

APUEA

Magazine

Digital Urban Energy

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Contents

PAGE

08

Interview with Clay Nesler, Johnson Controls
by APUEA

12

Maximizing the benefits of thermal energy storages in district cooling networks with optimization algorithms and artificial intelligence
by ENGIE

16

Setting the UPS standard - the ABB DPA 250 S4
by ABB

18

Supporting the lifecycle of energy infrastructures with Smart O&M
by Siveco

22

Make Building Heating More Energy Efficient by Artificial Intelligence
by LEANHEAT by Danfoss, China

26

The Potential of District Energy and Waste Heat Recovery in Asia Pacific
by IVL Swedish Environmental Research Institute

30

Renewables in Cities 2019 Global Status Report
by REN21

36

Recent APUEA Activities
by APUEA

42

Event Calendar

44

Member Directory

45

APUEA Membership Form

Editorial

As a sustainable energy promoter, the beginning of 2020 makes one puzzled. While energy-related CO₂ emissions flattened in 2019, which is good news, 2019 was the second-warmest year on record. For Europe, 2019 was the warmest year on record, and many countries have just experienced the warmest winter ever. We can conclude that the share of renewables in the electricity generation mix counts for around 25 percent, which is almost the same as half a century ago. When looking at the electricity mix for the last two decades, fossil fuel remains above two-thirds, while renewables have replaced about one-third of the share of nuclear energy.

In the light of the COVID-19 pandemic, we see energy consumption drop across sectors in affected areas, and urban pollution reduction is visible in many cities. Besides the negative health effects of the virus, the global economy is facing challenges. Even though the negative effects of the pandemic are significant, rapid change in public behavior and resolute governments gives hope for other global challenges to be fought – not at the least, climate change. We are starting to see that joint efforts by governments and the public for the better good can generate great results.

The urban population in Asia-Pacific exceeded 2.3 billion in 2019, corresponding to 54 percent of the urban population globally. The urban population in the region is expected to rise to more than 2.8 billion in 2030 and reach almost 3.5 billion by 2050. This increase is equal to four new Tokyo-sized cities every year and will require great efforts by local governments to develop sustainable urban energy and livable cities. I'm confident that this growth can be sustainable as long as there is political and public will and sufficient insights into the available urban energy solutions are provided. APUEA is dedicated to support this development and offer knowledge exchange and transfer to cities across the region.

I want to highlight the great work done by the APUEA secretariat in 2019, led by Peter Lundberg. In line with the member benefits, the APUEA secretariat supported members with marketing, sales, and matchmaking activities. In parallel, APUEA hosted and supported 13 urban energy events in the region. With the present focus on China, India, and Southeast Asia, events were held in Bangkok, Changsha, Hong Kong, Manila, New Delhi, Penang, Seoul, Singapore, and Xian. In this issue of the APUEA magazine, you can read more details about our events in 2019, as well as our events in 2020. Several of the APUEA events planned for the first half of 2020 are postponed

or have been transformed into online sessions, due to the COVID-19 pandemic. We believe the APUEA platform becomes even more important ahead, serving as a platform to promote our member's offerings and prepare for the development of sustainable urban energy projects when everything is back to normal.

On January 14th, the APUEA advisory board gathered for an online advisory board meeting reviewing and providing feedback on the APUEA operation. The recent initiative establishing a District Cooling focus group was presented. The District Cooling focus group led by Mr. Pär Dalin, President of Devcco, will utilize the APUEA platform to promote District Cooling across Asia-Pacific.

In this issue of the APUEA Magazine, you can read articles about smart O&M, Artificial Intelligence (AI), energy storage, heat recovery, and renewables in cities. We thank ABB, Engie, IVL, Johnson Controls, Leanheat by Danfoss, REN 21, and Siveco for contributing to the APUEA magazine this time.



Mikael Jakobsson
Executive Director,
Asia Pacific Urban Energy Association (APUEA)

Secretariat



Mikael Jakobsson
Executive Director



Kullakant Chertchutham
Secretary



Peter Lundberg
Head of Operations



Wilaiwan Kunchansombut
Publications Manager



Muhammad Ali
APUEA Australasia advisor



Ankit Kamra
India Representative



Xiawen Fan
Marketing Manager

Asia Pacific Urban Energy Association

Address: 1168/27 Unit B, 15th Floor, Lumpini Tower, Rama IV Road, Thungmahamek, Sathorn, Bangkok 10120, Thailand

