UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Low-Carbon and Climate Resilient Industrial Development in Africa

Impact Report

EGYPT

KENYA

SENEGAL

SOUTH AFRICA

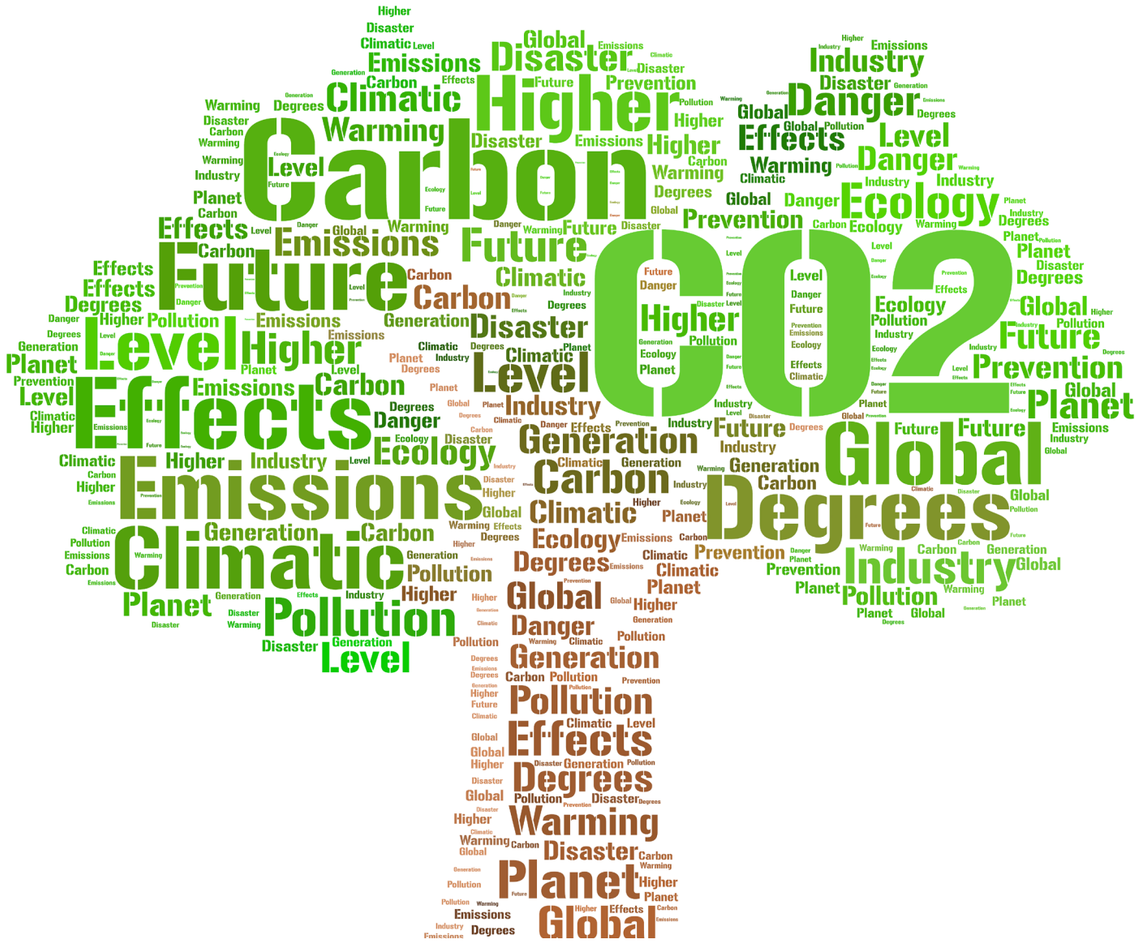
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

The aim of this publication is to promote understanding of the need for climate adaptation in industry, and to showcase the climate-resilient development benefits for pilot companies involved in the regional "Low Carbon and Climate Resilient Industrial Development in Africa" project, funded by the Government of Japan. The project was implemented by UNIDO with the cooperation of National Cleaner Production Centers in Egypt, Kenya, Senegal and South Africa - members of the Global Resource for Resource-Efficient and Cleaner Production (RECPnet).

For more information about the project, please visit:

From the People of Japan

Content



Climate Adaptation for Industry

Since climate change was recognized as a problem in the late 1980s, the major focus has been on mitigation (reducing atmospheric greenhouse gas emissions). But as it becomes clearer that even with mitigation, climate change is inevitable, there is a growing need to adapt to the conditions of the changed climate.

Mitigation and adaptation are conceptually complementary strategies to address climate change impacts. Creating synergies between them has multiple benefits, such as cost-effectiveness, that may not be achieved if they are addressed separately.

This is particularly true for the industrial sector, where awareness and implementation of adaptation strategies remain particularly low because adaptation is seen by stakeholders as an expense rather than an investment to tackle future climate risks. Developing countries usually have low financial, technological and institutional capacities to pursue low-carbon, climate-resilient development paths. And yet it is in developing countries, especially those of the African continent where the need for industrial sector adaptation is especially urgent, because of their higher vulnerability to climate change.

The agricultural industry is the largest economic sector in Africa, representing 15% of the continent's total GDP. For this industry, in developing countries like those in Africa, the impacts of climate change are felt not only in primary production, but also in post-harvest processes, such as processing, transportation and storage. Industry adaptation and mitigation approaches must consider sector-wide needs and should focus on post-harvest processes, where they can contribute to food security and increase the value of the final product.

