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Dalibor Kysela graduated with his Dipl. Ing. Degree from the Faculty of Chemical Technology from the Slovak Technical University (STU). He worked in the Regional Environmental Centre in Budapest, Hungary and was responsible for grants programmes on environmental rehabilitation and regional development in the economies of transition in Central and Eastern Europe.

Since 1997, he has worked in the UN system, first with UNDP Regional Bureau for Central and Eastern Europe (RBEC) in Bratislava, Slovakia; responsibility for planning and implementation of technical assistance projects in the NIS countries (former USSR). In 2001, he started at the International Atomic Energy Agency (IAEA) in Vienna. In 2008, he started in UNIDO and was responsible for planning of TC program and maintaining relations with UNIDO Member States covered by the UNIDO Regional Program for Europe and Central Asia.
DISTRICT COOLING

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1. Energy Efficiency of District Cooling

2. Thermal Efficiency of District Cooling

3. UNIDO Projects on District Cooling
1. Energy Efficiency
WHAT IS DISTRICT COOLING
WHAT IS DISTRICT COOLING

• District Cooling is based on central supply of cold water in a closed loop pipeline combined with cold storage

• DC can be based on free cooling (natural sources e.g. seas, lakes, rivers and ground water), electric chillers or absorption chillers

• Use of “Not-in-Kind” absorption chillers driven by surplus heat increase primary energy efficiency

• Thermal energy storage can help to increase thermal efficiency
FREE COOLING

• Cold water from oceans, lakes, rivers, or waste cool from processes (e.g. liquefied natural gas)

• Use of renewables results in low carbon emissions

• Does not use environmentally damaging refrigerants (unless the supply water is not cold enough)

• Highly efficient energy use reduces power consumption of the cooling system, particularly at peak

• May need backup sources if load demand is high and provision of cooling can be seasonal
VAPOR COMPRESSION CYCLE
ELECTRIC CHILLERS

• Use a high grade energy input leading to more CO2 emissions
• Typically have much higher COPs than decentralized air-conditioning units (about 7 compared to 2-4)
• Use refrigerants with low/zero ODS and lower GWP compared to decentralized air-conditioning units
• Uses electricity to drive a compressor although a lot less than decentralized air-conditioning units
VAPOR ABSORPTION CYCLE
ABSORPTION CHILLERS

• Use a low grade of energy in the form of waste (surplus) heat thus suitable for work on industrial waste heat streams; or heat produced with renewables (e.g. solar)

• Do not use environmentally damaging refrigerants

• Can be combined with CHP to produce cooling and heat (trigeneration CCHP)

• Have other advantages like silent operation which is not compared with other systems
VAPOR COMPRESSION VS ABSORPTION
ADVANTAGES OF ABSORPTION CHILLERS

• Energy source is surplus heat e.g. from waste incineration, various industrial processes, power production = increasing primary energy efficiency

• In high ambient temperature countries combination with a power station allows for cool production when power is in high demand

• Heat demand low during summer hence cooling production is additional revenue for a CCHP

• Do not use environmentally damaging refrigerants hence allow for phasing out of HCFCs and phasing down of HFCs
2. Thermal Efficiency
DAILY COOLING LOAD DEMAND

- Office
- Residential
- Hotel / Service Apt.
- Shopping leisure

Hours of the day

Loads of Peak %
AGGREGATED COOLING LOAD DEMAND

Percentage cooling load vs. Hours

Daily cooling Load demand profile
THERMAL EFFICIENCY OF DISTRICT COOLING

• DC systems provide chilled water for a district and thus make use of diversity (according to the type of building use in a district)

• Because of the diversity of usage and thus cooling load incidence during the day, the aggregated cooling load demand for a district is usually lower than the sum of cooling load demands for individual buildings in a district

• A district cooling system is thus much more efficient thermally than a similar distributed in-building chiller plant system
THERMAL ENERGY STORAGE

• Thermal Energy Storage allows sizing a DC plant at its average load, thus reducing the size of the plant = savings on capital cost

• The charging of the TES system is usually done at off-peak conditions (e.g. during the night when temperatures are milder than in during the day) = savings on operation costs