Tel: +66 2 285 6349

Fax: +66 2 285 6348

Mail: info@apuea.org

Web: www.apuea.org

Linkedin: www.linkedin.com/company/apuea/

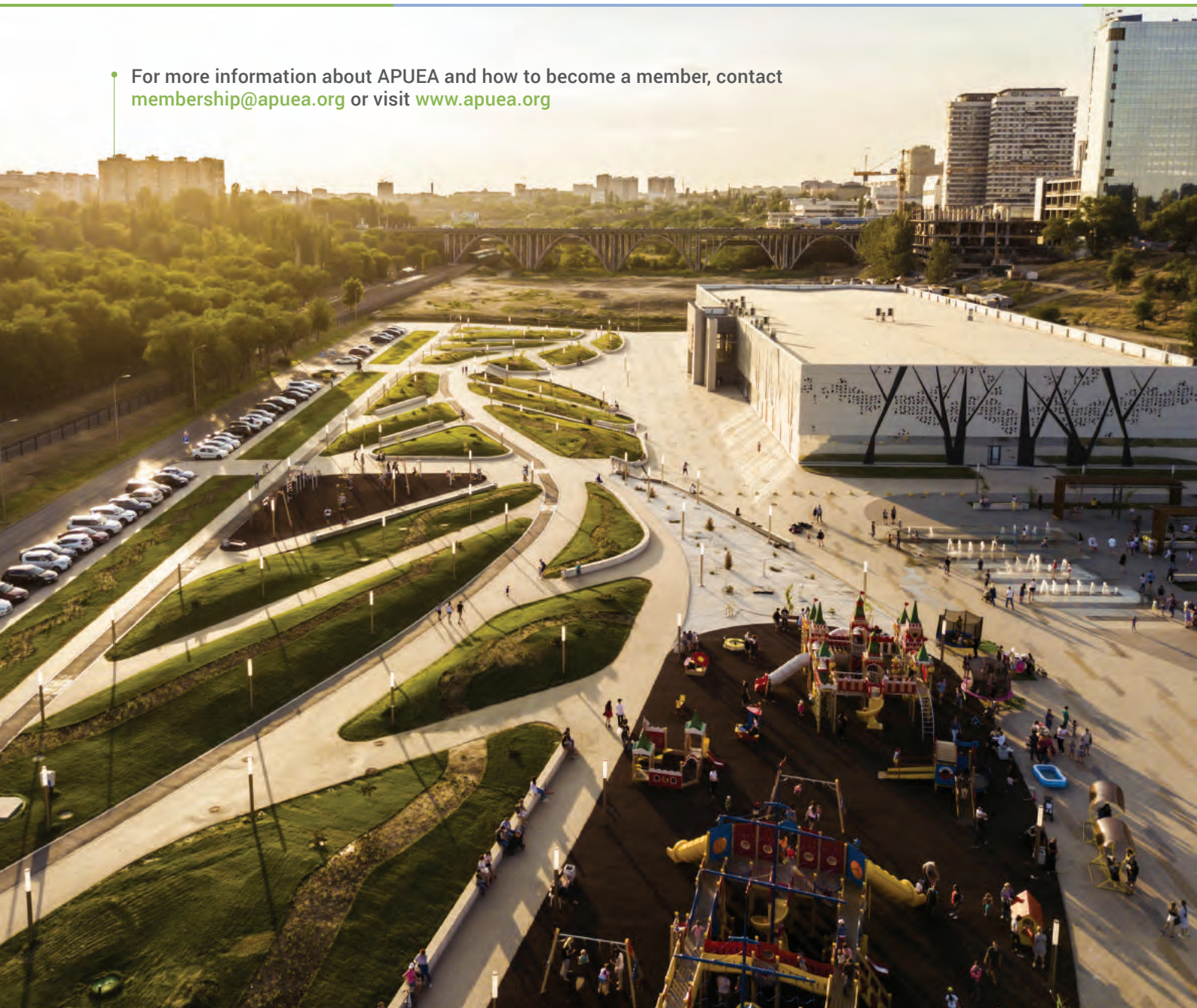


Asia Pacific Urban Energy Association

The APUEA is an initiative of the International Institute for Energy Conservation (IIEC) that promotes the development of sustainable Urban Energy Systems in the Asia Pacific region. The APUEA platform promotes public and private sector collaboration to develop sustainable urban energy systems that support livable cities across the Asia Pacific region. The Association's online portal serves as an information hub to support city policymakers, program managers, and other stakeholders in the design, development, and implementation of sustainable urban energy systems. Through this portal, APUEA events, conferences, and continuous outreach to its members, the Association shares international and regional best practices for planning and implementing sustainable urban energy systems—including policies and regulations, business models, and technologies for implementing district heating and cooling, smart grids, energy efficiency improvements, and renewable energy systems.

An APUEA membership will provide a unique opportunity to liaise with governmental agencies and important stakeholders and get access to valuable information and intelligence on urban energy developments, business opportunities, trends, and financing in one of the fastest growing energy and infrastructure markets in the world. Membership benefits include a marketing platform, newsletters, APUEA Magazine, Annual Publications, Annual General Meeting including Trade Exhibition and Direct Assistance.

For more information about APUEA and how to become a member, contact membership@apuea.org or visit www.apuea.org





ASIA PACIFIC URBAN ENERGY ASSOCIATION MEMBERSHIP

The Asia Pacific Urban Energy Association (APUEA) is a platform to collect and disseminate knowledge, best practices, and tools related to the development of sustainable urban energy systems, and thereby support the development of livable cities in the Asia Pacific region.

APUEA serves a broad range of members including but not limited to utilities, manufacturers, investors, engineering companies, donor agencies and sector associations that are active in the urban energy sector. Members can choose among several membership categories, depending on their sector and level of engagement in APUEA.

APUEA Membership categories are:



ACTIVE MEMBER

Member that benefits from the Association and take an active role in the Association in terms of its governance and operation. An Active Member will be able to influence the scope of APUEA publications and will be recognized in published material from the Association.

ALLIED MEMBER

Member that benefits from the Association and chooses not to take an active role in the Association in terms of its governance and operation.