STRATEGIES TO ADDRESS CLIMATE CHANGE IMPACTS

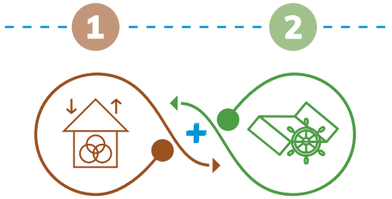
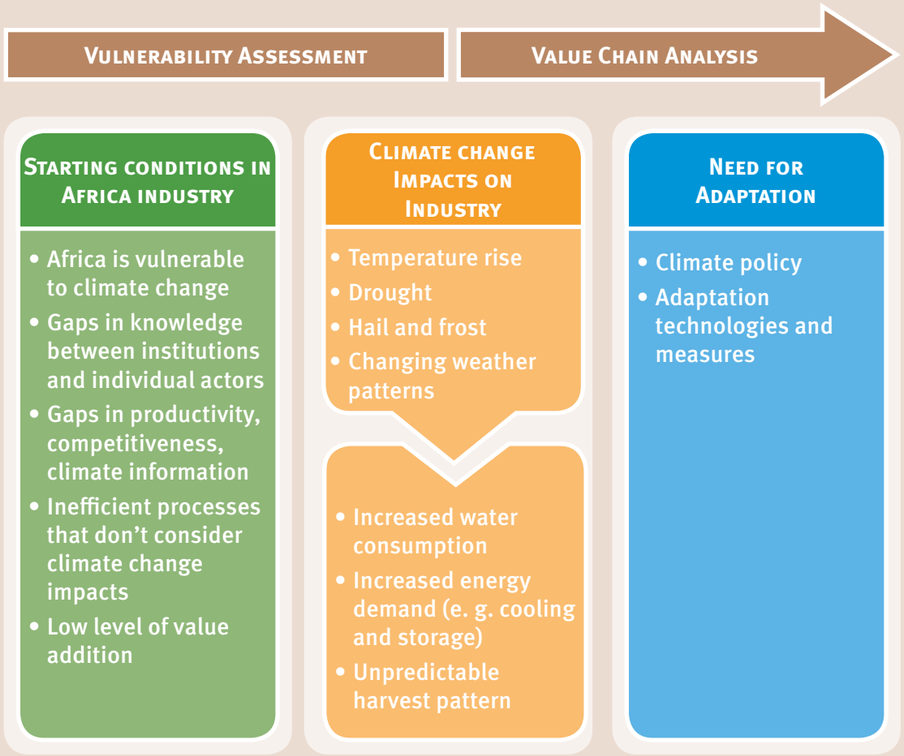


Figure 1. Illustration of Need for Industry Climate Adaptation in Africa



Industry Needs and Challenges: Adaptation in Africa

Industrialization has lifted millions out of poverty, created jobs, advanced technology and increased social prosperity in countries around the world. However, industry is also one of the leading emitters of greenhouse gases (GHG). In Africa, industrial development has not been accompanied by the robust structural transformation characteristic of industries. Many industries still apply inefficient processes and low levels of value addition. This situation can be exacerbated by climate change impacts which lead to diminished raw material supplies and product quality inconsistency.

Temperature rise, drought, changing precipitation patterns, hail and frost are climate change impacts observed in many countries in Africa. The rise in temperature is forecast to push up water and energy consumption. And the changing weather patterns generate unpredictable harvests, leaving many small-scale farmers and industries struggling to plan for the future. The adverse impacts of climate change are recognized, but the concept of adaptation less so, particularly in the industrial sector.

Gaps in knowledge between institutions and individual actors, as well as poor access to climate information, add to the challenge of raising adaptation approach awareness across the continent. Attempts to do so must also contend with the low income levels in African developing nations, which consequently have the lowest financial, technological and institutional capacities to pursue low-carbon, climate-resilient development initiatives.

Supportive national policies, including for example PV or biomass subsidization, or a prohibition on tree-cutting for firewood, can help foster climate adaptation awareness. Vulnerability assessments and value chain analyses are required to identify exact intervention needs and appropriate technologies to address vulnerability at factory level. That's what happened in Kenya, where the UNIDO project helped the Kiamokama tea factory install more efficient air blower technology to better control withering - the most energy-intensive processes in tea production. The pioneering technology reduced energy consumption, and thus production costs. Such actions foster awareness and demonstrate the opportunities and benefits of enhanced climate resilience and low-carbon growth in the productive industries.

Figure 2. UNIDO's Green Industry Initiative - a two-pronged strategy

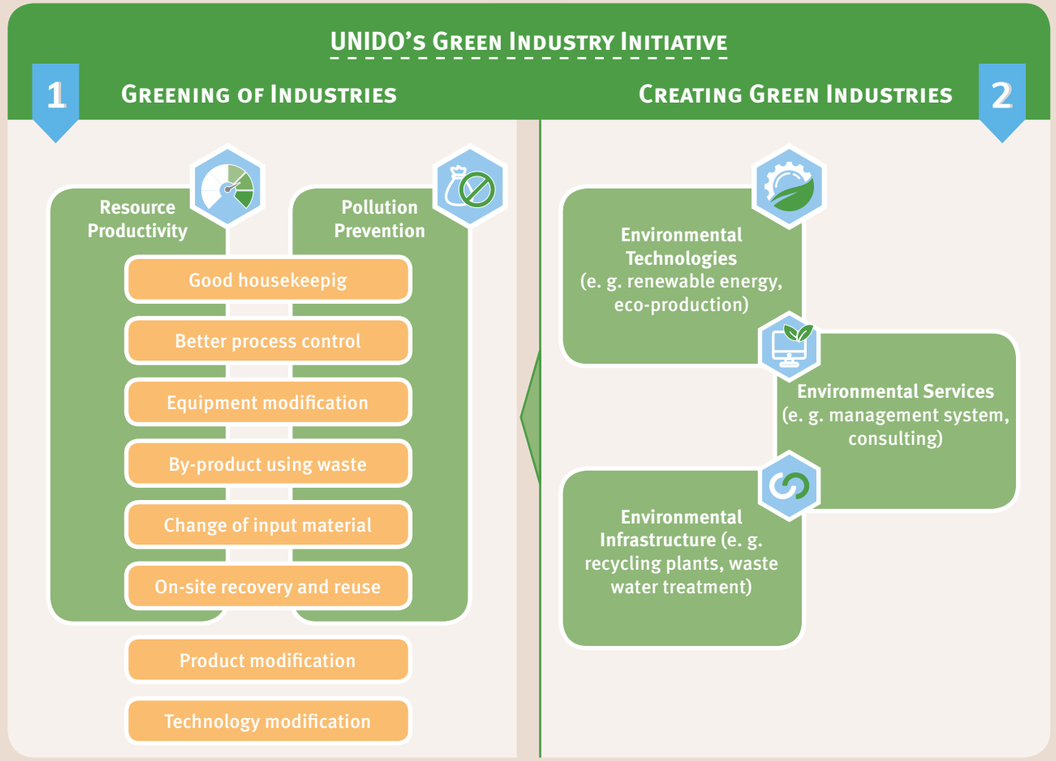
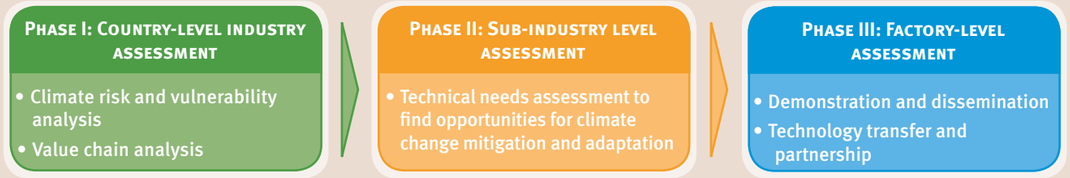


