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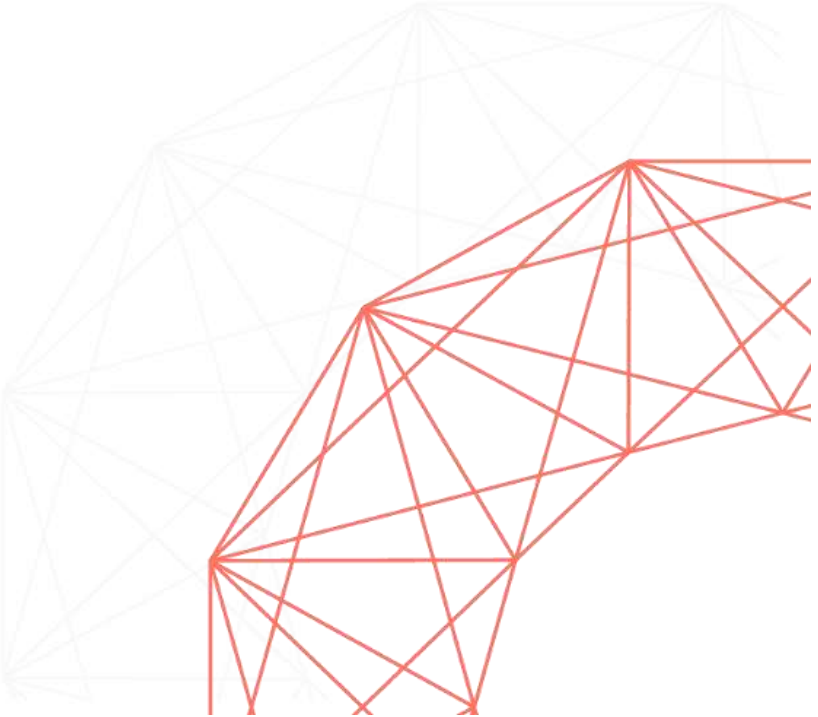
"CONNECTING POLICY, TECHNOLOGY & FINANCE THROUGH KNOWLEDGE"

Deep Dive Workshop - Access to Cooling

1 November 2019, Singapore

Jointly organised by
Asian Development Bank (ADB)
Sustainable Energy for All (SEforALL) and
Sustainable Energy Association of Singapore (SEAS)



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About our ADB's Partnership with SEAS

For over 40 years, ADB has been dedicated to helping developing member countries in the energy sector, particularly in the areas of expansion of electricity sector programmes, the training of government energy agencies, as well as the improvement of power sector reforms, governance, and efficiency. ADB also serves as the regional hub for the SEforALL in the Asia-Pacific region together with United Nations Development Programme (UNDP) and The United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP).

In line with this, the Sustainable Energy Association of Singapore (SEAS) has signed a Knowledge Partnership Agreement with the Asian Development Bank (ADB) in 2017 to foster improved capacity-building and training, research and development activities on energy in Asia-Pacific, knowledge sharing and enhancing the delivery of knowledge outputs.

The partnership is further strengthened by the funding of two deep dive workshops held at the annual Asia Clean Energy Summit (ACES), a flagship event under SEAS. The deep dive workshops which are jointly organised by the ADB, SEforALL and SEAS are attended by a diverse mix of participants comprising policy makers, regulators, utilities, and developers from the region at this year's ACES event.

The workshops encouraged the exchange of knowledge and information in ensuring sufficient, stable, and access to both electricity supply and cooling - particularly in off-grid areas as means of promoting equity in our society.

A total of 17 participants and 16 speakers participated in the Access to Cooling Workshop.

About the Asia Clean Energy Summit 2019

The annual Asia Clean Energy Summit (ACES 2019), the region's leading event focusing on clean energy technology, policy and finance took place at the Marina Bay Sands Expo & Convention Centre from 30 October - 1 November 2019.

Supported by leading government agencies, research institutes and industry in Singapore, the 6th edition of the annual summit and exhibition served as a platform for regional thought leaders in both the public and private sector to collaborate on critical issues and opportunities around harnessing clean energy for the future.

As part of the Singapore International Energy Week (SIEW), over 3000 thought leaders and participants discussed the challenges and opportunities in the drive towards energy transition and emissions reduction. ACES 2019 saw greater engagement among industry players, indicative of the increased prioritisation of the transition towards clean energy. We are proud to announce that ACES 2019 is a Carbon Neutral Event.

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Deep Dive Workshop – Access to Cooling

Cooling is an invisible industry essential to our modern society – from the cold chains that safely deliver our food and vaccines, to the air conditioners that make our workplaces and homes comfortable, to cooling servers for our insatiable demand for social media or data.

The "Chilling Prospects" report prepared by Sustainable Energy for All (SEforALL) identified that 1.1 billion people, of which 750 million living in Asia, are facing risks due to lack of access to cooling for basic needs – lack of access to nutritious food, vaccines essential for health, as well as the ability to find respite from temperatures beyond limits for human survival.

'Chilling Prospects' has identified nine priority countries taking into account the number of the population at risk. Of these nine countries at greatest risk from lack of access to cooling five are in Asia: Bangladesh, China, India, Indonesia, and Pakistan.

Ensuring cooling that is affordable, sustainable, and accessible to all who need it is essential to alleviating poverty and achieving global sustainable development goals (SDGs), specifically SDG 7 on ensuring access to affordable, reliable and sustainable and modern energy for all by 2030, and at the same time providing assistance to countries through the proper implementation of their Nationally Determined Contributions (NDCs) in fulfillment of their commitments to the Paris Agreement.

The objectives of this workshop are:

1. To provide a venue for discussing the various issues involved in accelerating access to cooling in the Asia and the Pacific Regions
2. To create awareness and appreciation by stakeholders in both government and private sector about the need and value of undertaking country-specific needs assessment and developing a national cooling plan

Session 1: Access to Cooling in the Asia and the Pacific

Welcome & Opening Remarks

Mr Vincent Low, SEAS Council member welcome all participants to the workshop and thanked ADB for their generous support towards this initiative.

