EFFICIENCY SOLUTIONS FOR INDUSTRIAL COOLING

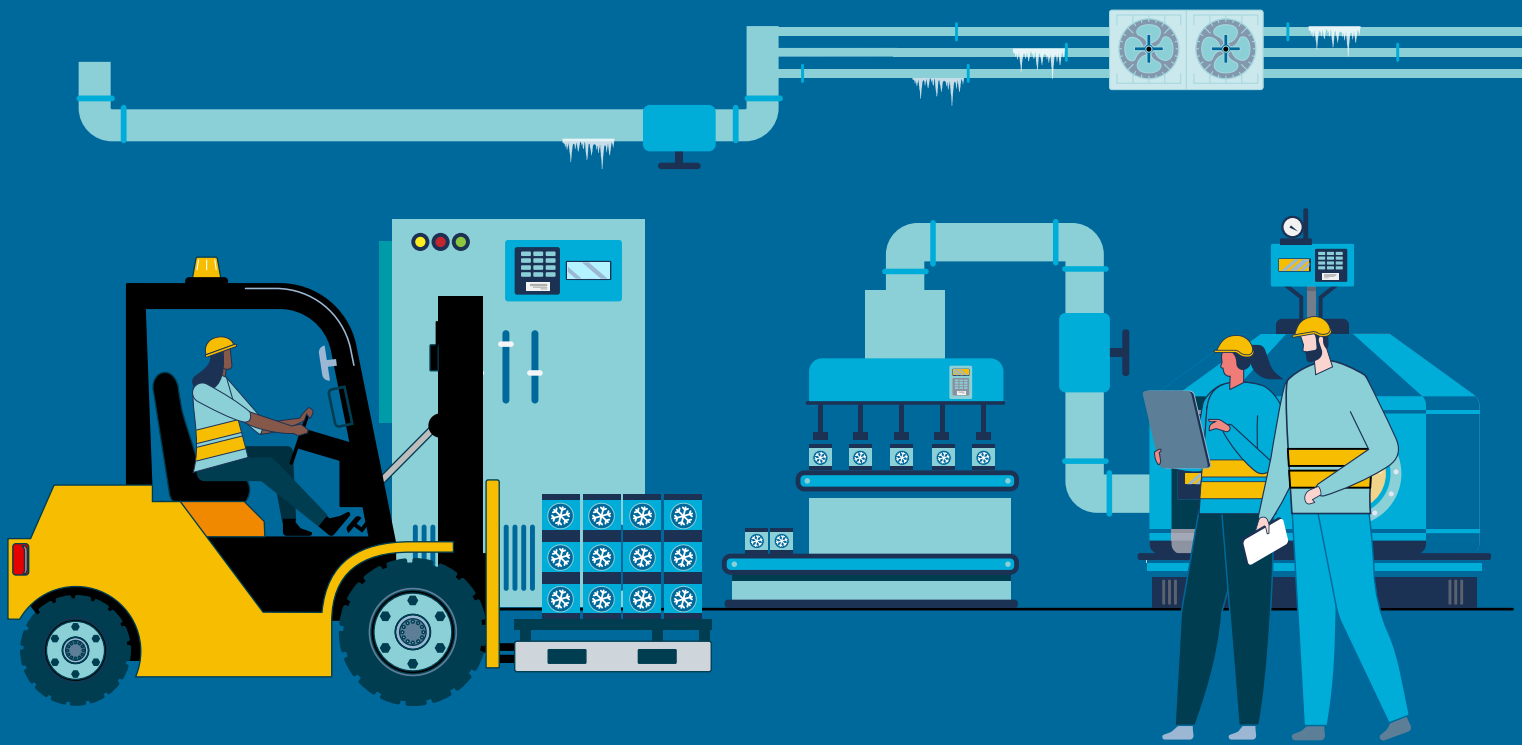
BROCHURE

INDUSTRIAL ENERGY ACCELERATOR

UNIDO

Industrial Cooling and Refrigeration Systems

Energy Efficiency Solutions Series



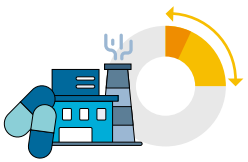
Introduction

From the ice trade of the late 19th century to the seamless cold chains responsible for transporting and storing food and vaccines, industrial cooling and refrigeration has become critical to our modern way of life.

