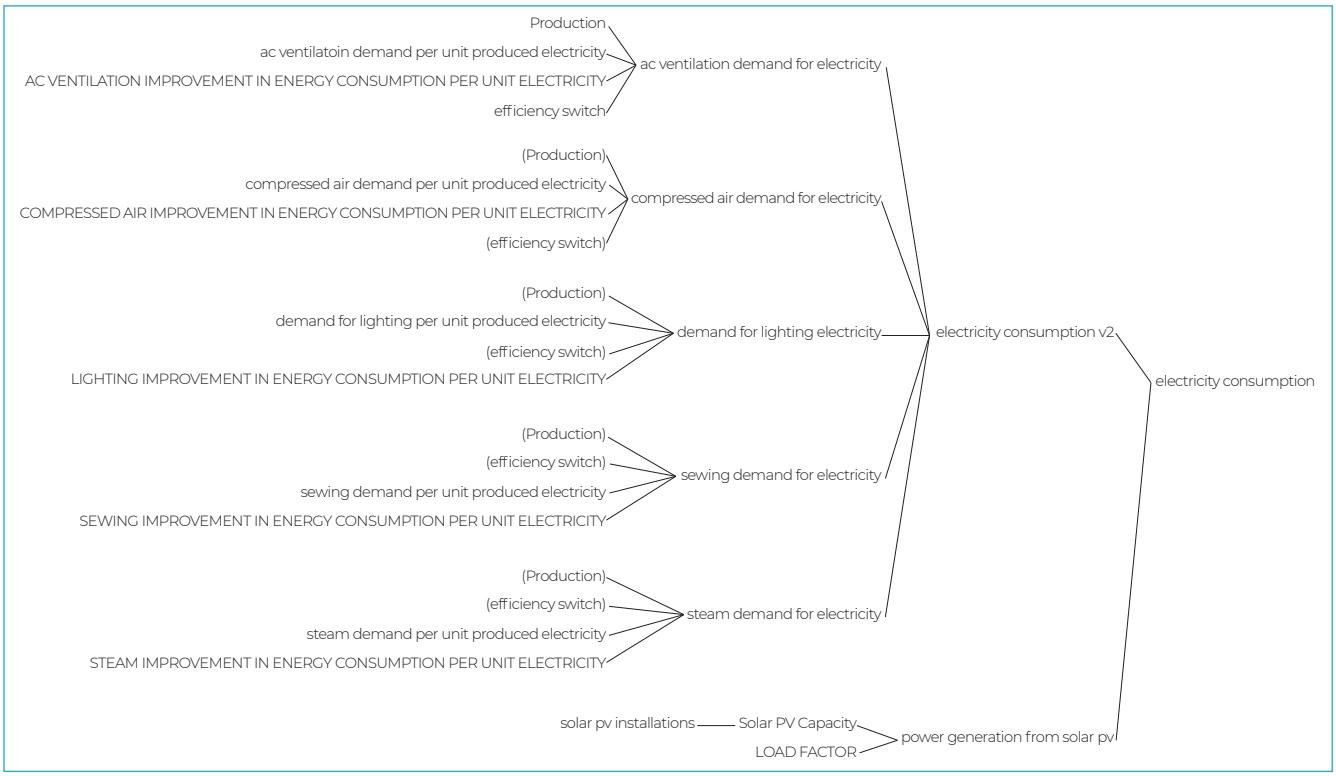
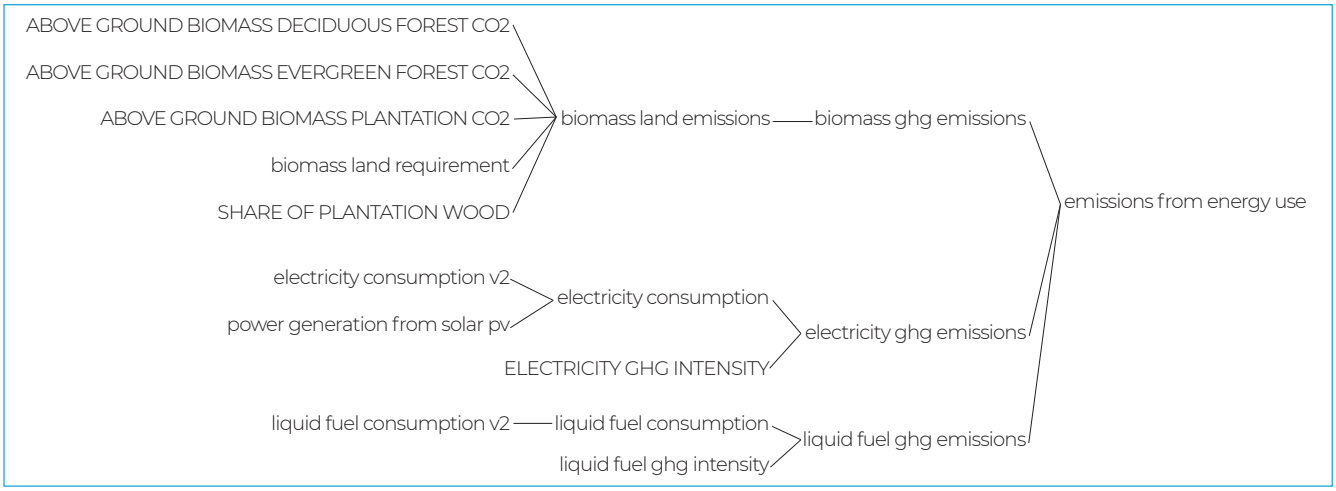