In his opening remarks, Dr Kee Yung Nam, Principal Energy Economist, ADB shared that cooling is a relatively new area that ADB is tackling. He shared that from 2008 to 2018, 9 billion USD was invested in energy access and this also includes the private sector operations. However, only a small percentage of this amount was spent on access to cooling. ADB is now looking at 2 new aspects. 1) Going beyond energy access for cooling (in South Asia or South East Asia) and heating (in North or central west Asia), 2) moving rapidly towards the energy sector in the multisector approach. Energy sector no longer stands alone and is now linked to the other sectors.

Dr Nam mentioned that ADB would like to hear from the participants on their challenges and their experiences. This will help in ADB's pilot testing and scale up their operations. He reiterated on the importance of working together to ease the challenges of energy access.

Mr Brian Dean, Head, Energy Efficiency and Cooling, Sustainable Energy for All shared that the findings from the "Chilling Prospects" report was a wakeup call. He spoke about the importance of cooling as a necessity to promote equity in our society as safe living and working conditions, safe and nutritious food, and effective vaccines and medical care depend on access to cooling.

Presentation: Tracking access to cooling for all in Asia and the Pacific

Speaker: Clotilde Rossi di Schio, Cooling Specialist, Sustainable Energy for All (SEforALL)

Ms Clotilde Rossi di Schio started her presentation by stating that achieving the SDGs is dependent to having access to cooling. She shared briefly on the findings from the Chilling Prospects report:

- 138 million of rural poor in Asia in 2019 as compared to 235 million in 2018. There is a

significant increase in rural energy access that would enable cooling, notably in India
- The continued urbanization and fast-growing cities in Africa and Asia meant that urban poor increased to 480 million urban poor in 2019 compared to 460 million in 2018.
- Increased purchasing power and growth of an established middle class (1.2 billion) in Asia

Globally, over 1 billion people without access to cooling face increasing risks to their health and their productivity because they can't store fresh food, receive a safe vaccine or find shelter in a heat wave. Therefore, fast action on access to cooling is needed. The recommendations and steps forwarded can be summarised as follows.

To raise awareness and generate knowledge across sectors	• Use data and evidence to support investment in agriculture • Engage the health community to form new partnerships • A focused analysis of gender-based impacts
To build capacity	• Establish training capacity and centers for promoting work on access to cooling in vulnerable countries
To benchmark progress and track finance	• Track financial flows directed towards access to cooling for vulnerable populations to prioritize new investments • Major financiers can contribute by self-reporting project investments directed towards vulnerable populations

Presentation: Understanding and Measuring Cooling for All - A needs-driven approach to our cooling demand

Speaker: Toby Peters, Senior Research Fellow, Transformational Innovation for Sustainability, Heriot-Watt University and Professor in Cold Economy, University of Birmingham

Professor Toby Peters stressed on the importance of cooling as livelihoods, food security and healthcare will be affected without access to cooling. He shared that 19 pieces of cooling equipment will be added per second for the next 30 years. Energy consumption will grow to 9,500 TWh by 2050 and will exceed IEA's implied "energy budget" for cooling in its 2°C Scenario by more than 50%.

Therefore, we need to rethink how we define cooling and "think thermally" on how to make, store, move, use and finance cold. This means that rather than thinking "how much electricity do I need to generate?', we should ask what is the service we require and how can we deliver it in the most energy efficient way. Once we do this, we can start unlocking our energy resources. Currently, we are not thinking about energy needs. Instead we are thinking about technology e.g. the number of pieces of energy efficient cooling equipment needed, instead of the whole energy system.

The purpose of a needs assessment is to enable states, communities and government to think about the cooling and services they require for cold chain, medicines, thermal comfort, food, etc and find the gap between current and projected needs. Next, understand what is the available energy resources and how to solve it. To do this, we can:

- Explore a portfolio of behaviour, aggregation, operational and technology options to meet the need while minimising costs, energy and emissions from the sector. E.g. Using natural shading, good building design, natural ventilation or harnessing waste heat into co-located service such as hot water for cleaning and washing applications in pack-houses.
- Provide a range of actionable outputs that can be the basis of policy interventions and financing instruments and establish a framework for tracking progress towards meeting unmet needs.

To use the assessment tool, we need to:

- Establish a baseline based on needs and not GDP growth projection for cooling, and track progress
- Understand the implications of cooling demand for energy services and climate change
- See how to aggregate demand to meet needs
- Align policy and finance to desired outcomes
- Create a merit order of intervention
- Tailor local and community level solutions – technology finance and business models
- Understand the technical capacity to meet demand as currently
- Understand the implications of climate change

Cooling sits at the heart of the SDG, Paris Agreement and the Kigali Amendment. The needs assessment will look at how we can deliver all 3 at the same time.

The rural community has wider demand than cold chain. Last year, about 70 million poultry died because of heat stress in India. How can we understand the needs and aggregate them? Professor asked if instead of building 70,000 new packhouses for cold chain in insolation, can we harness refrigeration solutions and make it slightly bigger and provide other services as an energy system to deliver aggregation economic models that are affordable and efficient. E.g. Instead of looking at refrigerators which are unaffordable for many, can we look at temperature-controlled lockers for food.

Therefore, we should not just look at technology, we need to understand the needs so that we can look forward and deliver sustainable cooling solutions.

Currently these needs tend to be thought about, and cooling solutions delivered, separately. We need to think differently and not business as usual.

Moderated Panel Discussion

Panellists: Ksenia Petrichenko, UN ESCAP, Toby Peters, University of Birmingham, Clotilde Rossi di Schio, SEforALL, Dr Kee Yung Nam, Principal Energy Economist, ADB. Moderator: Brian Dean, SEforALL

Ksenia Petrichenko briefly shared that there is no one policy for all cooling needs. Cooling cuts across many SGDs and several needs such as food and comfort which we need to take into account when designing policies for different roles and sectors, e.g. buildings or transportation in cities or municipalities. Putting these different needs together means we need a comprehensive and holistic policy. Governments need to design their national policies and set targets. We need to understand what is access to cooling and how we can deliver it sustainably. We should look at reducing demand first and see how we can use energy in the most efficient way and meet this demand with renewable energy. In South East Asia, more than 40% of power generation comes from oil and gas. Turning to electrification by using more appliances and equipment should come together with decarbonisation of energy supply. There must be a shift in thinking when it comes to cooling for policy makers and governments.