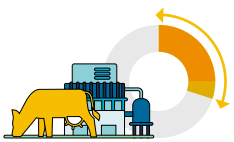
Yet, despite having played such a large role in the industrial revolution, much of the original technology and equipment used to generate cooling and refrigeration has hardly evolved. Considering that the increase in energy consumed by residential, commercial and industrial cooling systems is predicted to outpace that of heating in the coming decades, it is imperative for industry to pay more attention to this growing challenge. Simple and often low-cost cooling system optimization solutions can dramatically slash industry energy bills and emissions as a result.

There is no shortage of resources available for industrial managers looking to make their organizations more energy efficient. In fact, there is so much information it can often be very difficult to know where to start and what is worth pursuing further for implementation. This industrial cooling and refrigeration knowledge kit provides an overview for leadership teams looking to improve the efficiency of their cooling systems. In this kit, you will find insights from UNIDO's international cooling expert as well as external links to recommended references, manuals and technical guides. The introductory video, case studies and this brochure are perfect starting points for generating awareness about the added value and opportunities that cooling system optimization can provide for your organization.

Tackling the energy consumption of refrigeration in various industrial sectors is key



Pharmaceutical
7% to 25%



Dairy
25% to 30%

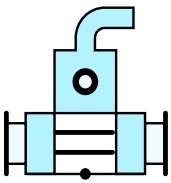
Frozen Foods
60%

Beverages
20% to 30%

INDUSTRY SECTOR
% of total electricity used for refrigeration

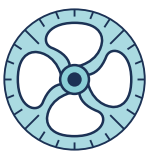
Source: Sustainable Energy Authority_Refrigeration Special Working Group

Common industrial cooling systems



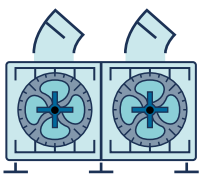
Process cooling

Chillers are used to remove heat from production processes given their ability to provide cooling for applications at all ambient temperatures and loads. Some industries which require process cooling include food and beverage, dairy, pharmaceuticals and chemicals.



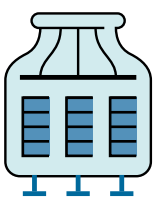
Large scale cooling

Large cooling, ventilation and air conditioning systems provide thermal comfort and maintain operations at specific temperatures so that production is not interrupted. Ventilation and cooling systems are used to purify and condition the air and control humidity in assembly plants, mining operations, data centers and buildings.



Industrial refrigeration

Refrigeration is used in industry to maintain very cold temperatures for the manufacturing, transportation and storage of specific products. Examples include refrigerated warehouses for food and beverage, dairy processing and specialty chemicals.



Thermal energy storage

Thermal energy storage acts like a battery for a system's cooling and air-conditioning demands. Depending on the specific technology, thermal energy storage enables cold to be stored and used later for various cooling processes. During off-peak hours, glycol or brine or water can be chilled. Ice can also be made and stored in appropriate storage tanks.

101: How to optimize your industrial cooling system

Unlike readily available household cooling and refrigeration appliances, industrial cooling systems need to respond to different operating temperatures and loads. There is no easy or quick formula to achieving the best operating efficiency in industrial cooling systems. This is because every industrial process is unique and therefore needs to be reviewed for its own merit, application, geographic location, system components and working fluids. The good news is that there are many ways industrial organizations can begin to optimize their cooling systems which often require no or relatively minimal investment.