Figure 3. Three Phases of LCCR Project



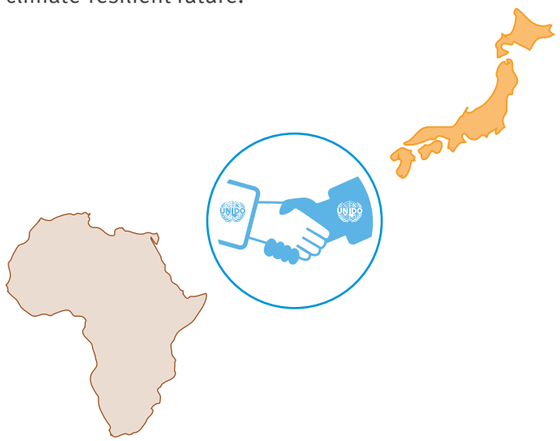
UNIDO's Contributions - and How they Help

Japan has funded the Low Carbon and Climate Resilient Industrial Development project (LCCR), on which UNIDO is collaborating to create awareness and demonstrate the opportunities and benefits of low-carbon growth and climate-resilient development in the manufacturing and processing industrial sectors. Inherent to the project is application of the combination of Green Industry (GI) principle and Resource Efficient and Cleaner Production (RECP) practices to overcome climate vulnerability in industry. GI development is based on best practice concerning resource efficiency and climate-friendly technology, and requires a change of philosophy, re-organization of industrial production and a shift towards green products and services.

UNIDO largely takes two approaches to implement the GI concept: "greening of industries" and "creating of green industries". The first refers to the improvement of existing industries through proven methods and techniques in order to achieve a reduction of GHG emissions and an increase of resource efficiency. The second targets the development, practical implementation and market introduction of green technologies, products and services. In this context, the LCCR project promoted **business partnership** between Africa and Japan, with UNIDO playing a bridging role to find technology suppliers from Japan that match the adaptation needs of the factories in the target countries. The green industries approach also aims at jobs creation and wage increases, both of which lead to poverty alleviation. Ultimately, GI aims to minimize climate-induced risks by increasing industry resilience and avoiding potential future costs.

The LCCR project targeted the four African countries Egypt, Kenya, Senegal and South Africa, and engage da wide range of stakeholders to assess national policy towards climate change, to identify vulnerabilities of selected sub-industries, and to tackle adaptation needs through low-carbon technology installations and demonstrations at factory-level. As such, the project in three different phases, with the LCCR methodology applied in a narrowing scope, starting from the national level, passing by a selected industry sector for each country, and finally targeting specifically selected factories and facilities.

Building on longstanding experience in safeguarding the environment, UNIDO takes a holistic approach to facilitate the transformation of industries in developing countries and economies towards a low-emission and climate-resilient future.



PROJECT COVERAGE

4 AFRICAN COUNTRIES

EGYPT

SENEGAL

KENYA

SOUTH AFRICA

Egypt

Resource Efficiency in the Face of Climate Change: Egyptian Food Production Industry Goes Low-Carbon, Climate-Resilient

Climate change is hitting Egypt's industries hard. Extended summers, higher temperatures, extreme weather peaks, and unpredictable weather changes have led to higher refrigeration costs, cooling system failure, crop wipe-outs through disease, ad hoc harvest date shifting, higher waste, and loss of business. Add to this a government plan to increase electricity prices to an international-standard level by 2022 and it's easy to see how daunting a challenge Egyptian companies face. But it's not an unclimbable mountain. Thanks to UNIDO's project, Egyptian companies are embracing smart low-carbon climate-resilient technology – and reducing costs.

More Efficient Cooling Means Lower Costs, for Frozen Foods Producer Frozena

Climate change means rising temperatures in Egypt. **Frozen** foods however need to be kept cold, very cold. This explains why as a result of the climate impact leading Egyptian frozen foods producer Frozena was using more and more electricity for its chillers. In fact, electricity accounted for over 60% of the company's energy costs, including gas and fuel. A 2018 tariff rise – more than doubling the early 2015 tariff – pushed up Frozena's total electricity costs by a whopping 145%. As electricity rates – and costs - rose, so did Frozena's concern.