To answer the question on ADB's role in access to cooling, Dr Nam shared that from ADB's point of view, the criteria on defining what is access to cooling must be set. Cooling must be looked at from the backward and forward linkages. What is the set of real criteria for the real cooling demand that has impact on the backward link? It requires information and a needs assessment. From an operation point of view, there is also a need to remove double counting. Cooling technology and pilot testing of solutions is also key.

Clotilde Rossi di Schio shared that without access to cooling, developing countries face many risks such as loss of productivity, loss of opportunity for children to learn among others. Therefore, what can governments do to reduce the gaps in access to cooling. Professor Peters shared that by using "electrification" as the solution to everything, it will not work. Most waste heat in the world is too cold to produce electricity efficiently, but it is great to produce cooling efficiently. Most electrical appliances use electricity to produce cooling and we have to stop thinking about producing electricity for cooling. Instead, we should harness our thermal resources like waste heat, waste cold. Unless we start thinking thermally, we will not reduce the demand for energy and make behavioural changes. While we can generate renewable energy, the supply is not sufficient to meet the demand. E.g. In 2018, we deployed 170GW of room air-conditioning vs 104 GW of solar PV.

Therefore, governments should think thermally, and not simply electrification. Governments should also recognise skills and build capacity. If cooling equipment is not maintained properly, it will lose 20%-25% of its efficiency. Besides behavioural changes such as designing buildings with cool roofs or use of trees as shadings, regulation can also help to reduce the overuse of cooling which is energy intensive.

Professor Peters stressed that we need to think thermally as the backend of a cooling process is heat. "We can use waste heat to provide hot water and heating and integrate it into the network. There must be thermal energy balances. We need to look at a thermal network. This is important because for the 70% of buildings that have not been built in India - this is now the time to look at it and put in the infrastructure to allow thermal networks."

Session 2: Innovative Cooling Technologies

The session will showcase innovative cooling technologies with a particular focus on the link between distributed, decentralized renewables and cooling technologies, especially for areas not connected to the national grids.

Cooling Innovations: How technology is making an impact to lives and livelihoods

Speaker: Mr Dexter Huerto, Segment Marketing Manager, Asia Pacific & India Region, Danfoss

Mr Huerto shared the case study of how Danfoss's pre-cooling and cold storage solutions extended the life of bananas which made long distance transport possible and improved the lives of farmers.

India is the world's largest banana producer and 30% comes from Tamil Nadu. However, a third of the production is lost due to insufficient pre-and post-harvest methods and only 1% of the bananas are exported. Partnering CII, Danfoss set up a process to identify gaps in the banana industry and educated farmers on pre-and post-harvest best practices with an emphasis on cold chain technologies.

Better post-harvest management (pre-cooling and cold storage) extended the life of bananas from 1 week to 35 days and made long distance transportation possible. Ripening chambers resulted in better quality bananas for consumers and reduced wastage by 20%. Farmers had the power to control when bananas are released into the market. The new technology has given farmers new opportunities and increased their incomes by 300%. By the end of end of 2018, bananas from India are sold not only to their local markets but are also exported to Europe.

Linking renewable energy and cooling: Examples of technology and business model innovations

Speaker: Ms Nyamolo Abagi, Manager, East Africa, CLASP

In her presentation, Nyamolo Abagi of CLASP shared that EcoZen is one of the finalists participating in the CLASP-managed Global LEAP Awards Off-Grid Cold Chain Challenge (OGCCC). The OGCCC is an international competition to identify and promote the most energy-efficient, sustainable and cost-effective technologies that can meet cold room storage requirements for fresh fruits, vegetables, and dairy products in Kenya, Nigeria, Rwanda, Tanzania, and Uganda.

EcoZen cold unit made the journey to sub-Saharan Africa from the company's headquarters in Maharashtra state, India. With EcoZen, Blue Sky Farm currently produces eleven different types of herbs, each with their own specifications for harvest and storage temperature, in a green, reliable, efficient and cost-effective manner.

Unlocking the potential of clean cooling technologies to increase incomes of smallholder farmers in India

Speaker: Mr Akbar Sher Khan, Co-Founder, Impagro Farming Solution Pvt Ltd

In Akbar Sher Khan's presentation, he shared that to tackle the issue of food loss, small holder farmers need proper connectivity to the market. Small hold famers face issues such as small harvest volume, distress sales, high selling cost and low-price realisation. Impagro aims to maximise income for smallholder farmers by reducing post-harvest loss and increasing market access using clean cooling. Its pilot project located in the Ratapani region (Raisen district) of Madhya Pradesh has a cold room and pack-house that provides facilities for horticulture farmers to sort, grade, store and aggregate their produce at the farm level. The facility allows farmers to benefit from innovative cold storage technology to help reduce post-harvest losses.

Passive cooling technologies for smart and integrated road and rail cold chain transportation – from materials to commercialization

Speaker: Mr Ding Yulong, Director of the Birmingham Centre for Energy Storage (BCES), PCM road/rail container, collaboration between BCES and China

Professor Ding shared briefly on Birmingham Centre for Energy Storage's research findings on clean cooling:

- Thermal energy storage for pure electrical vehicles leads to increased range and energy efficiency
- Thermal Energy Storage for Passenger Trains leads to 20% weight reduction, energy consumption reduction by ~18%, significant improvement of customers experiences due to reduced stop-start frequency

- An example of passive cooling technologies for smart and integrated road and rail cold chain transportation was the transfer of containers between the rail and road without a power supply. A trial in China showed that, once charged, the interior temperature of the container can be kept between 5 and 12˚C for up to 120 hours (~+8°C PCM) and between 0 and 5°C for up to 194 hours (~-4°C PCM), and all goods passed the third-party tests at the receiving ends.

The role of reflecting roofs in helping to provide thermal comfort

Speaker: Ms Farizan d'Avezac De Moran, Senior Partner, GreenA Consultants Pte Ltd

Farizan d'Avezac De Moran shared that few buildings place importance on its thermal conductivity, instead more focus is placed on its aesthetics. Roofs are largely regarded as a functional element meant as a shelter or MEP space. Often, there are no codes or policies in place and there is no clear ownership of it. e.g. is it the role of engineers or architects or building owner to ensure a cool roof? Therefore, switching on the air-conditioner seems like a convenient and fast way to cool the building. However, cooling buildings or cities can be achieved with cool roof paints.