*Figure 10: Causes tree total GHG emissions garment*



Emissions from electricity and liquid fuel use are calculated based on the total amount of energy consumed and a respective emission factor. The use of renewable energy contributes to the reduction of grid electricity and hence emissions from electricity generation. Similarly, energy efficiency policies will also modify the energy consumption and emissions generated by each product.

Emissions from land use represent the carbon sequestration capacity that is lost because of production, as specifically because of biomass consumption. In other words, these are the emissions generated by using biomass as energy source. Figure 11 below provides an overview of the variables used to estimate GHG emission from biomass. Biomass energy use is converted to tons in order to determine the total amount of land for growing the required biomass. The amount of land and the composition of the land used (i.e. deciduous forest, evergreen forest, plantations) are then used to determine biomass related GHG emissions.

The economic valuation of emissions, representing the cost of GHG emissions, is based on the health impact of emissions, considering the increased incidence of respiratory diseases and the growing frequency, impact and cost of weather-related natural disasters. This is also called Social Costs of Carbon (SCC) and an average cost of USD 31 per ton of GHG is used (Nordhaus, 2016).

The starting point is the estimation of annual emissions, which are then multiplied by the value of emissions per ton. The following equation is used to calculate the value of emissions:

*Valuation Of Emissions = emissions from energy use * SCC*

### 9.2.6. Equipment and Related Cost

The equipment modules keep track of energy efficiency improvements that can be phased in for simulating different policy scenarios as well as the cost that occurs for establishing more energy efficient equipment. Figure 12 below provides an overview of the variables that are used to calculate the total cost of infrastructure upgrades, which is the sum of costs across all equipment categories.

*total infrastructure upgrade cost =*

*annual cost compressed air electricity unit upgrade + annual cost lighting unit upgrade + annual cost sewing electricity unit upgrade + annual cost steam biomass unit upgrade + annual cost steam liquid fuel unit upgrade + annual cost steam electricity unit upgrade + annual cost ventilation electricity unit upgrade*

The calculation of energy efficiency upgrades and related cost is structurally identical across all categories (i.e. estimates the number of units that are substituted with more efficient ones, and related cost) and the structure for upgraded lighting units is proposed for illustration purposes. The causes tree for the annual cost of upgrading lighting (i.e. replacing light bulbs) is presented in Figure 13.