Frozena needed to bring down electricity use while maintaining quality and productivity. That's why it is replacing two single-stage compressors with compound two-stage screw compressors from Japanese industrial refrigeration manufacturer **Mayekawa**, creating a more efficient cooling system with a cooling capacity of at least 450 kW. This will reduce power demand by 40kW, at current cooling demand and production volume. Assuming 24-hour operation, that means energy savings of almost 600,000 kWh per year.

A Climate-Friendly Refrigerant with no Global Warming and Ozone Depletion Potential

The refrigerant for the new chillers is ammonia, which has a number of benefits: It can be applied at a broad range of temperatures – important in the food and beverage industry; it's energy-efficient, especially in combination with CO_2; it's one of the world's most environmentally friendly refrigerants, with zero global warming and ozone depletion potential; although toxic

and flammable at certain concentrations, its characteristic odour means leaks are easily detected[1]; the pipe sizes and heat transfer area required are smaller; it's inexpensive; and it's readily available.

Frozena is so happy about the energy savings generated by the project and the positive effects of the Resource Efficient and Cleaner Production (RECP) approach, it plans to adopt a heat recovery system and solar photovoltaic plant, to meet future energy needs while actually increasing production. So, the energy savings are actually allowing the company to invest *more* in strengthening climate resilience.

Fruit Producer Blue Skies Harnesses the Sun's Energy – and Reaps the Cost Benefits

Climate change has brought with it challenges for Egyptian fruit salad and juice producer **Blue Skies**. Extended summers, higher temperatures, extreme weather peaks and unpredictable weather patterns have driven up refrigeration costs, cooling systems have failed in 50°C+ temperatures, and crops have been damaged by disease. Nights that are too hot ruin the sweetness and colour of the fruit. The quality of the company's raw material is threatened. Maintaining it drives up certain costs. And so others, like energy, need to come down. Because if quality is compromised, business opportunities may be lost.

But Blue Skies sees opportunity where others may see pitfall. It's setting up a solar photovoltaic (PV) plant, whose roof-shading panels, manufactured by Japan's iconic **Mitsubishi Electric**, reduce heat gain in the fruit-handling building, to counter increased electricity consumption from refrigeration and cooling. The innovative climate change adaptation technique will allow the factory to cover part of its energy requirements through electricity generated by the PV plant instead of from the grid.

Egypt's yearly irradiation, at around 2,400 kWh/m^2, means favourable conditions for a solar energy solution like this. It's going to save an estimated 240,000 kWh per year and bring down annual CO_2 emissions by 120,000 Kg – according to calculations based on data from the Photovoltaic Geographical Information System - as the PV panels from the project would generate 120,000 kWh per year and partially replace electricity from fossil fuel production. A bonus effect is that payback periods for further PV plant investments in the coming years will shorten as the cost of PV panels continues to drop globally.

For Blue Skies, the sky's the limit. It is a solar power solution pioneer, helping the Egyptian government achieve a landmark target: 20% electricity generation from renewable resources by 2020[2].

Through a series of awareness campaigns, the company plans to highlight the benefits of its Low Carbon and Climate Resilient Industrial Development Project.

A wind of renewables change is blowing through Egypt and if this renewable energy development impetus is maintained, and other companies emulate its strategy, Blue Skies sees no reason why Egypt shouldn't become a regional energy exporter, transporting power to its neighbours.

[1] Food Manufacturing. "Distributed Refrigeration: The Benefits of Ammonia Refrigeration Without the Risk." Food Manufacturing. 22 May 2015. ‹https://www.foodmanufacturing.com/blog/2015/05/distributed-refrigeration-benefits-ammonia-refrigeration-without-risk› (accessed July 6, 2018)

[2] Climate Investment Funds. Egypt. n.d. ‹https://www.climateinvestmentfunds.org/country/egypt› (accessed July 5, 2018)

Kenya

Climate Change Impact Challenges Kenyan Industry

Climate change is having a stark impact in Kenya. Annual average maximum temperature is expected to rise by 0.4°C to 2°C, and average air temperature to surpass 23.5°C, based on UNIDO's vulnerability assessments[3]. Rainfall distribution will become more uneven, as rain amounts decrease between September and April, and increase between May and August. This is all bad news for the tea sector, which is the country's leading exporter and thus a pillar of Kenya's industry. The temperature rises and rainfall instability mean a shrinkage of suitable areas for tea growing. Although moderate heat can improve tea quality, the increases in temperature because of climate change do the opposite. Heat extremes damage leaves, affecting tea quality and flavour. Higher temperatures, together with greater humidity, also fuel the proliferation of new pests and diseases. It's no surprise, then, that as climate patterns become more unpredictable the tea industry, and the small-scale tea farmers who drive much of it, are struggling to plan for the future.

[3] ‹https://www.unido.org/climate-resilient-industrial-development›

At the Kiamokama Tea Factory, Improved Technology as a Climate Adaptation Measure, also Lowers Costs and Emissions

Kiamokama Tea Factory, commissioned in 1976 in the western Rift Valley, is one of the oldest factories managed by the Kenyan Tea Development Agency (KTDA), which currently oversees 68 small-scale tea producers. Kiamokama manufactures and sells CTC (Crush, Tear, and Curl) Black Tea, most of it exported. Since the farmers who grow the tea are shareholders in the factory, the profits go back to them.

Climate change has had a profound effect on the industry. Between October and December 2016, the factory saw a 40% decline in tea leaf harvesting – stark evidence of the fluctuations caused by erratic rain patterns and extreme temperature swings triggered by climate change. Kiamokama realised it needed to stabilise production costs and, in particular, lower fixed costs – most of which were going to energy.

The factory began energy saving measures by implementing suggestions made by the Kenya Cleaner Production Center as part of a technical assessment. It has replaced 36W and 58W fluorescent lights in sorting and CTC areas, with 30W LED floodlights. Translucent roofing sheets allowing for natural lighting during the day have been fitted. And 'Switch off lights when not in use' signs are visible at various switch points.