With global warming, scaling of cool roofs in countries with large numbers will help those facing heat stress risks. The Million Cool Roofs Challenge is an initiative of the Kigali Cooling Efficiency Program, the Global Cool Cities Alliance, Sustainable Energy for All and Nesta Challenges. GreenA Consultants together with RwGBO aim to cool 1 million sqm roofs by December 2020 with their "Cooling Rwanda Project" proposal. As a finalist for the Challenge, they will receive a seed grant of USD100,000 to implement a co-ordinated approach to scaling up cool roof nationwide to improve access to cooling. The project is broken down into 2 phases. Phase 1 includes 3 demonstration projects covering a total of 30,000 sqm and the development of a "heat-map" over Kigali to determine areas which need cool roofs, as well as scale up the awareness of cool roofs. Phase 2 involves training.

Moderated Panel Discussion:

Panellists: Mr Dexter Huerto, Segment Marketing Manager, Asia Pacific & India Region, Danfoss, Nyamolo Abagi, Manager, East Africa, CLASP, Mr Akbar Sher Khan, Co-Founder, Impagro Farming Solution Pvt Ltd, Mr Ding Yulong, Director of the Birmingham Centre for Energy Storage (BCES), PCM road/rail container, collaboration between BCES and China, Ms Farizan d'Avezac De Moran, Senior Partner, GreenA Consultants Pte Ltd. Moderator: Ms Grace Yeneza, Consultant, Asian Development Bank (ADB)

Q: 'is there a consideration to use other technology such as PCM or solar cooling to store cold air instead of storing electricity' for the solar-powered driven refrigeration unit in Africa?

Nyamolo Abagi shared that for the off-grid cold challenge, none of the participants used PCM. However, for the refrigeration competition, there are manufacturers using PCM. The technology is still considered expensive considering the buying power of the African market and it is still not affordable yet. A lot of factors go into the high cost but factors such as the high import duties and shipping costs can add up to about 30% of the price.

Q: Is it possible that the light that is reflected back into the sky is absorbed by the clouds which then increase the temperature of the whole city and creating a heat island effect?

Ms Farizan d'Avezac De Moran commented that there is a lot of diffused radiation in equatorial climates which causes the heat and therefore, one must also be careful about the roof reflecting the heat onto the next building.

Q: Predict when will the next disruptive cooling technology drawing energy from waste heat, solar thermal, ocean thermal be more commercially viable and compete with present cooling technology? Do you ever see cooling energy as a tradable energy commodity that could happen in the region? e.g. drawing cold energy from China and bringing it down to the equatorial parts of Asia

Professor Peters commented that they are interlinked. The cooling technology exists today and are commercially viable. However, the business model does not exist today. He said that we are so used to business models providing electrical solutions, but the challenge is how we can create a business model that can harness the waste heat of LNG and use it to provide cooling in a bus or transport refrigeration unit or ship it. "We need to first create a thermal grid where I can put my waste heat and someone uses it to produce cold. Currently this does not exist". Therefore, this is not a technology problem, but a business model challenge.

Mr Dexter Huerto commented that one of the opportunities for the Asia Pacific region that Danfoss see in energy efficiency will be industrial heat pumps. This is currently not available in the region and is not widely adopted. For a large industrial system that requires a hot water heat source, currently the predominant source will be gas feed boilers. In industrial refrigeration plants, there is a surplus of heat. Therefore, if we are able to recover that amount of heat, it will provide water temperatures of up to 60^{o}C and above. If we need 80^{o}C, we will need another sub system behind that. Industrial heat pumps are still in nascent stage in Asia Pacific, but Mr Huerto feels it will be a big thing in the future.

Session 3: Role of financing to scale up Sustainable Cooling solutions

The session will discuss financing options available from public and private sectors as well as other financing institutions/investors and the roles they have played (different mechanisms and approaches including challenges and lessons learned) in financing sustainable cooling solutions. The session can also highlight the risk/reward parameters that each can take and what incentives are needed to encourage investments/financing.

UK International Climate Finance for Sustainable Cooling

Speaker: Dr. Peter Warren, Head of Climate Finance for Innovation and Technology, Department for Business, Energy & Industrial Strategy, UK Government

Dr Peter Warren started off his presentation by emphasing that sustainable cooling-for-all is crucial as temperatures are rising. The projected number of AC units will increase from 900m today to 2.5b units by 2050. Temperatures are expected to increase by another 0.5°C by 2100 from residential ACs along. Currently, only 0.04% of Official Development Assistance (ODA) is allocated to cooling which is small compared to energy efficiency or renewables. Of the 9 countries at greatest risk from a lack of access to cooling, five are in Asia and they are Bangladesh, China, India, Indonesia and Pakistan.

Since 1990, the UK has reduced its emissions by 42% whilst growing its economy by 72% (fastest rate of decarbonisation in the G20). UK's International Climate Finance uses Official Development Assistance (ODA) to help developing countries to tackle climate change and move to sustainable economic growth. The amount for ODA has increased over the years to £11.6b for the next 5 years.

As part of its climate financing programmes, $2m support is provided to World Bank for its work on improving energy efficiency when phasing down HFCs. The UK government has currently supported £26m for sustainable cooling innovation, R&D and technical assistance.

Here are some other examples of Official Development Assistance (ODA) – Wider UK Programmes:

- Market Accelerator for Green Construction (MAGC) Programme: £106m to drive the financing and construction of more energy efficient, green buildings, including cooling (technical assistance and concessional finance)
- Climate Leadership in Cities (CLIC) Programme: £27.5m to support 15 megacities in Asia and Latin America to develop climate action plans, expanding the C40 Cities Finance Facility and global research & national advocacy
- Clean Energy Fund Technical Assistance (CEF TA) Programme: £19.5m to support clean energy project preparation, capacity building and policy development (including cooling)

Financing Green Cooling Technologies -- Demonstration and Scale-Up in Thailand

Speaker: Dr. Philipp Pischke Project Director, Sustainable Cooling and Energy Efficiency, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

GIZ wants to transform the market for cooling technology towards using cleaner refrigerants (such as CO2, hydrocarbons, ammonia) and curb direct emissions that comes from energy use. The RAC NAMA Fund, implemented by GIZ, is a programme that aims to promote the market introduction of green cooling technologies with financial instruments designed for various target beneficiaries in air conditioning sector.