• TES systems when incorporated in DC system reduce or even avoid consumption at high electric demand tariff that is associated with peak demand loads = savings on operation costs
DC COMPARED TO TRADITIONAL AC (1)

• Up to 40% less energy consumption than traditional AC
• Decreased energy costs, whilst it is noted that initial capital investment is higher, however, in the long run the investment costs are recovered and financial gains made
• Can store up to 30% of potential output by holding chilled water in reserve, therefore easily meeting demands in seasonal variations
• Annual maintenance costs substantially lower
• Longer life of the equipment - 30 years for DC compared to 15 years for traditional AC
DC COMPARED TO TRADITIONAL AC (2)

- Greater reliability due to the high standard industrial equipment utilized and back-up chillers on stand-by
- Reduced CO2 emissions due to low power consumption particularly during peak demand periods and TES
- Enhanced real estate value due to remote location and freeing up space for other uses
- Phase-out of HCFC/HFC refrigerants and reduction of refrigerant need for the same end-user demand for cooling comfort
3. UNIDO Projects
UNIDO PRAHA PROJECT

Implemented with the National Ozone Units of the Gulf Coordination Council (GCC) countries

DC accounted only for about 14% of the estimated total installed air-conditioning systems

The existing systems mostly use conventional technologies with high-GWP refrigerants

District cooling installations in the region are estimated to double by the year 2030

Opportunities exist to promote low GWP refrigerants or non-vapor compression techniques
UNIDO RESPONSE – DEMONSTRATION PROJECTS

75ExCom – 2 proposals for demonstration projects

• Feasibility Study on District Cooling Egypt

• Comparative analysis of 3 Not-in-Kind Technologies for Use in Central AC Kuwait

Lead IA: UNIDO  Cooperating IA: UNEP
DEMONSTRATION PROJECT EGYPT

Project Objectives:

• To study a centralized district cooling system with a hybrid solar and gas thermal driven absorption chiller

• To provide detailed technical, financial environmental and energy assessment and road map for the Government
DEMONSTRATION PROJECT EGYPT

Project Elements:

• Design and assessment of a solar-assisted district cooling system (UNIDO)

• Assessment of infrastructure and regulatory framework (UNEP)

• Governmental co-financing mechanisms (UNIDO and UNEP)
DEMONSTRATION PROJECT KUWAIT

Project Objectives:

• To comparatively assess three not-in-kind technologies for central AC and DC

• To provide technical and economical evidence to be disseminated to government officials as well as private investors
DEMONSTRATION PROJECT KUWAIT

Technologies to be considered:

• Deep sea water cooling systems

• Waste heat and absorption technology

• Solar assisted absorption cooling systems
DEMONSTRATION PROJECT KUWAIT

Project Elements:

• Assessment of suitable technologies (UNIDO)
• Energy saving mechanisms (UNIDO)
• Assessment of legal barriers (UNEP)
• Governmental co-financing mechanisms (UNEP)
UNIDO DEMONSTRATION PROJECTS

Main features of the UNIDO Demo Projects:

• Holistic rather than pure technical approach
• Focus on efficient use of primary energy
• Establishment of an appropriate policy framework
• Developing cost data for comparison against baseline technologies
WHY DISTRICT COOLING?

• Greenhouse gas emission reductions (decrease in primary energy consumption)
• Reduction of negative health impacts (air quality improvements)
• Energy efficiency improvements (up to 90-95% primary EE)
• Use of local and renewable energy resources
• Resilience and energy access (reduced dependency on fossil fuel imports and price volatility)
• Green economy (avoided/deferred investment costs and local wealth/employment creation)
OPPORTUNITIES FOR DISTRICT COOLING

• In the Gulf countries:
  • DC could provide 30% of forecasted cooling needs by 2030
  • Avoid 20 GW of new power capacity and 200,000 barrels of oil equivalent per day in fuel

• In the EU:
  • Less the half of the calorific value of waste incinerated in waste –to-energy plants currently recovered
  • Almost 100 million tons of non-recycled waste is deposited in landfills
Thank you for your attention

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