AFFILIATE MEMBER (Invitation only)

Individual or agency invited by the Association to participate as an individual member; and entities such as regional NGOs, development agencies, and utility organisations. An Affiliate Member benefits from the Association but does not take an active role in the Association in terms of its governance and operation.

The annual membership fee depends on the membership category and organization size:

Member Category	Employees		
	≤ 1,000	1,000 - 10,000	≥ 10,000
Active Member	USD 4,000	USD 5,500	USD 7,000
Allied Member	USD 3,000	USD 4,500	USD 6,000
Affiliate Member	N/A		

BENEFITS

- ✓ Online Portal (www.apuea.org)
- ✓ Newsletters
- ✓ APUEA Magazine
- ✓ Publications
- ✓ Direct Assistance
- ✓ Regional and International Events
- ✓ Annual Meeting and Trade Exhibition



Interview with Clay Nesler, Johnson Controls

We continue our series of interviews with the founding members of APUEA. In the first issue of the APUEA Magazine in 2020, we are happy to share a conversation with Clay Nesler, vice president of global sustainability and regulatory affairs at Johnson Controls. During our conversation, we talked about strategies, geographical focus, trends of energy efficiency investment, technology, and more.

by APUEA

Clay Nesler

Vice president of global sustainability and regulatory affairs, Johnson Controls



Q: Can you give us an introduction to Johnson Controls and describe your role in the company?

Johnson Controls was founded in 1885 by Professor Warren Johnson, who invented the room thermostat. He got tired of tapping the pipes in his college classroom to let the boiler operator in the basement know when the temperature was uncomfortable, so he invented the electric thermostat. Since then, we have made significant additions to our portfolio in the building technology and solutions space. We acquired York International, a major provider of HVAC equipment, chillers, and air handling units, among others. A couple of years ago, we merged with Tyco International, which is a leading provider of building technologies in the fire, life safety, security, and video surveillance area. Our company grew over the years to include a battery business, an automotive interior enterprise, and a facility management venture that we, since then, have spun off or sold. Today, Johnson Controls is a pure-play building technology and solutions company. I am the vice president of global sustainability and regulatory affairs but have had a number of different roles in the U.S. and Europe over the past 37 years.

Q: Can you elaborate on Johnson Control's geographical focus?

We operate in 150 countries, and I have had the pleasure of visiting many of them. I spend a significant amount of time outside the U.S. and particularly in the Asia-Pacific region because the growth is so significant there. I spend time working with our regional offices and working with governments to develop policies that will drive investment in smart and sustainable building technology and solutions.

Q: How do you see competition in the market from Johnson Controls' point of view, and what is your value proposition to the market – how do you differentiate yourselves from your competitors?

We believe our strength is that we bring an integrated set of technologies to address the need of key vertical markets, like healthcare, higher education, government and transportation on a global basis. We differentiate ourselves by being able to integrate all those technologies at a building level, campus level, and increasingly at a community or city level.

Q: Buildings stand for 30 percent of the final energy consumption in the Asia Pacific and, in general, buildings account for a large part of GHG-emissions in cities. What are the key challenges for buildings to minimize energy consumption and carbon footprint?

There is a tremendous opportunity to leverage and improve energy efficiency in new construction as well as in existing buildings. That is why we are so active in working with governments and through organizations like the Asia Pacific Urban Energy Association (APUEA) and the International District Energy Association (IDEA), the Sustainable Energy for All Building Efficiency Accelerator, the Cool Coalition and the Three Percent Club to introduce policies and programs that drive greater efficiency and reduce carbon emissions. Effective policies range from more stringent building codes, equipment standards, building performance benchmarking, and encouraging governments to show leadership in the buildings they design and occupy. We believe it is important for the private sector to participate in both policy development and advocacy. The private sector has the expertise, and they bring the capital. They also bring the capability to encourage countries and cities to be more ambitious, both in their goals and in their actions.

Q: In your opinion, which technologies will play a major role in creating sustainable urban energy systems for cities in the future?

We see a transition from the focus of efficient individual components, devices and equipment to more systems-oriented approaches, and utilizing digital technologies, such as advanced building controls, analytics, and machine learning. Our research shows that low carbon buildings are increasingly incorporating a range of different technologies to optimize performance. We also see a trend in new construction buildings of taking advantage of district energy systems; for example, a campus served by a high-efficiency district energy system, powered by renewable energy and incorporating thermal and battery storage. We see these trends as an opportunity to provide the next level of energy efficient and resilient supply.

Q: Do you think that there can be a decoupling between economic growth and energy consumption and carbon emissions?

I certainly hope so, and I think energy efficiency shows us the way. The International Energy Agency (IEA) says that reducing carbon emissions by 40 percent is possible through currently available, cost effective energy efficiency technologies. These benefits can be realized if countries commit to a three percent annual improvement in energy efficiency. Unfortunately, we are off track to meet this target in many parts of the world.

Q: What is your take on different sustainable concepts, such as smart cities, eco-cities, and future cities?

We have been researching the industry globally for over a decade in our energy efficiency indicator research (previously published in APUEA Magazine, issue 4, February 2019). Our research on Smart Cities has taught us that the priorities, drivers, and investments in smart cities are very much focused on connected technologies, sustainable buildings and resiliency. Cities around the world where their investments are going, and the answers are, distributed energy systems, district energy systems, and energy efficiency improvements like LED street lighting, etc. Energy is central to a smart city strategy.