1. Cooling Load

Every plant should make an effort to understand exactly how much cooling is needed and at what temperature. It is wasteful to excessively cool something down only to reheat it again to bring it to its required temperature. In many cases, energy efficiency opportunities involve replacing or reconfiguring equipment which is 'oversized and/or inefficient' for the process at hand. In some cases, the efficiency solution can be as simple as combining two under-used cooling systems into a single larger system which can then operate at a much higher efficiency and also enhance the reliability of the system significantly.

Reducing the cooling load can also be achieved by reducing infiltration, improving insulation and avoiding heat gains from people, lighting and process equipment. For example, if a cold room door is in constant use, plastic strip curtains can help to keep cold air in and warm air out. The simple application of plastic strip curtains can reduce operating costs by up to 30 per cent.

2. Operating Hours

Plant and process operating hours are usually fixed by geography and manufacturing schedules. However, there are still many optimization opportunities which can be realized through strategic batch-processing or by analysing cooling loads at different times and levels of production.

For example, often it is not required to run evaporator fans 100 per cent of the time. Switching them off, when a cooled area is not in use, when no cooling is needed or the required temperature is reached, will enable significant energy savings. Intelligent controls such as defrost-on-demand systems are another way to minimize defrosting which can cut energy consumption by up to 9 per cent.

3. System Efficiency

The importance of evaluating systems as a whole rather than as individual components is slowly transforming industry as we know it. When it comes to industrial cooling and refrigeration, taking a 'systems' approach to energy efficiency essentially calls for evaluation of the energy performance from a whole plant or an entire process level perspective. From there, industrial organizations can effectively identify potential energy efficiency measures which will likely have a larger and more long-term impact.

For example, the overall chilled water system efficiency should consider all energy consumers: refrigerant compressors, chilled water pumps, cooling tower pumps, fans, etc. Sometimes an engineer may conduct a project to reduce the fan system energy but inadvertently increase the refrigerant compressor energy usage, therefore compromising the overall system efficiency.

Six signs you need to optimize your cooling and refrigeration systems

1. You are unaware of the total energy use consumed by your process cooling or refrigeration system.
2. You cannot remember the last time you assessed or maintained your cooling system.
3. You are unsure about your cooling load and the optimal temperature your processes require.
4. You believe component nameplate efficiency is the best efficiency point of the process cooling system.
5. There is no nominated person or team responsible for the performance of the plant's entire cooling system.
6. Your team lacks the knowledge, data and tools required to make informed decisions about your cooling system.

The benefits of cooling system optimization

Aside from the multiple environmental benefits that come from cooling and refrigeration system optimization, current state-of-the-art technology and best practice knowhow can lead to energy savings of more than 15 per cent with none or minimal capital investments. The money saved goes directly to the organization's bottom-line. In UNIDO's experience some companies have achieved more than 30 per cent of energy savings through cooling system optimization. Such savings offer numerous, and often indirect, benefits including system reliability, a boost to staff morale, reductions in workplace safety hazards and an overall elimination of harmful pollutants.

CASE STUDIES

Winemaker

Distell Group, a UNIDO case study

Plastic product manufacturer

An American Council for an Energy-Efficient Economy case study

Food processing

Anawa Devi Factory, a UNIDO case study

Chemicals

Dow Chemicals, Enhancing energy efficiency of refrigeration units

Beverages

South Africa's largest tomato distributor puts inefficiency energy use on ice , a UNIDO case study

Industrial buildings

Cooling efficiency at major South African airport, a UNIDO case study

Cooling in a warming world

Until recently, industrial cooling systems have somehow managed to fly under the climate change radar. When it comes to energy efficiency most people tend to think of energy in terms of heat, light or transport. However, in a somewhat peculiar irony, cooling systems are emerging as one of the leading contributors to global warming.

Almost all process cooling and industrial refrigeration systems are driven by electric motors which consume a large proportion of electrical energy worldwide. The majority of this electrical energy – more than 75 per cent – is derived from fossil fuels. Hence, there is a strong correlation between the energy consumed by cooling and refrigeration systems and greenhouse gas emissions. Improving the energy efficiency of a process cooling and refrigeration system will go a long way to reducing the carbon footprint of the industry.