Currently, some of the barriers to using climate friendly technologies are:

- No critical mass of natural refrigerants in the market. For many, this is still an unknown technology.
- High upfront cost for production line extension
- Lack of trained technicians who are crucial in maintaining the equipment as well as advising customers on what to purchase.
- Obstructive or missing regulation which makes adoption of cleaner technology more difficult

EGAT (Electricity Generating Authority Thailand), is the host and Project Fund Manager (PFM) of the RAC NAMA Fund to promote energy-efficient and climate-friendly technologies. EGAT is the decision-making body of the RAC NAMA Fund and serves as the link between GIZ and the recipients. There are 2 types of funding: 1) grant funding for production, 2) loan funding for products.

Lessons Learnt

- Select organizations for which the implementation of the financial mechanism is (close to) business as usual
    - Provide grants through government bodies, not banks
    - Market introduction instruments through suppliers and banks
- Do not interfere with the implementation of the financial mechanism, but ensure appropriate governance structures
- Consider investing into greening the production, not into green products
- Grants for greening the production are more cost efficient than loans for green products

Scaling up efficient cooling through innovative ESCO finance

Speaker: Mr Alexander Ablaza, Co-Chair, Asia-Pacific ESCO Industry Alliance (APEIA)

Alexander Ablaza started with a brief introduction of APEIA. The alliance of ESCO associations from China, India, Japan, Korea, Malaysia, Philippines, Singapore and Taiwan is a regional platform to accelerate ESCO market growth.

USD24.5 trillion is needed in global energy efficiency capital mobilization. USD8 trillion can be mobilized through business-as-usual EE capital while USD16.5 trillion off-balance sheet (outside the end user energy efficient solution or technology) EE capital flows through ESCO performance, PPP transactions, government, large-scale retrofit programmes and other modalities. There is a need to enable more off-balance sheet capital mechanisms.

There are 2 models of ESCOS and debt financing: 1) Guaranteed savings (often called North American) which is dependent on the end-user credit worthiness, 2) Shared savings (often called French) model which is dependent on the credit worthiness of the ESCO. Neither models are effective in achieving scale as it is dependent on the credit worthiness of the end user or ESCO.

This is current state-of-play for EE Financing:

- EE debt finance works, but lending volumes are still small
- Up to 98% of ESCOs in developing Asia do not have suitable access to bank lending to pursue contract pipelines
- For banks, project finance does not work for energy efficiency projects because of smaller deal size
- Equipment leasing unable to compete with bank lending because of higher rates
- Banks need to de-risk larger exposure to energy efficiency projects and use of guaranteed energy savings as debt security
- Most markets do not have existing channels or aggregators for off-balance sheet capital flows
- Economies generally do not invest in EE project development or in developing nascent ESCO markets

To address the gaps in EE financing, here are the solutions for scaling up:

- Set up risk sharing facilities behind bank lending portfolio to Increase bank exposure or Reduce loan pricing to EE projects
- Set up ESCO Guarantee Funds or Insurance Facility to provide guarantee cover behind energy savings performance guarantees issued by ESCOs, or additional credit guarantees to allow ESCOs to go down-market and cover larger SMEs
- Create new equity channels (e.g. super-ESCO, equity funds, SPV investors, etc.)
- Create and sustain viable businesses to focus on identifying and preparing investment-grade/bankable EE projects
- Develop capacities in ESCO sector (e.g. template contracts, CMVP training, etc.)
- Develop innovative financing channels (PPP, utility-based, property-based, etc.)
- Tighten EE regulation by setting progressive targets for SEC reduction

- Incentivize third party investments in EE portfolios
- Broaden procurement regulations to enable ESCO contracts
- Reclassify EE as infrastructure development and integrate EE in energy resource planning of economy

Building the business case for clean cooling from district cooling

Speaker: Ms Eloise Burnett, South East Asia Manager, Carbon Trust

Demand for cooling is expected to continue to grow rapidly. For example, 19 pieces of cooling equipment is forecasted to be sold every second by 2050 and that this will only fulfil 2/3 of the demand for cooling. Hence, district cooling has the potential to help combat some of the challenge posed by the cooling crunch.

District cooling involves the central production of cold water. The cold water is then distributed to buildings in the network via an underground piping. The building will circulate cold air by using fans and air handling units. Warm water then returns to the energy centre.
In dense areas, district cooling systems can reduce energy use and greenhouse gas emissions by using more efficient plant and equipment than standalone systems. Depending on the technology decisions made, district cooling systems can also:

- Support countries to achieve HFC phase down by using lower global warming potential refrigerants.
- Reduce peak electricity requirements and use lower cost off-peak electricity by using chilled water or ice storage.
- Where there is a carbon intensive electricity grid using non-electric technologies can increase energy system resilience by reducing the demand for electricity and, if a CHP is used, provide reliable electricity.
- If the right conditions are met, use free cooling to minimise energy required for cooling.

For both case studies (Iskandar, Malaysia and Thane, India) mentioned in the presentation, district cooling involves the following 4 stages of 1) pre-feasibility study, 2) city-wide mapping of cooling demand, 3) policy and regulatory recommendations and 4) training. In the pre-feasibility stage, it is important to ask hard questions along the stages of a) energy demand assessment, b) network assessment, c) energy centre: central plant options and d) economic assessment.

It is crucial to engage stakeholders such as the local authority to get their buy-in as they would create enabling policies, sign off on the project and drive it. Often, they would have the local knowledge of the area and benefits can be maximized if the local authority is involved. On the other end of the scale, it is just as important to engage with the end users and community and design with the customer in mind which helps build investor confidence and maximise benefits.