Kiamokama also commissioned an in-depth energy audit by an external expert – who found that the factory's most energy-intensive processes were withering, drying and 'Crush, Tear, Curl', which accounted for 32%, 31% and 30% of energy consumption, respectively.

Improved Control of Withering Process Helps Adjust to Climate Change Impact

In tea processing, the withering and drying processes are the most energy-intensive. They can account for as much as 60% of electricity consumption, are sensitive to fluctuating temperature and moisture and are thus highly vulnerable to the impact of climate change. So it was on these very processes that Kiamokama decided to really focus its climate adaptation response.

The company's 91 withering troughs, each fitted with an air fan and steam-operated heat exchanger, were inefficiently controlled with on/off switches for the motors and open/close switches for the dump valves. Their motors and blades were also mostly inefficient generators of required air volume. That's why the suggested technology intervention involved fans with (Variable Speed Drive (VSD) motors and highly efficient blades. Since the withering beds are independent units, the intervention could be gradual rather than a one-time conversion of the entire withering section. The UNIDO project supported the initial new-technology conversion steps, for demonstration purposes.

The more efficient fans and electronic controls now ensure the appropriate air volume for specific climate conditions can be applied to the fresh leaves. This improvement of the withering process, which is particularly sensitive to moisture control, has increased efficiency. Because the VSD motors, in combination with the efficient blades, from **Taiyo Electric**, need less power to generate the required air volume, they have allowed energy savings of more than 60% . And this has in turn lowered production costs - which has also benefited the farmers who own shares of the factory.

Kiamokama's implementation of a low-carbon and climate-resilient solution has already led to electricity savings in comparison to business-as-usual and that can be translated into a significant CO_2 reduction.

This is a good example of taking a climate adaptation measure resulting in mitigation of CO_2 and becoming more green.

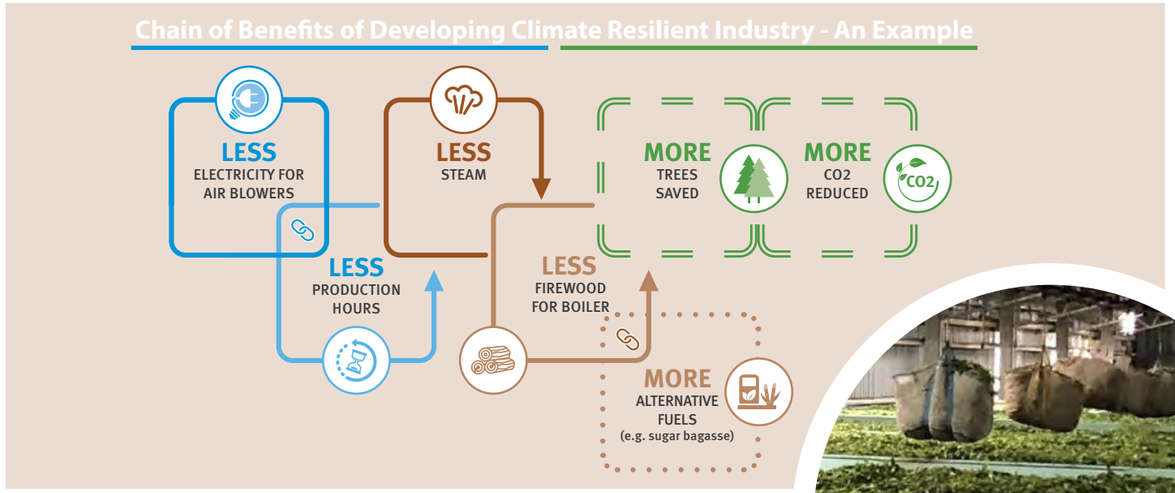
Kenyan Sugar Industry Eyes Waste as Circular Economy-Boosting Resource

Kenya's sugar industry, from which an estimated six million people derive their livelihood, is also highly susceptible to the variations associated with climate change, throughout the value chain. But here too, climate resilience and resourcefulness, generate hope. The project's technical assessments identified that there are plans to reclaim waste and its by-products so they can be used in the factory process, and so boost the circular economy. For example, excess bagasse can be used in paper manufacturing or can be sold in the form of briquettes as an energy source for other companies hitherto using firewood, such as the Kiamokama tea factory.

This helps save forests by reducing tree consumption as an energy source, and contributing to mitigation of CO_2 emission as well as climate impact mitigation.

In a similarly circular move, ethanol can be produced from molasses, as a renewable fuel. That cuts carbon dioxide emissions by roughly 90%.

With such resource circularity strengthening, UNIDO is encouraging stakeholders to innovatively think beyond energy efficiency, about ways of making the industry more climate resilient.



Senegal

In Senegal, Food processing Industries Facing Climate Challenges See Need for Resource-Efficient Adaptation

Senegal's cereal milling and fruit processing sectors, which rely on agricultural produce, are, throughout their value chains, highly vulnerable to climate change. Among the threats to the industry's factories, and in particular the harvesting and drying process, are droughts and, paradoxically, flash floods caused by uncharacteristic, erratic, climate-induced bursts of rainfall in certain months. And then there's the increased temperatures, by up to 3°C, mostly in coastal areas, the rising sea levels, saline intrusion and coastal erosion – all of which constitute a comprehensive threat to the industry. The fluctuating temperatures and increased humidity affect storage structures and processes like cooking and drying. For example, higher temperatures raise the risk of degradation in storage. Clearly, climate resilient action is needed, especially in the areas of post-harvest processing and management, where awareness of the need for adaptation is low.

From Sun Drying to Solar Drying: Senegalese Millet Processors Tap Climate-Resilient Technology

Three millet processing companies are heeding the climate change call by adopting innovative adaptation measures that minimise resource loss. Before the project, they relied on open-sun drying of their products, which invites contamination through dust and insects and an inconsistent drying process because of the varying strength of the sun, in turn affecting quality. But through the project, they started using mixed energy dryers, in a focus on renewable technologies (solar and biomass), with a combination of pre-drying greenhouses.