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We all have to play a part in creating a sustainable planet for generations to come. Realize that our cooling and refrigeration systems will always be needed. So why not make them efficient and do our bit to ensure that these systems continue to run reliably and at the same time minimize our carbon footprint.”

Riyaz Papar, international industrial cooling systems specialist

The added burden of refrigerants

Worldwide, the majority of cooling is still produced by what is known as vapor-compression refrigeration. This age-old technology uses refrigerants: fluids, usually hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), made up of carbon and/or chlorine, fluorine and hydrogen which absorb and release heat. The problem is that while these refrigerant fluids are relatively effective and efficient, they also happen to be very potent global warming gases. While the 1987 Montreal Protocol has greatly helped to phase out the most harmful chlorofluorocarbons (CFCs), there is still a considerable way to go on the HCFCs and HFCs front, especially in the industrial sectors of emerging economies where more time is needed for alternative technology markets to mature.

The Kigali Amendment

The Kigali Amendment to the 1987 Montreal Protocol aims to reduce HFC consumption by 80% before 2047. Such a reduction in HFC consumption will avoid up to 0.5 °C increase in global temperature by the end of this century.

ADDITIONAL RESOURCES

UNIDO, 2017

READ

Mapping the HFC phase down

UNIDO

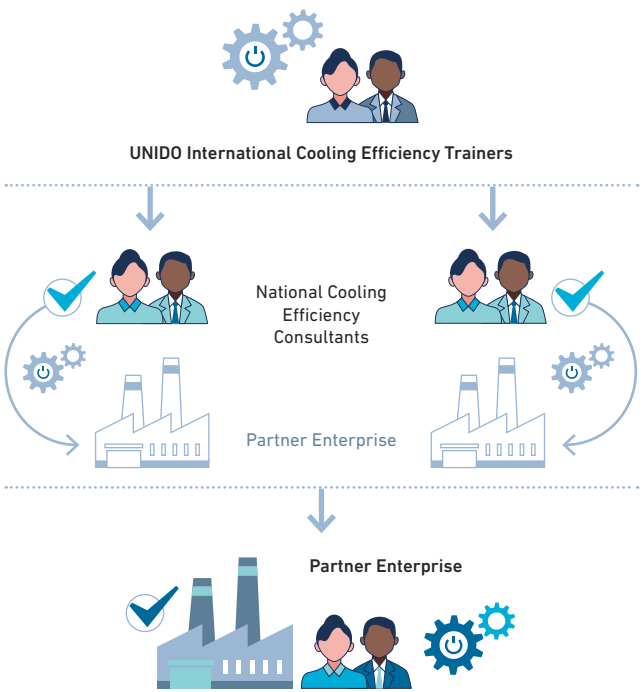
READ

- **Some Like it Cool: UNIDO and the Montreal Protocol**
- **The Montreal Protocol evolves to fight climate change**

UNIDO's approach

As energy demand for cooling threatens to make our planet even hotter, UNIDO is gearing up in this critical time to support industrial organizations unlock the huge energy saving potential within their cooling and refrigeration systems.

Being a technology and vendor agnostic organization, UNIDO is able to deliver impartial technical training and guidance to companies and related government departments. As a global implementing agency of the Kigali Amendment to the Montreal Protocol, UNIDO is well positioned to simultaneously assist industries in developing countries and emerging economies transition toward energy efficient and climate friendly refrigerant (HFC) alternatives.



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In addition to the energy savings achieved with support from UNIDO's Industrial Energy Efficiency project in Myanmar, we now have so much more peace of mind thanks to the reliable and more consistent cold room temperature achieved through system optimization. This alone is a huge benefit."