Moderated Panel Discussion:

Panellists: Dr. Philipp Pischke Project Director, Sustainable Cooling and Energy Efficiency, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Mr Alexander Ablaza, Co-Chair, Asia-Pacific ESCO Industry Alliance (APEIA), Ms Eloise Burnett, South East Asia Manager, Carbon Trust. Moderator: Dr. Peter Warren, Head of Climate Finance for Innovation and Technology, Department for Business, Energy & Industrial Strategy, UK Government

One of the questions asked by the panelists was if district cooling should be regulated. In an ideal world, the answer would be yes especially when new cities/ developments are being planned or build. However, Alexander Ablaza commented that instead of imposing technology regulation or regulating district cooling, the focus should be on the actual consumption of energy. E.g. impose cooling consumption per square metre and this would be more effective.

Adding on to the discussion, Philipp Pischke mentioned that typically in Europe, regulation comes before measures or promotions are put in place to help ease the pain for companies that are being regulated. He commented that Thailand is a good example of promoting cooling instead of regulating it; and to put it bluntly, the ODA grant is a replacement for regulation.

Governments should avoid changing the rules of the middle of the game. Alexander Ablaza shared the example of malls in South East Asia who had to pull out thermal energy storage because governments narrowed the differential in mid-process, and this disrupted technology deployment and financing as investors look at long-term payback.

To address the question on the role of multilateral banks in scaling up climate finance beyond grants and technical assistance, the panellists shared that there is a huge role for multilateral development banks to come in and fill the gap as commercial investors may find it too risky, however there is a need to look beyond debt financing as financing instruments. Developmental banks can play the role of upscaling financing where commercial banks are not ready to do so. They can also bridge the gap between ideas on paper and pilot projects/ execution.

Session 4: National Cooling Plans

The session will present how national cooling plans are accelerating access to cooling. During this session, completed country-specific national cooling plan will be presented, highlighting status and outcomes of their presented.

India Cooling Action Plan (ICAP) - Thermal Comfort for All

Speaker: Sudha Setty, Director at Alliance for an Energy Efficient Economy (AEEE)

Ms Sudha Setty shared that India's cooling action plan was launched on 8 March 2019. Cooling a developing country like India is unlike cooling in a developed nation as majority of ACs and refrigerant volume has yet to come. This presents a unique opportunity for India to address the root of the problem by minimizing the demand for cooling. India has one of the lowest access to cooling (7% to 9%) across the world.

Increasing population, per capita income and urbanization will drive increase in cooling demand. There are vast disparities in the levels of per capita energy consumption towards space cooling in buildings. India is far below China, an equally populous country, and the world average. According to IEA's 2018 The Future of Cooling report, India's per capita space cooling energy consumption is at 69 kWh per person as compared to the world average of 272 kWh.

In India, cooling is a development need and to address the future of cooling, India can undertake the 3-step approach which is:

1) LEAN (reduce cooling load in buildings by using climate-appropriate building design and construction such as high-performance glazing, cool/ green roof, natural ventilation
2) MEAN (achieve cooling efficiently by using e.g. energy efficient cooling appliances
3) GREEN (reduce carbon footprint e.g. using climate-friendly refrigerants/ renewable energy)

Sustainable cooling is a national priority and ICAP (India Cooling Action Plan) is a flagship initiative by India's Ministry of Environment, Forest and Climate Change (MoEF&CC) to address the challenges of use of refrigerant and use of energy. India is the first country in the world to develop such a document (ICAP), which addresses cooling requirement across sectors and lists actions to reduce cooling demand. The overarching goal of ICAP is to provide sustainable cooling and thermal comfort for all while securing environmental and socio-economic benefits for the society. To address ICAP's objectives, the plan covers 7 thematic groups and involves various different stakeholders from R&D institutions/ think tanks, government and the industry.

The key findings of ICAP are:

- India will experience 8-times growth in cooling demand over 2 decades
- There will be 6.5-times growth in refrigerant demand. With intervention scenario, there is a 25% saving potential
- Over and above the 30% savings potential for India's total primary energy supply (TPES) for

cooling, a reduction potential of about 20% in cooling load could be achieved by 2037-38

Other highlights:

- Residential sector is likely to be driver for uptake of AC equipment in India due to low current penetration, increasing affordability and urbanization trends
- Even with growing penetration of ACs, fans and coolers will consume a substantial share of energy even in 20 years' time, as much as large commercial ACs combined
- Cold-chain and refrigeration is poised for significant growth with important connotations for India's socio-economic development (farmers' income and food security)
- Active interventions in cold chain can achieve around 10% reduction in cooling energy requirement
- Refrigeration equipment efficiency improvements, replacement of old inefficient stock and better O&M practices can reduce refrigeration energy consumption by 25-30% in 20 years
- Growing stock of passenger vehicle (mostly air-conditioned) will have a significant bearing on fuel and refrigerant demand
- Policy measures liked improved fuel efficiency of vehicles, incentives/rebates for EE technologies, push towards public transportation can help reduce fuel and refrigerant demand
- Largely unorganized sector with immediate opportunity to providing increased employment, better livelihood through training & certification
- Important to reduce leakage of refrigerants and maintaining the rated EE of in-use equipment

Examples of socio-economic co-benefits include thermal comfort for all, increased productivity, reduced food wastage, improved health and well-being among others.

China's National Cooling Plan: Implication and Impact

Speaker: Hu Min, China Advisor, Kigali Cooling Efficiency Program

China's National Green and High Efficient Cooling Action Plan (GCAP) was launched in June 2019. It is the third national cooling plan after India and Rwanda. China is the largest producer, consumer and exporter of cooling technologies. It accounts for 80% of the global AC market and 60% of global refrigerator market with total revenue around USS100 billion as well as provide 3 million jobs.

According to a report, China produced around 84 million room air-conditioners (RACs) in 2017, accounting for about 70% of the total RAC production worldwide (120 million units). This is comparable to the total solar capacity (100GW) added in 2017 in China, and hence there is a need to improve cooling efficiency.

The following are GCAP's goals:

- The MEPS of major cooling products to meet or exceed the developed countries level
- Tier one energy efficiency cooling products to reach international best practices
- To improve energy efficiency of the cooling sector by 25%, with 2019 as the baseline
- To increase market penetration of key cooling products by 40% in 2030
- To increase MEPS level by 45% in 2030

- To improve public building cooling energy efficiency by 30% in 2030, with 2019 as the baseline

GCAP helps to open policy windows for new MEPS. e.g the new standards for residential AC in 2020 will bring China's MEPS to be overall the most stringent one around the world. In addition to policy making, the plan will help to implement programmes to improve energy efficiency of cooling systems. E.g adding top-runner and GWP info on the EE labels, to revise public procurement guidelines to include high EE low GWP products, etc.