Q: Many buzzwords are used today in the industry. Can it be problematic to use popular concept names like Smart Cities?

That is true; in India, for instance, there are over one hundred official smart cities, and I am not sure how many of those would be defined as a smart city in exactly the same way. My mother always told me, "smart is what smart does," and I think we need to talk more about the outcomes we are providing to the communities, visitors and businesses. Shenzhen, in China, is a great example of a green city. The city is a leader in sustainable transportation with electric buses, and they have many low energy buildings, including net-zero energy buildings. It is very much a green city from an urban planning standpoint, and they are embracing concepts like district energy and community solar systems. I think that the more we showcase cities where we can show the many benefits of integrated urban energy systems, the more we can address urban challenges and opportunities.

Q: How do you see the trend of energy efficiency investments in the Asia-Pacific region?

In our annual Energy Efficiency Indicator survey, we follow current and planned investments, key drivers, and organizational barriers to improving energy efficiency in facilities. In

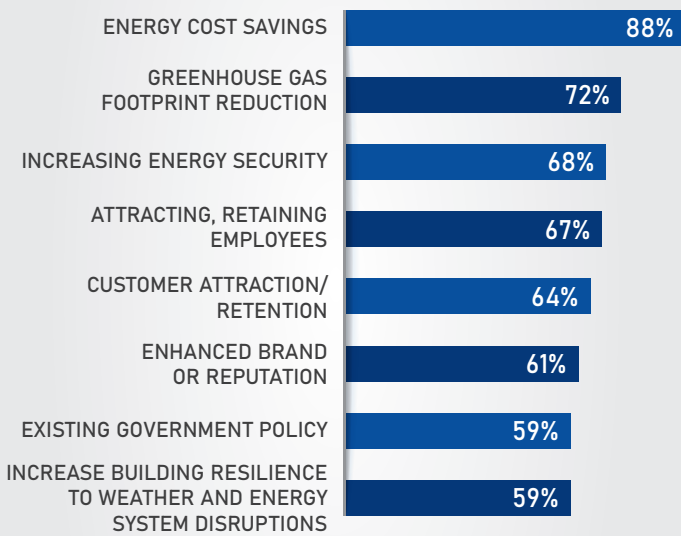
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We see a transition from the focus of efficient individual components, devices and equipment to more systems-oriented approaches, and utilizing digital technologies, such as advanced building controls, analytics, and machine learning.

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our latest survey from 2018, we see that that investment in energy efficiency, renewable energy, and smart building technologies is rising in the Asia-Pacific region. Looking at the survey, 61 percent of organizations in Asia and 70 percent in China plan to increase investment during the next year, which can be compared to 59 percent globally. We can see that the energy cost savings are the most significant drivers of investment in Asia. Several other factors are important in making decisions around energy efficiency and smart building technology. These include greenhouse gas footprint reduction, increased energy security, and attracting and retaining employees and customers, which are identified in the survey as important factors in investment.

Organizations rating as extremely or very important:



* Graph from the 2018 edition of the annual Energy Efficiency Indicators Survey conducted by Johnson Controls

Q: How is Johnson Controls utilizing the ongoing Digital Transformation in its business?

The digital transformation is a critical element of our business, and perhaps the most exciting area where we are deploying these advanced digital technologies is in district energy systems. We have over the past few years been developing a suite of tools that we call Central Plant Optimization, and it is suitable for campuses such as universities, large hospital complexes, military installations, and other large community-scale applications. The system includes planning tools, design tools, and, most importantly, the operational platform to optimize, not only energy use but energy storage using ice, chilled and hot water and electric batteries. The system can also coordinate distributed energy generation through combined heat, cooling and power and renewable energy systems. Our software essentially predicts the heating,

cooling, and power load requirements for the campus seven days in advance. It downloads or predicts the energy prices over that period, it uses weather forecast to adjust its estimate of the thermal loads, and it optimally stores and dispatches energy to minimize cost, energy use or carbon emissions. We have a number of successful campus installations now that are automating and optimizing plant operations previously done manually by teams of very experienced engineering professionals

Q: What is the strategy/next step for Johnson Controls in the Asia-Pacific region?

We try to connect our business strategies with ongoing megatrends in the various regions of the world. The Asia-Pacific region has so much construction through urbanization and the rising middle class, so there is a real opportunity to be able to influence codes and standards and community-level design for lots of new construction. That is a focus for us. Another ongoing megatrend is electrification, and as we talked about in previous issues of the APUEA Magazine (issue 1, 2018), we are very much involved in applying our heat pump technology to enhance the efficiency in the output of district heating systems in northern China. In the winter, to meet the heating demands for the communities they serve, the combined heat and power plants are running at maximum capacity. This leads to excess electricity on the grid and the reduction of renewable power generation. We can provide additional thermal output at much higher efficiencies, utilizing efficient technology like heat pumps or the generation of cooling through absorption chillers or steam turbine-driven systems. We also see digitalization as a megatrend. Buildings are becoming more sophisticated, and more building owners are striving towards net-zero energy buildings or net-zero carbon buildings. Controls and automation play an increasingly important part of being able to deliver that and also connecting buildings to microgrids and other energy assets within cities and communities. These very exciting technology-driven trends address serious economic and environmental challenges and provide a path for the future of the company in Asia-Pacific and globally.