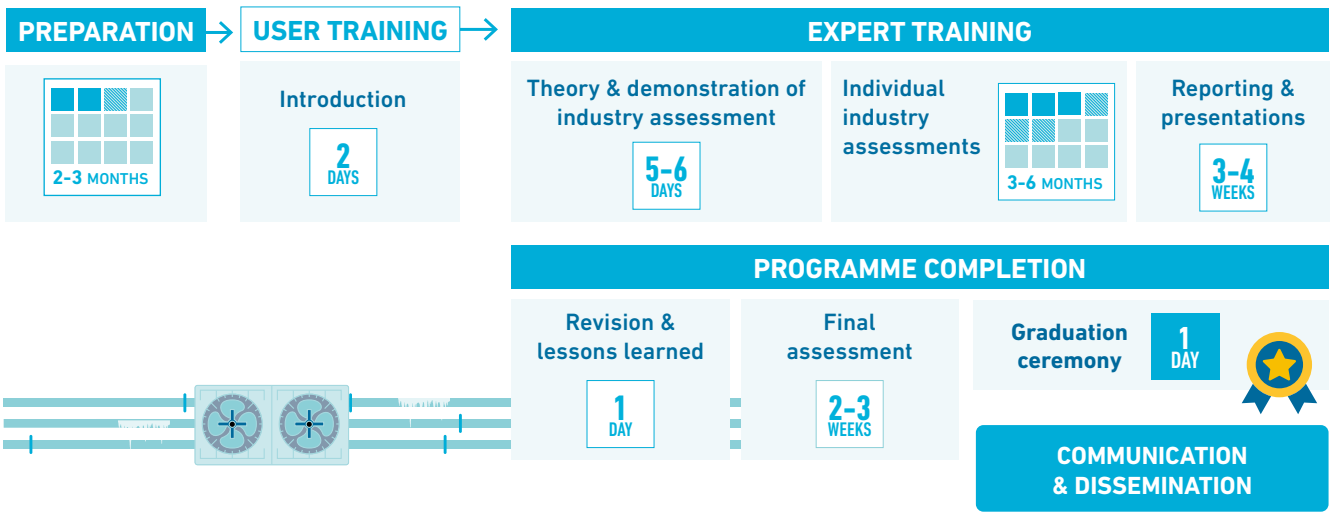
Khaymar Khine, Executive Director, Anawa Devi Daiichi Joint Venture

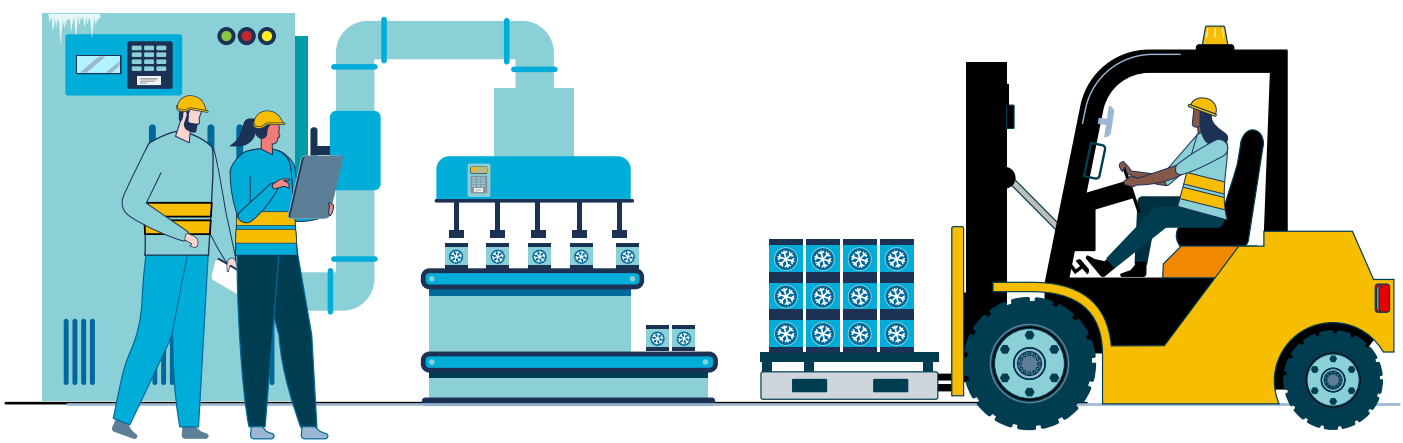
With training and technical support from UNIDO, fish processing factory Anawa Devi Daiichi was able to reduce its electricity consumption by 7 per cent.