The energy conservation retrofitting programme will also look at cooling systems for public buildings, data centers, cold chain and residential. This programme is important because often the government will provide subsidies/ financing for ESCOs to tap on for greater impact.

GCAP aims to achieve 100 billion kwh electricity savings by 2020, 400 billion kwh electricity savings in 2030. From energy system modelling, the plan will help reduce additional 18% electricity demand in 2030. The plan will require at least 5% improvement in a year and will help speed up the energy efficiency improvement of China's cooling system.

This year, China launched the BRI Green Cooling Initiative through "international collaboration and comparison of energy efficiency standards and testing protocols, explore regional and global standards harmonization. The plan also looked at promoting access to sustainable cooling by facilitating the removal of green cooling products trade barriers.

After the plan was launched, business response has been positive. Moving on, the plan can be further improved.

Moderated Panel Discussion:

Panellists: Hu Min, China Advisor, Kigali Cooling Efficiency Program, Sudha Setty, Director at Alliance for an Energy Efficient Economy (AEEE). Moderator – Ms Clotilde Rossi di Schio, Cooling Specialist, Sustainable Energy for All (SEforALL)

To answer the question of lessons learnt on national cooling plan, Ms Sudha Setty commented that the uniqueness of ICAP is the synergies between ministries, which is key for programme implementation. There is good private and public alignment on the trajectory for future cooling of India. There are multiple efforts to fill up information gaps from government data to speaking to subject matter experts to secondary research.

For China, the most important learning is to find the entry point to convince the government on the importance of cooling. There are different angles such as climate change, HFC, however, energy conservation is the right entry point. Also, the energy conservation department has more influence on the industry. If this was developed by environmental agencies, it may not be as impactful.

Should cooling action plans should have greater aspirations? ICAP is a living document and modifications can be made. Hu Min commented that the global cooling price focuses on residential

AC, and as consumers are more cost sensitive, it is not the role of national cooling plan to address aspirational targets.

On the question if policy makers considered the impact of renewable energy development on cooling plans, Sudha Setty commented about India's Lean, Mean, Green approach, specifically the Green part is related to renewables. This means design well and using climate-friendly refrigerants/ solar trajectory type of systems and energy efficient technologies. Hu Min commented that a weakness of the GCAP is that it addresses what we already know e.g. existing policies or MEPS, but it does not address what we do not know. E.g. new business models, integration of different technologies, integration of renewable to cooling. Hu Min shared that cold chain has the potential to have zero emissions if renewables can be integrated well and this aspirational model needs to be further explored.

Why are national cooling plans only developed by developing countries, and so few of them? How can developed countries, including Singapore can be involved in this? Clotilde Rossi di Schio commented that SEforAll is pushing for more national cooling plans. Currently about 25-27 are under development. Governments are now paying more attention to it especially in the last few years, and the number of countries looking at it has grown.

Policy and regulation drives energy efficiency. On the flipside, it is the private sector investment that is delivering energy efficiency. Therefore, what is the role of the cooling plan in enabling private investment? In India's cooling plan perspective, the government can seek additional funding if required, otherwise, it can look towards the Kigali amendment or Montreal Protocol to tap the multilateral financing. In China, many banks are SOEs and the cost of financing is low.

Agenda: Deep Dive Workshop – Access to Cooling

Time	Activity
9:00 – 9:10am	**Welcome Remarks:** Vincent Low, Council Member & Chairman - Energy Efficiency, Sustainable Energy Association of Singapore & Vice President, G-Energy Global
9:10 – 9:25am	**Opening Remarks:** Asian Development Bank Dr. Kee-Yung Nam, Principal Energy Economist Sustainable Energy for All Mr. Brian Dean, Head, Energy Efficiency and Cooling
9:25 – 10:30am	**Session 1: Access to Cooling in the Asia and the Pacific** *The session will discuss the status of access to cooling in the Asia- Pacific region including current technical, policy and market challenges and risks. It will highlight the role of governments – specifically what governments can or needs to do to promote and achieve access to cooling, i.e. policy and regulatory framework that is conducive to private sector investment in cooling technologies. The session will also emphasize the necessity of conducting a country-specific needs assessment study and discuss the important steps and considerations in the conduct of needs assessment studies covering the different market segments (i.e. residential, commercial and industry), as each has its own and differing demand characteristics.* **Tracking access to cooling for all in Asia and the Pacific** Speaker: Clotilde Rossi di Schio, Cooling Specialist, Sustainable Energy for All (SEforALL) **Understanding and Measuring Cooling for All - A needs- driven approach to our cooling demand** Speaker: Toby Peters, Senior Research Fellow, Transformational Innovation for Sustainability, Heriot-Watt University and Professor in Cold Economy, University of Birmingham **Joining the panel discussion: Ksenia Petrichenko, UN ESCAP** **Moderated Panel Discussion:** Moderator – Mr. Brian Dean, Head, Energy Efficiency and Cooling,

	Sustainable Energy for All (SEforALL)
10:30 – 10:45am	**Networking Break**
10:45am – 12:30 noon	**Session 2: Innovative Cooling Technologies** *The session will showcase innovative cooling technologies with a particular focus on the link between distributed, decentralized renewables and cooling technologies, especially for areas not connected to the national grids. Presentations shall include examples of cooling technologies already successfully implemented and pilots of emerging technologies.* **Cooling Innovations: How technology is making an impact to lives and livelihoods** Speaker: Dexter Huerto, Segment Marketing Manager, Asia Pacific & India Region, Danfoss **Linking renewable energy and cooling: Examples of technology and business model innovations** Speaker: Nyamolo Abagi, Manager, East Africa, CLASP **Unlocking the potential of clean cooling technologies to increase incomes of smallholder farmers in India** Speaker: Akbar Sher Khan, Co-Founder, Impagro Farming Solution Pvt Ltd **Passive cooling technologies for smart and integrated road and rail cold chain transportation – from materials to commercialization** Speaker: Ding Yulong, Director of the Birmingham Centre for Energy Storage, PCM road/rail container, collaboration between Bham and China **The role of reflecting roofs in helping to provide thermal comfort** Speaker: Farizan d'Avezac De Moran, Senior Partner, GreenA Consultants Pte Ltd **Moderated Panel Discussion:** Moderator – Dr. Kee-Yung Nam, Principal Energy Economist/Ms. Grace Yeneza, Consultant, Asian Development Bank (ADB)
12:30 – 1:30pm	**Lunch Break**