The YORK YDST Heat Pump



Q: In June 2017, Johnson Controls announced the opening of a new Asia-Pacific headquarters in Shanghai that is built entirely around green building principles. What role do the new headquarters play in your strategy?

It is a great example of what can be delivered when integrating disparate building technologies. With a fundamentally energy-efficient design, the building uses almost half of the energy of the energy of modern office buildings. It also uses 40 percent less water and has 20 percent less embodied energy in its construction materials. The building provides a comfortable, productive, and healthy environment for our employees and visitors. The building is a showcase project of the U.S.-China Clean Energy Research Center Building Energy Efficiency Consortium and has LEED Platinum, IFC Edge/net-zero ready and China Three Star green building certifications. We view our Asia-Pacific headquarters as a showcase of state-of-the-art in sustainable design and building technology while demonstrating the many owner and occupant benefits of smart, safe and sustainable buildings.



Johnson Controls Asia Pacific Headquarters

Accelerating the development of Sustainable Urban Energy Schemes

Asia Pacific Urban Energy Association (APUEA)





Maximizing the benefits of thermal energy storages in district cooling networks with optimization algorithms and artificial intelligence

By Jeremie Fricker, ENGIE

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FOR DISTRICT COOLING NETWORKS, A THERMAL ENERGY STORAGE (TES), LIKE CHILLED WATER STORAGE OR ICE STORAGE, IS REGULARLY MENTIONED AS A WAY TO IMPROVE SAFETY AND GENERATE OPERATIONAL SAVINGS, BUT THESE POTENTIAL SAVINGS COULD BE ONLY ACHIEVED IF THE TES IS WELL DESIGNED AND PERFECTLY MANAGED

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The use of energy for space cooling is steadily and globally growing. Cooling needs tripled since 1990 and at the same time greenhouse gas emission due to cooling systems tripled as well. The need for more efficient cooling systems become crucial. Thus, the role of District Cooling Networks (DCN) become more complex: they must provide the cooling capacity to meet each client cooling need, while reducing the operational costs, energy consumptions and CO₂ emissions.

Algorithms to get the maximum benefits of our thermal energy storages

As a leader of DCN, ENGIE is constantly improving the operation of its networks by using new tools, methods, and technologies. For DCN a Thermal Energy Storage (TES), like chilled water storage or ice storage, is regularly mentioned as a way to improve safety and generate operational savings, but these potential savings could only be achieved if the TES is well designed and perfectly managed. A cooperation between several entities of ENGIE - from internal research labs to DCN operating teams - led to algorithms capable to help us to achieve better performances in terms of TES management.

These algorithms combine three different approaches:

1. Energy balance models associated with models of production strategies (smoothing, peak shaving, planning).
2. Optimization algorithms to go further classic TES control strategies and find out the best TES profile loads: charge and discharge curves.
3. Machine learning (artificial intelligence) to forecast the future cooling demand.

High speed simulations for design

Designing a TES to get high energy and economy efficiencies is a complex task. Indeed, in addition of space and budget constraints designing calculations must consider simultaneously electricity prices, equipment's performances, cooling load and TES production strategy. Thanks to energy balance models our algorithms test all the combinations over technologies, sizes and control strategies. The results of these high-speed simulations (1-year simulation time ~ 7 minutes of computation time) are displayed in graphs to compare them and finally to assist in decision-making.

The following graph shows results of design simulations for an example of 1-week simulation: two technologies are tested, chilled water and ice storage represented respectively by circles and crosses, their sizes are related to the storage energy capacities and their color indicate the control strategies simulated. The blue markers concern simulations made without using a TES, they can be considered as a reference point to compare energy (x-axis) and costs (y-axis) savings by using a TES with the different design and control options tested.

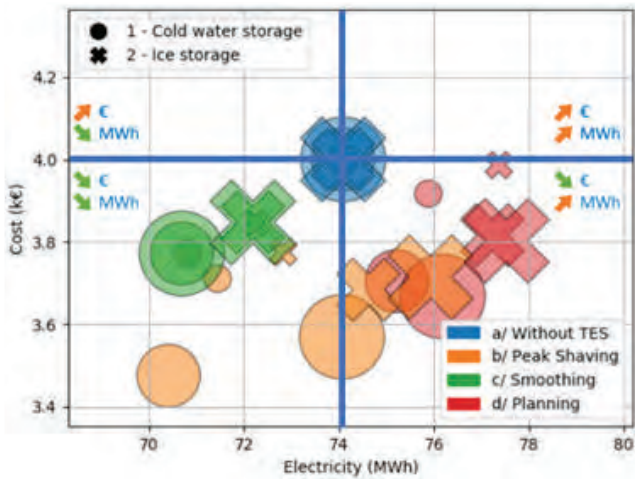


Figure 1 : Comparison of several TES designs

Optimization algorithms to find out the optimal way to use the TES

To go further, an Optimization Algorithm (OA) is implemented to determine the best daily charge and discharge curve of the TES with the aim to minimize operational costs or electricity consumption. These computations can be realized with past cooling demand profile to evaluate additional savings or with the future one to do a daily management of the TES.

Optimal management of TES could be calculated for all the different design options, the following graph is an update of the previous one including the results of OA for the different

TES technologies and capacities. It is shown that the medium size water storage is still the most relevant design. As expected, the optimal command (here optimal costs) brings additional savings.