The solar dryers generate a stream of hot air from solar collectors that can be efficiently directed with pipes to the dryer boxes, and operate in tandem with the low-cost greenhouses whose air-circulating fans intensify the pre-drying process. They allow far greater control of the drying process, lowering contamination risk through dust, insects, birds, animals and the fossil fuels that were used when sun drying was insufficient. In fact, the move to solar has a series of benefits, including the possibility of eliminating fossil fuel use altogether; a speeded-up drying rate due to the increased temperatures, more intense movement of air and lower humidity, reducing the risk of spoilage by micro-organisms; a higher throughput of food; a reduction of the size of the drying area by roughly a third, due to the improved drying rate; elimination of the need to move the food when it rains; low construction costs; and longer storage of the final product because it contains less moisture – brought down to 40% by the pre-drying modules linked to the dryers in a process that ensures high levels of cleanliness and hygiene. In fact, the greenhouses – which can bring

moisture content down to 8% when it is sunny and dry – can be so efficient that sometimes it may not even be necessary to move on to the solar dryers.

For the companies involved, the post-adoption numbers speak for themselves. From 11 hours sun-drying and eight with the dryer, they are now – thanks to the greenhouses and new efficient dryers - down to six to seven hours pre-drying and three with the dryer. The result? Energy savings and efficiency are up - allowing the factories to raise production capacity.

The climate resilience-promoting, newly designed and developed renewable-energy dryers and greenhouses really are an innovative leap in Senegal, rendering the three companies included in the project veritable pioneers in the use (and benefit showcasing) of mixed energy sources (biomass and solar thermal energy) in a heat circulation system.

The project aligns with the Bureau de Mise à Niveau's (BMN - Senegal National Cleaner Production Centre) identification of the agri-producers' drying process as an area with high potential for improvement in terms of efficiency and climate resilience. And since the millet production processes don't differ much from company to company, the intervention is easily replicable.

Four Companies: One Low-Carbon and Climate-Resilient Industrial Development Goal

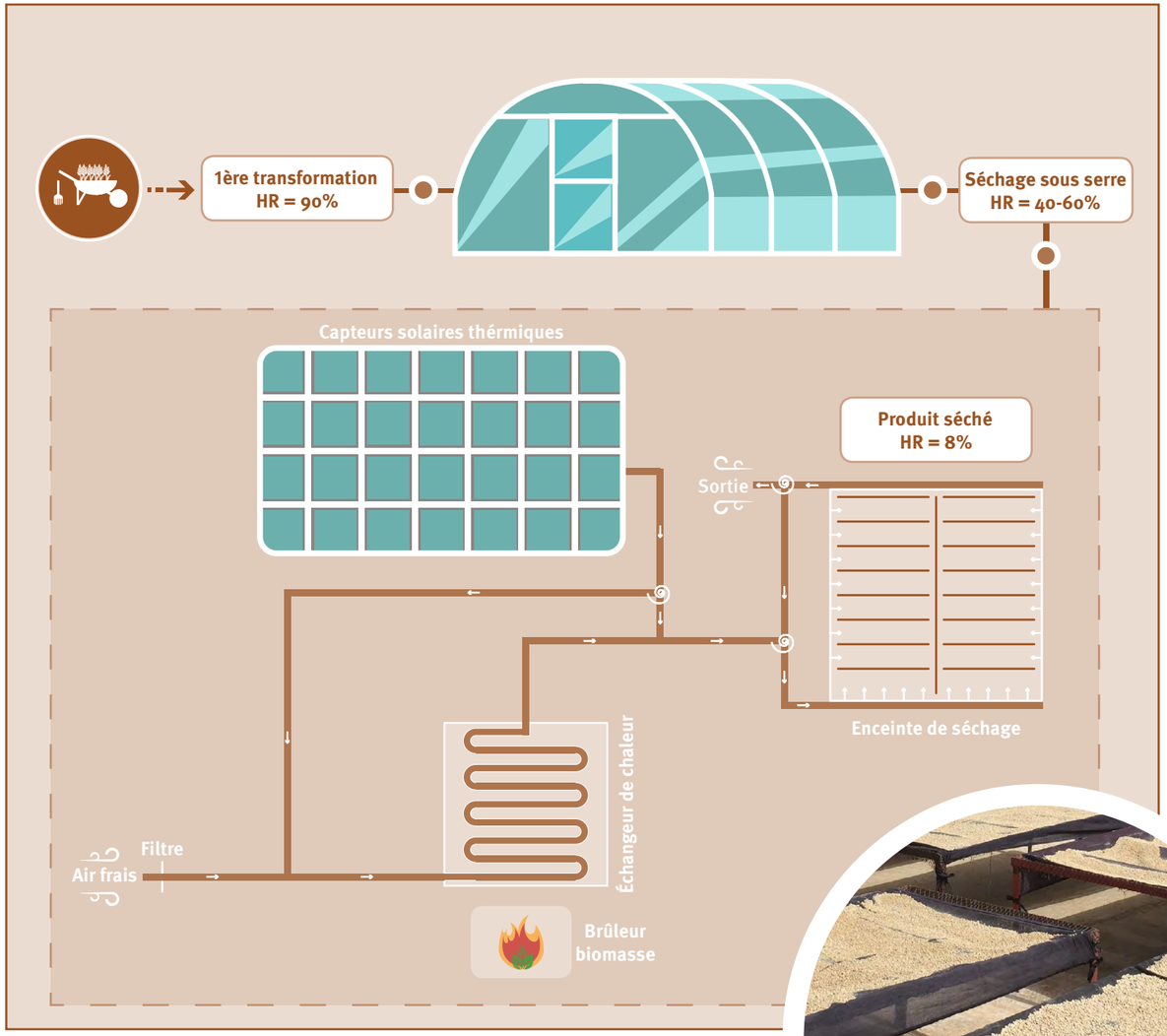
The appetite for climate-resilience investment, among partner companies, is growing.