1:30 – 3:00pm	**Session 3: Role of financing to scale up Sustainable Cooling solutions** *The session will discuss financing options available from public and private sectors as well as other financing institutions/investors and the roles they have played (different mechanisms and approaches including challenges and lessons learned) in financing sustainable cooling solutions. The session can also highlight the risk/reward parameters that each can take and what incentives are needed to encourage investments/financing.* **Financing mechanisms available for promoting large scale distribution of cooling systems** **UK International Climate Finance for Sustainable Cooling** Speaker: Dr. Peter Warren, Head of Climate Finance for Innovation and Technology, Department for Business, Energy & Industrial Strategy, UK Government **Financing Green Cooling Technologies -- Demonstration and Scale-Up in Thailand** Speaker: Dr. Philipp Pischke Project Director, Sustainable Cooling and Energy Efficiency, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH **Scaling up efficient cooling through innovative ESCO finance** Speaker: Alexander Ablaza, Co-Chair, Asia-Pacific ESCO Industry Alliance (APEIA) **Building the business case for clean cooling from district cooling** Speaker: Eloise Burnett, South East Asia Manager, Carbon Trust **Moderated Panel Discussion:** Moderator – Dr. Peter Warren, Head of Climate Finance for Innovation and Technology, Department for Business, Energy & Industrial Strategy, UK Government
3:00 – 3:15pm	**Networking Break**

3:15 – 4:15pm	**Session 4: National Cooling Plans** *The session will present how national cooling plans are accelerating access to cooling. During this session, completed country-specific national cooling plan will be presented, highlighting status and outcomes of their presented.* **Presentation of National Cooling Plans by Asian Countries** **India Cooling Action Plan (ICAP) - Thermal Comfort for All** Speaker: Sudha Setty, Director at Alliance for an Energy Efficient Economy (AEEE) **China's National Cooling Plan: Implication and Impact** Speaker: HuMin Hu, China Advisor at Kigali Cooling Efficiency Program **Moderated Panel Discussion:** Moderator – Ms. Clotilde Rossi di Schio, Cooling Specialist, Sustainable Energy for All (SEforALL)
4:15 – 4:30pm	Closing remarks

Participants

No	Sal	Name	Designation	Organisation	Country
1	Ms.	Kriselda S. Lumapas	Engineer A	National Electrification Administration	Philippines
2	Ms.	Laila Kanji	Senior Policy Advisor & Climate Finance Investment Lead	UK Government (Energy & Industrial Strategy (BEIS)	UK
3	Mr.	Jimmy Loh	General Manager	G-Global Energy Pte Ltd	Singapore
4	Ms.	Mikell O'Mealy	Senior Adviser	Abt Associates	USA
5	Mr.	Alessandro Romagnoli	Cluster Director	NTU	Singapore
6	Mr.	Naveen Kumar	Director	PTC India Financial Services Ltd (PFS)	India
7	Mr.	Chris Crawley	Director	Skycool	Singapore
8	Ms.	Kitty Bu	Asia Finance Lead	European Climate Foundation	Singapore
9	Ms.	Hiba Saleem	Director		UK
10	Mr.	Khor Jun Onn	Researcher	NTU	Singapore
11	Mr.	Lizhong Yang	Researcher	NTU	Singapore

No	Sal	Name	Designation	Organisation	Country
1	Mr.	Vincent Low	V-President	G-Global Energy Pte Ltd	Singapore
2	Dr.	Philipp Pischke	Director of the RAC NAMA Project	GIZ	Thailand
3	Mrs.	Farizan d'Avezac De Moran	Senior Partner	GreenA Consultants Pte Ltd	Singapore
4	Mr.	Akbar Sher Khan	Co-Founder	Impagro Farming	India
5	Ms.	HuMin Hu	China Advisor	Kigali Cooling Efficiency Program	China
6	Ms	Clotilde Rossi di Schio	Cooling Specialist	Sustainable Energy for All	
7	Mr.	Brian Dean	Head Energy Efficiency and Cooling	Sustainable Energy for All	
8	Dr.	Peter Warren	Head of Climate Finance for Innovation and Technology	UK Government (Energy & Industrial Strategy (BEIS)	UK
9	Ms.	Ksenia Petrichenko	Economic Affairs Officer	UN, ESCAP	Thailand
10	Mr.	Ding Yulong	Director	University of Birmingham	UK
11	Prof	Toby Peters	Professor in Cold Economy	University of Birmingham Heriot Watt University	UK
12	Ms.	Sudharani Nagaraja Setty	Director	Alliance for an Energy Efficient Economy	India
13	Mr.	Alexander Ablaza	Co-Chair	Asia-Pacific ESCO Industry Alliance	Philippines

14	Ms.	Eloise Burnett	South East Asia Manager	Carbon Trust	Singapore
15	Mr.	Dexter Huerto	Senior Segment Marketing Manager	Danfoss	Singapore
16	Ms.	Nyamolo Abagi	Manager, East Africa	CLASP - East Africa	Kenya

No	Sal	Name	Designation	Organisation	Country
1	Dr	Kee-Yung Nam	Principal Energy Economist	Asian Development Bank	Philippines
2	Dr	Zhai Yongping	Technical Advisor	Asian Development Bank	Philippines
3	Ms	Maria Dona Aliboso	Operations Analyst	Asian Development Bank	Philippines
4	Mr	Dae Kyeong Kim	Senior Energy Specialist	Asian Development Bank	Philippines
5	Ms	Ana Maria Tolentino	Consultant	Asian Development Bank	Philippines
6	Ms	Grace Yeneza	Consultant	Asian Development Bank	Philippines