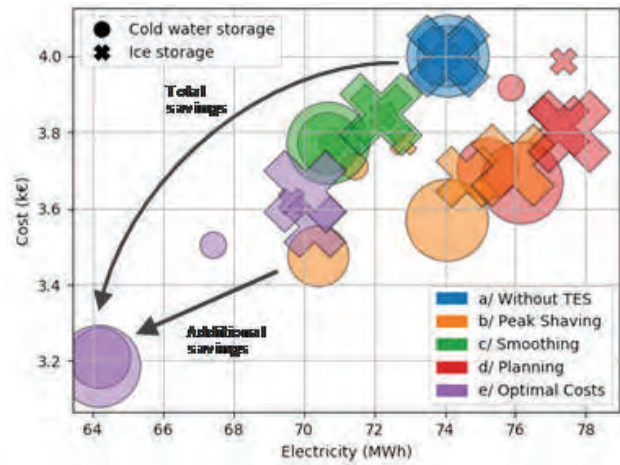


Figure 2 : Comparison of several TES designs including optimal management

The related optimized charge/discharge curve for this specific design is shown in Figure 3. Optimized curves are quite interesting to be studied since it turns out that they are a combination of some classic production strategies. The OA optimizes the system by constantly selecting the relevant production strategy in accordance with real conditions: cooling demand, weather conditions and utility prices.

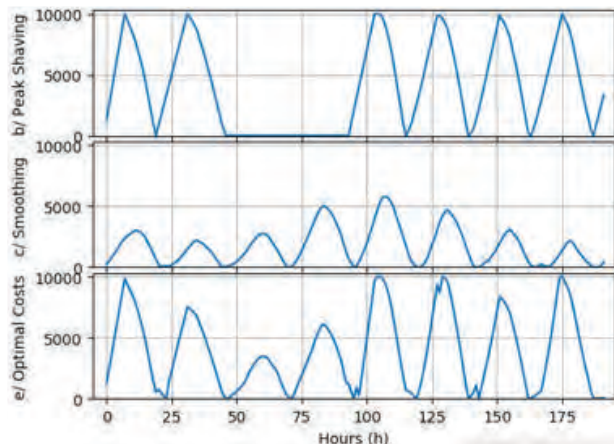


Figure 3: Classic and optimal charge and discharge curves of a TES

Artificial Intelligence for demand forecast

The previous computations provided guidance on design and control features. Since the optimal charge/discharge curve depends on future cooling demand, we must calculate it to make relevant decision for the next day production. It could be found thanks to AI and more specifically Machine Learning (1-year of historical data as a baseline of the learning process). In practical terms, a Long Short-Term Memory networks (LSTM), which are a special kind of recurrent neural network capable of learning long-term dependencies, is automatically generated thanks to data. The graph below is a comparison between real and machine learning prediction of cooling demand. Thus, a daily optimal curve can be forecasted and followed by operators.

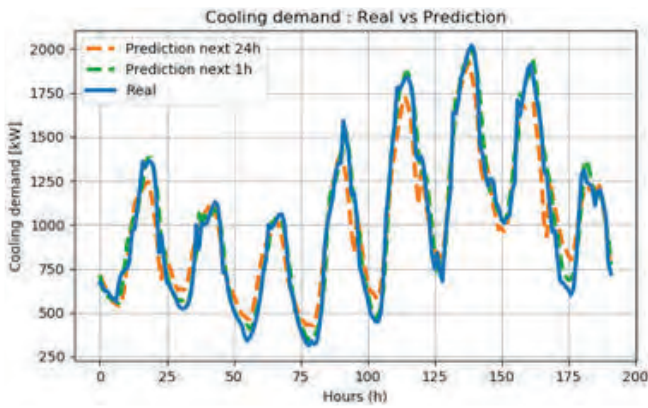


Figure 4: Cooling demand forecast

Results for real cooling plants

In order to evaluate the expected savings for real cases, two existing cooling production plants of European DCN were modelled and simulated during a significant period of time. Their hydraulic schemes are different, but both are designed with ice storages. The simulations were realised with past datasets, using the real cooling demand profile provided by the cooling production plants. Since, the simulations were conducted on a high share of the annual cooling capacity (more than 80 %), the results could be extrapolated for the whole year with good confidence.

For both case studies the charge and discharge profiles given by optimization algorithms would lead to energy savings between 4 % and 5 % and cost savings between 5 % and 7,7 % of costs savings. In the same time, simulations revealed that classic automated methods would not provide significant savings.

Savings are strongly dependant on the initial cooling plant design, TES size, electricity prices, cooling demand profile and

must be calculated for each case study. Although the studied cooling production plants are intensively operated only a few months in a year, the savings calculated by our optimization algorithms would be from 225 to 270 MWh for energy savings and from 16 to 33 k€ for cost savings.

These results came from simulations and assumed that the cooling demand profile was perfectly known in advance, so they represent the maximum potential of savings. In the future, these features of optimization and demand forecast, could be directly added as an automation tool to do predictive management of our cooling plants as a decision making tool for operators.