Free Work Service, which processes local agro-products, is introducing more efficient climate-resilient elements to its couscous steaming processing, including: low-pressure extrusion machines to reduce water consumption (less drying needed) and therefore time and labour input; a self-made biomass burner that uses sawdust from a nearby saw mill, instead of LPG fuel, decreasing costs and CO_2 emissions. The company also envisions adopting gasifier technology which will greatly ameliorate combustion efficiency and controllability, reduce costs further.

Agro Saafi, which since 2011 has been producing as much as one ton of millet products a day, has a plan to adopt a cheaper-to-operate lower-carbon biomass steam boiler. Gaseous flammable fuel can be produced through the gasification of rice husks – a far cry from the less climate resilient LPG.

And another agro-producer, **Maria Distribution**, is considering replacing the manual rolling process for couscous with a couscous machine. This will bring down water use, and the end product will be cleaner.

Fruit juice producer **Esteval** plans to use an oil-fired boiler together with a biomass gasifier burner, for its pasteurisation process. The benefits? No more diesel, increased efficiency and drastic cost reduction. An added advantage: the gasifier process combustion residue is 'bio char', which can be used as a fertiliser and soil conditioner for agriculture and as a fuel for cooking stoves, in a full-circle climate change resilience effect.



South Africa

Increased Drought, Erratic Rainfall: A Climate Change Challenge for South African Juice Manufacturer Sir Fruit

'There is no Planet B', so Sir Fruit is urging others to 'reduce, reuse, recycle'.

For **Sir Fruit**, one of South Africa's leading juice manufacturing companies, climate change is not a vague concept. It's a very distinct and intensifying challenge. The company, which produces fruit juices, smoothies, fruit pulp and fruit salad, and is one of the principal suppliers of the country's hospitality industry, has been struggling with the effects of more droughts. Fruit supply has been affected. Raw material prices have shot up. Production in Cape Town has decreased. At the same time, erratic intense rainfall has had an impact on logistics and quality – the taste and content of the fruit required to manufacture juice has diminished. Water shortages have imperilled production. And floods have jeopardized the shipping of packaging materials, with ports inoperable. As far away as China, climate change has wiped out cotton crops, causing PET shortages for Sir Fruit's packaging.

However, Sir Fruit is pushing back by embracing a resource-efficient and climate-resilient approach to its business which includes installation of efficient industrial refrigeration equipment centered around a chiller unit with a condenser and heat recovery unit. The company has recognized the potential productivity-boosting synergies between the need to embrace climate resilience and the benefits of efficient technology. Their move is a prime example of a pioneering climate adaptation measure resulting in mitigation of CO_2.

Efficient Cooling System Safeguards High Quality of Finished Products

Sir Fruit's quality products need to be chilled. That requires electricity. And electricity costs money. The more climate change pushes temperatures up, the more electricity is required for chilling, and the higher the costs. That's not good for business.

Most of Sir Fruit's chillers were started when the factory began operations, and so they're outdated. Electricity is unsurprisingly one of the company's main operational costs – cooling and heating account for more than 50%. The cooling is needed for the storage of goods before they're processed and is crucial for Sir Fruit's finished high-quality products, and so it's vital to have an efficient and reliable cooling system. Hot water, too, is important for ensuring the hygiene of the end products.

Sir Fruit's solutions supplied by Japan's **Mayekawa**, one of the world's most advanced companies in manufacturing industrial refrigeration compressors, are

going to help alleviate the energy and cost concerns born of climate change. The outdated chiller systems, and de-centrally located old geysers (installed without pipe insulation) have been replaced with a combined heating and cooling system that generates hot water through a heat recovery mechanism from the cooling system. The hot water tank was installed in a central location with short pipe connections leading to locations with hot water demand – which, for Sir Fruit, is at least 1,400 L/day, at 50 - 60°C.

The UNIDO project has really got Sir Fruit excited about the benefits of climate-resilient adaptation. So, beyond the scope of the UNIDO project, the company has other plans lined up.

Climate change is expected to drive up cooling demand in the food and beverage sectors, and yet Sir Fruit, with its new, more efficient chiller expects potential savings of roughly 40% of energy consumption. The company plans to invest those cost savings in solar PV, with envisaged total savings of 50%.

To further increase the efficiency of the cooling process, Sir Fruit is considering the possibility of repainting the roofs white, over the rooms containing the chillers. Thermal tests show that a white repaint could bring surface temperatures down by as much as 20°C, meaning the chillers will need even less electricity to run.

Sir Fruit: A Sustainability 'Champion'

Sir Fruit also plans to replace toilet cisterns, saving roughly 170,000 litres of water a year, implement a rainwater collection procedure, and reuse greywater – from sinks and shower areas – for outdoor cleaning. It intends to employ a tracking system which allows for efficient route planning, and economical driving (again, costs are reduced *and* climate resilience is advanced). And it has recognised the potential of reprocessing citrus pulp to extract essential oils with further commercial value. Greenhouse gas emissions are being further reduced by Sir Fruit's replacement of the refrigerant with one that has an ozone depletion potential (ODP) of *zero*.

Sir Fruit isn't just adopting efficient low-carbon technology to push *down* costs. It's doing so to drive *up* awareness – as a 'champion of Mother Nature'. 'There is no Planet B', so the company is urging others to 'reduce, reuse, recycle'. It has taken an impactful first step to reduce its plastic footprint. All of its juice bottles are made with 50% recycled plastics, and boast a super-smart plastic-reducing design. That's Sir Fruit's emphatic resource-efficient, climate-resilient commitment to the 'Three P's': 'People, Planet and Prosperity'.