*Figure 11: Causes tree total GHG emissions from biomass use*

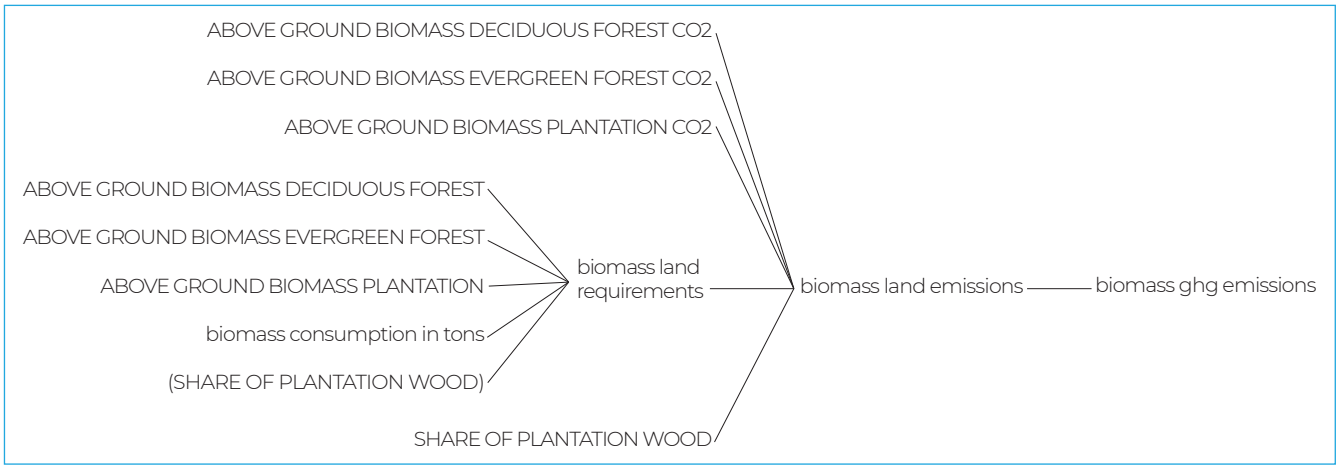


*Figure 12: Causes tree total infrastructure upgrade cost*

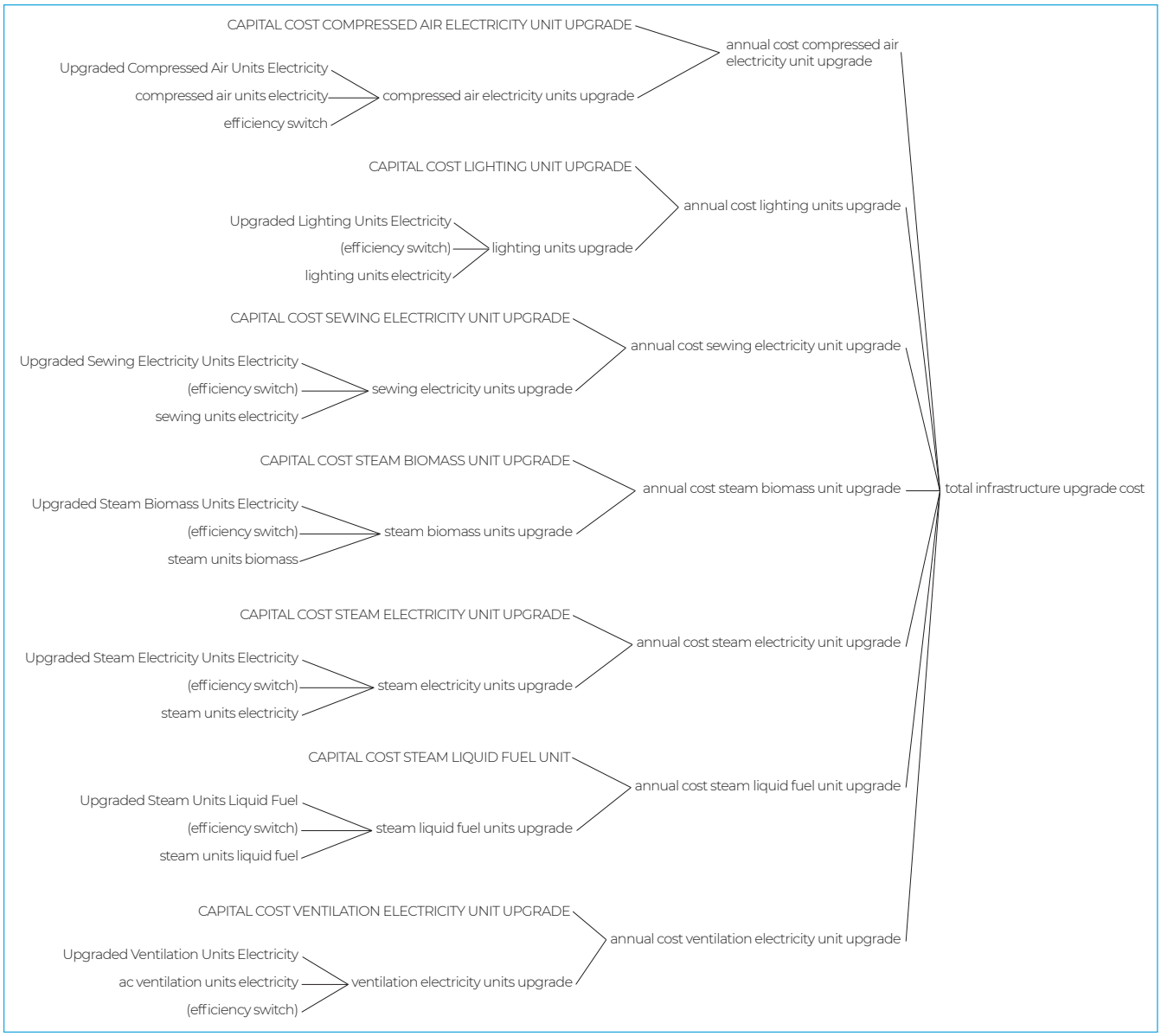
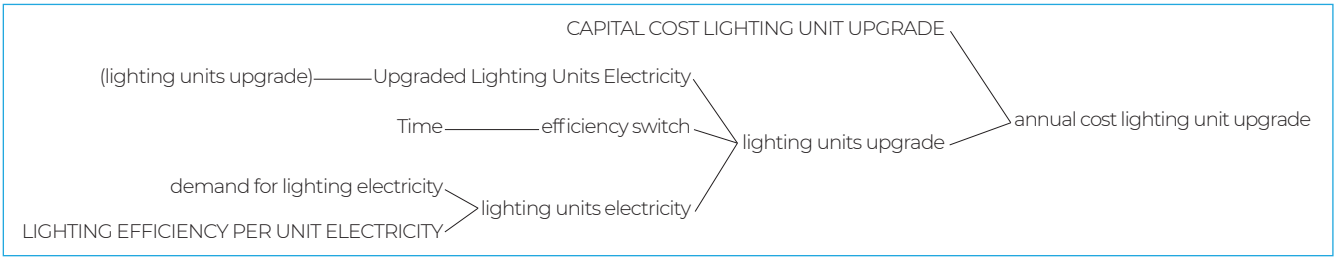