“ENGIE Asia Pacific is a leading energy and services company focused on three core activities: low-carbon power generation, global networks and client solutions. With our regional headquarters in Singapore, we operate low-carbon power plants that focus on natural gas and renewable energy across Asia Pacific. Apart from our suite of renewable technologies including wind, solar, and hydro plants, our retail arm is based mainly in Singapore and Australia.

We are also growing our services business, largely in Singapore, Philippines, Malaysia and Australia. With the energy mix and fast-growing demand for power in Asia-Pacific providing significant opportunities for growth, we are striving towards our zero-carbon ambitions.”



Accelerating the development of Sustainable Urban Energy Schemes

Asia Pacific Urban Energy Association (APUEA)

www.apuea.org





Setting the UPS standard - the ABB DPA 250 S4

Dave Sterlace, Global Head of Data Center Technology, ABB
Diana Garcia, Mid- to high-power UPS Product Manager, ABB

In 2018, ABB launched its new modular uninterruptible power supply (UPS) – the DPA 250 S4. This UPS embodies, in one product, many of the technological innovations that ABB, a pioneer in the UPS business, has introduced to the market in recent times. The DPA 250 S4 will set the trend in UPS technology for years to come so it is worthwhile to explore what advantages its capabilities can bring to users. Dave Sterlace, ABB Global Head of Data Center Technology, and Diana Garcia, ABB UPS Product Manager, give the facts about the DPA 250 S4.

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THE DPA 250 S4 BRINGS HIGH EFFICIENCY AND HIGH AVAILABILITY TOGETHER IN A SMALL PACKAGE.

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ABB: Dave, can you please tell us a bit about the client’s challenges when it comes to power protection in today’s data centers?

Dave Sterlace (DS): Sure, I can! Power quality and uptime remain at the heart of data center operations. However, with the growth of hyperscale data centers, and their corresponding huge power usage, more emphasis has now been put on efficiency. You can see that with such high power bills, every little improvement in efficiency is worth a lot in dollar terms. The same lesson applies to smaller data centers too. There is also a new dimension: edge computing. The advent of edge computing requires high efficiency in sites that previously would have put the premium only on uptime. New solutions are, therefore, required to achieve both efficiency and availability.

ABB: What is the customer considering when choosing UPSs for the data centers?

DS: In the past, UPS decisions were based around “how big is it?” “how fast can I get it?” and “how much does it cost?” with no discernable difference between the UPSs. Now, there have been significant break-throughs in both topology and controls, allowing the UPS to be discernably more efficient and able to be a more active part of load management.

ABB: Diana, from the Product Manager point of view, why do you think customers choose DPA 250 rather than any other UPS?

Diana Garcia (DG): In a word, “efficiency.” At 97.4 percent, the new DPA 250 S4 UPS is the most energy-lean UPS on the market – thus decreasing power losses and the total cost of ownership. Further, the modular architecture makes it easy to expand and service as you can add or remove modules even with the power on. Uptime is good too, as each module has all the functional units needed for independent operation. If one module fails, the others immediately jump in and take up the load. That way, system reliability and availability are high compared to other modular UPS solutions.

ABB: What features of the DPA 250 assist the customer in making their decision?

DS: As Diana mentions, the decentralized parallel architecture – DPA – sure is a big plus. The ability to change consumable parts within 10 minutes affords a much lower MTTR than previous designs,

boosting the reliability of the entire system. We can also install interface cards for remote control and monitoring of the UPS so we can have things like status and environmental data. This seamless integration into data center automation platforms gives a client an unprecedented insight into the running of their data center.

ABB: Why is DPA 250 S4 a suitable power protection solution for today's data center?

DG: The DPA 250 S4 brings high efficiency and high availability together in a small package. And, as Dave says, the DPA architecture allows a customer to raise reliability significantly versus traditional monolithic and modular solutions. Unlike traditional monolithic and other modular solutions, the UPS modules are on-line swappable, which allows the user to maintain the UPS without impacting the IT equipment. Furthermore, the possibility of an N+1 design using 50 kW building blocks versus a 2N 500 kW design with a monolithic solution offers unparalleled efficiency. We're also excited about the technology behind the DPA 250 S4, which uses three-level converters and interleaving controls that give performance equivalent to more exotic technologies like silicon carbide – but without the added costs. Of course, the storage options include lithium-ion batteries with their higher power density, better recharge characteristics and longer service life – an option more and more data centers are taking up.

ABB: And, Diana, what specific customer problems does the DPA 250 solve?

DG: Apart from the advantages already mentioned, one aspect a lot of people forget is cooling. In a data center around 40 percent of all power consumed can go towards cooling! The DPA 250's high efficiency means less cooling is required – which, saves a lot of energy – and the cooling system is smaller, which itself, saves even more power.

ABB: Can you explain the Xtra VFI feature and how it helps the overall efficiency?

DG: As you may know, UPS power modules work most efficiently when they are heavily loaded. Light loading is simply inefficient. Let's say you have a DPA 250 cabinet with five modules. Xtra VFI is a clever feature that looks at the load the UPS is supporting and works out the optimal number of modules to use so they are all working in the best part of their efficiency curve. Then it switches the others to standby, ready to immediately jump into action if the load increases. This saves a lot of power and money, especially in locations with high power usage, like data centers.

ABB: How easy is it to specify, install and commission DPA 250?