"Climate change is expected to drive up cooling demand in the food and beverage sectors, and yet Sir Fruit, with its new, more efficient chiller expects potential savings of roughly 40% of energy consumption. The company plans to invest those cost savings in solar PV, with envisaged total savings of 50%."

The way forward

Climate resilience in industrial contexts means the capacity 1) to absorb stresses imposed by climate change and maintain productive functions, and 2) to adapt, renew, re-organize, and develop desirable pathways and more sustainable practices that help industries better prepare for future climate change impacts[4].

With the Low Carbon and Climate Resilient Industrial Development project (LCCR), UNIDO is fostering awareness and demonstrating the opportunities and benefits of enhanced climate resilience and low-carbon growth in the productive industries. The project shows the co-benefits of both climate change adaptation and mitigation, including the protection of the health and safety of workers, and draws attention to industry's climate resilience needs.

The outcome of the LCCR project shows that industry in developing countries clearly needs further assistance with climate adaptation measures – especially Micro- Small- and Medium-Enterprises (MSMEs), whose growth capacity is generally weak. Even after this project ends, UNIDO will continue to promote climate-resilient industrial development. We recognize the potential to promote renewable energy for climate adaptation and at the same time upgrade technology, to become climate-resilient.

The LCCR project created five technology showcases in the recipient countries. The interventions helped the selected partner companies adapt to climate change and at the same time reduce energy consumption while increasing production efficiency and quality, in a powerful illustration of the synergy between adaptation and mitigation. A shift to renewables-based energy and better refrigerants actually increased productivity at the same time.

Below is a summary of the adaptation measures that were taken in the four selected countries to counter the impact of climate change in production, and that simultaneously contributed to CO_2 mitigation:

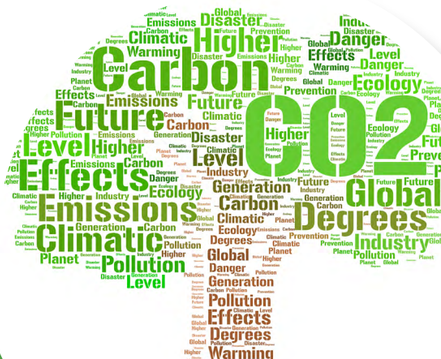
- In Egypt, UNIDO assisted companies to optimize input energy requirements by adopting effective renewable solar PV energy, and maximize system efficiencies by replacing refrigeration compressors.
- In Kenya, with UNIDO's help a tea company matched energy usage to requirement by installing variable speed drives and resizing motors.
- In Senegal, UNIDO helped develop an innovative drying process solution: Efficient solar dryers generate a stream of hot air from solar collectors that can be efficiently directed with pipes to the dryer boxes, while low-cost greenhouses with air-circulating fans improve the pre-drying process.
- In South Africa, UNIDO assisted in maximizing system efficiencies by replacing refrigeration compressors and recovering lost energy with a heat exchanger.

After the end of the project, the respective National Cleaner Production Centres (NCPC) in each recipient country will remain in contact with the beneficiaries. As the private sector beneficiaries in each of the countries want to continue working on resource-efficient production approaches, it will be the NCPCs' role to provide the technical advisories.

The NCPCs will further monitor the results and sustainability of the LCCR project. This will not only ensure reliable ground data for UNIDO, but will also demonstrate how local NCPCs can further promote the low-carbon and climate-resilient industrial development concept in their countries.

It is anticipated that the NCPCs will also continue to promote the LCCR concept at the national and regional level with this successful cases, as the private sectors adopt the NCPC-suggested climate-resilient and resource-efficient measures and shows the evident benefits.

UNIDO believes that a climate-resilient industry builds on cleaner, resource- and energy-efficient production practices and technologies. Only in this way can an industry cope with the risks arising from climate change.



[4] Folke, Carl. "Resilience: The emergence of a perspective for social–ecological systems analyses." Global Environmental Change 16, 2006: 253–267.

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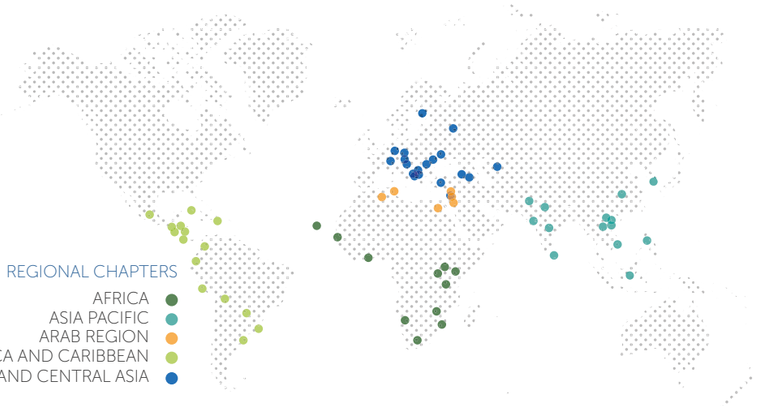
The technical information of this booklet is based on the technology assessment reports prepared by Dr. Robert Wimmer and Dr. Myung-Joo Kang representing GrAT (Center for Appropriate Technology) TU Wien, the technology expert team for the LCCR project.

Designed by Maria Grineva and Mauricio Mondragon (Athenea International/Omnilang).

Global Network Resource Efficient and Cleaner Production
RECPnet

Global Network for Resource Efficient and Cleaner Production (RECPnet)



REGIONAL CHAPTERS
- AFRICA
- ASIA PACIFIC
- ARAB REGION
- LATIN AMERICA AND CARIBBEAN
- EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA

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Mitigation and adaptation are conceptually complementary strategies to address climate change impacts. Creating synergies between them has multiple benefits, such as cost-effectiveness, that may not be achieved if they are addressed separately. This is particularly true for the industrial sector.

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