UNIDO's Process Cooling and Refrigeration Optimization Training Programme

Understanding the cooling system as a 'whole'

UNIDO's expertly tailored training modules focus on helping participants see the big picture, while also providing them with the tools and resources required to achieve energy savings. Trainees who complete UNIDO's basic 2-day end-user classroom training are encouraged to conduct an assessment of their own organization's cooling systems and then recommend efficiency opportunities which are feasible for implementation. UNIDO's 'expert' cooling system optimization training is much more in-depth and hands-on, which typically requires 3-6 months of both classroom and onsite training.





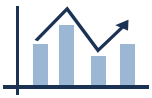
OUR GOALS OVER NEXT 5 YEARS

In the summer of 2021, UNIDO will officially launch a dedicated cooling and refrigeration efficiency training programme for industrial organizations, policymakers and equipment vendors. Over a five year period UNIDO expects to accelerate the adoption of process cooling and refrigeration system optimization, in addition to heightening global awareness around the importance of energy efficiency for industrial cooling.

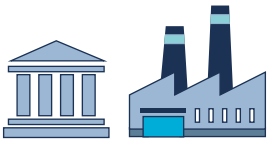
COOLING SYSTEM OPTIMIZATION TRAINING delivered in **10 COUNTRIES**

100+ EXPERTS QUALIFIED in cooling and refrigeration system optimization assessments and implementation

100+ ENTERPRISES receive dedicated assessment and training



50+ DEMONSTRATION PLANTS implemented measures and showcased benefits of process cooling & refrigeration systems optimization



1000 + industrial stakeholders, policymakers and related organizations engaged

750+ GWh in CUMULATIVE PRIMARY ENERGY savings achieved as a direct result of UNIDO's training

MORE THAN **1 MILLION TONS of CO_2** avoided through cooling system optimization and the phasing out of HFCs

Your Cooling and Refrigeration Questions Answered

UNIDO has steadily grown its cohort of international and cooling and refrigeration efficiency experts over the past decade. With collective experience in many of the world's major industrial countries and regions our team of specialised consultants have a long track record of leading organizational teams to achieve impressive results. In this kit you will find a video featuring our cooling system expert who answers common questions about energy efficiency for industrial cooling and refrigeration systems.

Riyaz Papar

Riyaz is a registered Professional Engineer (ME), a Certified Energy Manager and a Fellow of ASME (American Society of Mechanical Engineers) and ASHRAE (American Society of Heating Refrigerating & Air-Conditioning Engineers). Using a systems approach methodology to achieve efficiency in thermal systems, Riyaz has successfully completed more than 150 energy assessments both in the US and internationally, saving industrial organizations millions of dollars in energy costs along the way.

About the Energy Efficiency Solutions Series

The Industrial Energy Accelerator is a UNIDO-led network of international initiatives working to inspire global action on industrial energy efficiency. Throughout 2020 and 2021, the Accelerator is drawing on its collective wealth of experience and expertise to produce a series of knowledge kits on industrial energy efficiency. These kits cover five key energy efficiency solutions: Energy Management Systems; Efficiency Solutions for Motor-Driven Systems; Efficiency Solutions for Industrial Heat; Efficiency Solutions for Industrial Cooling and Refrigeration; as well as Energy Metrics and Performance Indicators. Through this series, the Accelerator aims to inspire and equip industry practitioners to take the first step towards enhancing their energy systems.

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NEXT STEPS

Visit our knowledge hub for more information on the processes and technology that will help you achieve energy efficiency in your company.

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to find out how UNIDO'S Industrial Accelerator can help you.

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