*Figure 13: Causes tree annual cost lighting unit upgrade*




The model calculates the total amount of lighting units (read: light bulbs) based on the electricity demand for lighting and the average consumption per lighting unit. If the energy efficiency switch is active (switch value bigger than zero), the model estimates the amount of lighting units that are more energy efficient, using the following equation.

*lighting units upgrade =*

*lighting units electricity * efficiency switch - Upgraded Lighting Units Electricity*

The efficiency switch is a user defined policy variable that is formulated as a time series function and can take a value between zero (no upgrade of equipment) to one (representing 100% of equipment upgraded to be more energy efficient). The number of upgraded units accumulate into a stock with upgraded units, in the case of lighting, the "upgraded lighting units electricity". This implies that the equation presented above is a goal seeking function that ensures that the share of equipment upgraded, and hence units of equipment upgraded, correspond to the user-defined fraction.

The upgrading of equipment is subsequently multiplied by the capital cost per unit of upgraded equipment to calculate the annual cost incurring from energy efficiency improvements.

*annual cost lighting unit upgrade =*

*lighting units upgrade * CAPITAL COST LIGHTING UNIT UPGRADE*

### 9.2.7. Air Pollution from Energy Use and Power Generation

The model estimates the generation of air pollutants from energy consumption and from power generation. In total, 11 pollutants across energy sources estimated, and we consider only the industrial sector in the model. The emission factors were obtained from the emission factor database of the LEAP Integrated Benefits Calculator (IBC), which is publicly available[188]. The air pollutants considered in the analysis are:

- CO2
- CO
- NOx
- NMVOC
- CH4
- PM10
- PM2.5
- Black carbon
- Organic Carbon
- Ammonia (NH3)

Air pollutants for energy consumption and power generation are calculated separately. Air pollutants from final energy consumption are calculated by multiplying final energy demand (by energy source) by a respective emission factor by type of fuel and sector. For example, pm10 emissions from biomass use, for the industrial sector (which includes garment), are calculated by the following equation.

*pm10 emissions from biomass =*

*normalized biofuels and waste demand* PM10 EMISSIONS PER TJ OF BIOMASS BY SECTOR/KG PER TON*

The same approach is used for all other fuel types (petroleum and biomass in our analysis). Air pollutants from power generation are calculated by multiplying the fuel used for the generation of electricity by a respective emissions per TJ of fuel used multiplier. In our study we consider diesel generators for the estimation of air pollution, as a proxy for the use of fossil fuels (diesel for small generators, coal for centralized power supply).

*fuel use for power generation in tj[power generation technology] =*

*fuel use per mwh by technology new[power generation technology]*electricity generation rate[power generation technology]*

The emission factors used for the estimation of air pollutants from energy consumption and power generation are summarized in Table 25

[188] https://leap.sei.org/default.asp?action=IBC

The economic valuation of air pollution is performed considering a few, and most relevant, air pollutants for human health. Specifically, we consider PM2.5, NOx and ammonia, as follows (Gilmore, et al., 2019):

- pm2.5:
    - low 29,000 USD/Ton (value for SA)
    - high 130,000 USD/Ton
- NOx:
    - low 6,300 USD/Ton
    - high 11,000 USD/Ton
- NH3:
    - low 32,000 USD/Ton
    - high 51,000 USD/Ton

*Table 25: Overview of Air Pollution Multipliers for Energy Consumption and Power Generation*

| Fuel type/ Sector | CO2 | CO | Nox | NMVOC | CH4 | PM10 | PM2.5 | Black Carbon | Organic Carbon | N2O | NH3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ton/ TJ | kg/TJ | | | | | | | | | |
| **Coal** | | | | | | | | | | | |
| Residential | 94.6 | 2,610 | 34 | 484 | 300 | 490.1 | 440.4 | 72.85 | 196.4 | 0 | 38.74 |
| Commercial | 94.6 | 931 | 173 | 88.8 | 10 | 117 | 108 | 6.9 | 5.2 | 1.5 | 0.0093 |
| Industry | 94.6 | 931 | 173 | 88.8 | 10 | 117 | 108 | 6.9 | 5.2 | 1.5 | 0.0093 |
| Transport | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| **Petroleum** | | | | | | | | | | | |
| Residential | 67.46 | 93 | 306 | 20 | 10 | 21 | 18 | 10.1 | 2.89 | 1.51 | 0.108 |
| Commercial | 74.1 | 130 | 942 | 50 | 10 | 96 | 96 | 40 | 28 | 0.6 | 0.168 |
| Industry | 74.1 | 66 | 513 | 25 | 3 | 20 | 20 | 11.2 | 3.6 | 0.6 | 0.154 |
| Transport | 69.3 | 5,808 | 644.2 | 741.81 | 33 | 161.64 | 161.64 | 9.27 | 116.38 | 3.2 | 31.03 |
| **Natural gas** | | | | | | | | | | | |
| Residential | 56.1 | 26 | 51 | 1.9 | 5 | 1.2 | 1.2 | 0.065 | 0.54 | 0.1 | 0.181 |
| Commercial | 56.1 | 29 | 74 | 23 | 5 | 0.78 | 0.78 | 0.03 | 0.26 | 0.942 | 1.214 |
| Industry | 56.1 | 29 | 74 | 23 | 1 | 0.78 | 0.78 | 0.03 | 0.26 | 0.1 | 1.214 |
| Transport | 56.1 | 271.7 | 543.48 | 12.14 | 92 | 0.725 | 0.725 | 0.036 | 0.326 | 2.72 | N/A |
| **Biofuels and waste** | | | | | | | | | | | |
| Residential | 95.6 | 4,753 | 134.6 | 1,654 | 300 | 512.35 | 409.88 | 51.24 | 178.4 | 134.57 | 53.7 |
| Commercial | 112 | 570 | 91 | 300 | 300 | 143 | 140 | 39.2 | 72 | 4 | 37 |
| Industry | 112 | 570 | 91 | 300 | 30 | 143 | 140 | 39.2 | 72 | 4 | 37 |
| Transport | 79.6 | 5,808 | 51 | 0.69 | 18 | 1.9 | 1.9 | 0.16 | 0 | 0 | 0 |
| **Power generation (by fuel type)** | | | | | | | | | | | |
| Fuel and diesel oil | 77.4 | 15.1 | 142 | 2.3 | 3 | 25.2 | 19.3 | 0.957 | 0.359 | 0.6 | 0.101 |
| Cogeneration | 77.4 | 15.1 | 142 | 2.3 | 3 | 25.2 | 19.3 | 0.957 | 0.359 | 0.6 | 0.101 |
| Natural gas | 565.1 | 39 | 89 | 2.6 | 1 | 0.89 | 0.89 | 0.022 | 0.022 | 0.1 | 1.829 |
| Coal | 96.1 | 8.7 | 247 | 1.4 | 1 | 7.9 | 3.2 | 0.083 | 0.167 | 1.5 | 0.012 |
| Waste incineration | 91.7 | 90 | 81 | 7.31 | 30 | 155 | 133 | 1.444 | 0.222 | 4 | 0.222 |

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*** Note on citation: KIIs for this project were conducted in 2021. KIIs conducted for a research project on green investments in the garment sector in Cambodia from 2019 were also utilized; these KIIs are marked with ''(2019)''.

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