DG: We put in a lot of design effort into making it easy to install this UPS. We see that as a good selling point. For instance, the DPA 250 has a small footprint so it's not difficult for the customer to find a corner in their, usually very crowded, facility to fit it in. The modular architecture means that the specification is flexible as we can simply add a module or two should power needs grow or be larger than anticipated. Online access to status and environmental parameters and a clear HMI also ease commissioning as does



the bottom and top cable entry, which means the footprint is not increased by having an extra cabinet for cable entry or having to leave space to get cables in.

ABB: Dave, if we may have your vision of the future, what challenges do customers still have, even with DPA 250, and how do you see these problems being solved in the future?

DS: Moving forward, I think we'll see the UPS become an even more critical part of the data center. I envision a data center as an active part of the grid, where a smart UPS could be a virtual power plant, taking on functions like frequency response, load balancing and demand response, allowing data center operators more flexibility in how they run their business. When integrated with ABB Ability data center automation systems, the data center of tomorrow will function as an active, integral part of a smart city's electrical and IT fabric.

ABB: Dave and Diana, thank you for your time!



ABB (ABBN: SIX Swiss Ex) is a pioneering technology leader in electrification products, robotics and motion, industrial automation and power grids, serving customers in utilities, industry and transport & infrastructure globally. Continuing a history of innovation spanning more than 130 years, ABB today is writing the future of industrial digitalization with two clear value propositions: bringing electricity from any power plant to any plug and automating industries from natural resources to finished products. As title partner of Formula E, the fully electric international FIA motorsport class, ABB is pushing the boundaries of e-mobility to contribute to a sustainable future. ABB operates in more than 100 countries with about 147,000 employees.



Supporting the lifecycle of energy infrastructures with Smart O&M

By Siveco

“

EXPERIENCE SHOWS THAT THE EARLIER MAINTENANCE IS TAKEN INTO ACCOUNT, THE BETTER THE RESULTS IN TERMS OF LIFECYCLE COST.

”

In the era of industry 4.0, most energy projects in Asia still enter commercial operation without a maintenance system in place. Instead, the operation and maintenance (O&M) team, already busy with start-up issues, struggles to gather technical documentation, to define paper-based procedures, and when time allows, years later, to implement a computerized system.

For maintenance, the earlier, the better

Experience shows that the earlier maintenance is taken into account, the better the results in terms of lifecycle cost. Maintenance should be specifically addressed from the design stage and throughout construction until the plant is finally handed over to the O&M team. In practice, however, maintenance preparation tends to be overlooked. Construction projects are full of challenges, EPC companies and equipment suppliers lack an overall lifecycle perspective, and the owner's construction teams naturally focus on the problems at hand.

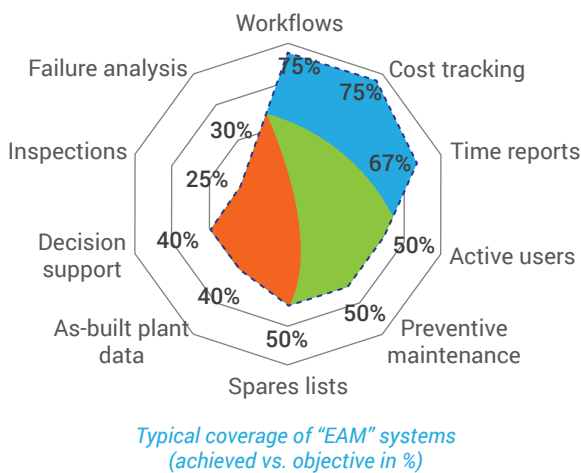
The implementation of the supporting IT system (commonly known as Computerized Maintenance Management Systems or CMMS, often referred to as Enterprise Asset Management or EAM in IT parlance, sometimes part of an ERP system) usually come as an afterthought, in spite of its proven value as a tool to handover technical documentation and to structure the maintenance organization. As a result, most plants start up and sometimes run for years without a structured and modern maintenance system in place. Plants are instead relying on paper forms and Excel sheets where historical records are hard to find, and systematic analysis is impossible.

This depressing state of affairs persists in the age of Industry 4.0 and Smart Plants.

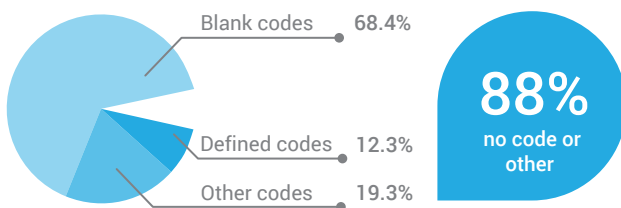
A more in-depth look into “EAM” projects

When the IT system is finally online a few years later, its usage seldom meets expectations. Paper and Excel processes usually remain with the new system adding another layer of mandatory administration. Technology vendors are prompt to blame clients for their lack of maturity: the software was good, but the team is not ready for it! The objective of the project (the need to improve) becomes an excuse for its failure.

Siveco's in-depth audits of Asia utilities, having implemented CMMS/EAM solutions, consistently show that the areas most essential for maintenance improvement (as per the ISO 55000 Asset Management standard) are gravely lacking. Instead, projects cover administrative needs of little value for industrial improvements, such as time and cost tracking and approval workflows, as illustrated in the radar chart below. This is understandable, as virtually all EAM projects are driven by IT departments and IT vendors with limited understanding of maintenance.



The example of failure analysis provides a good illustration: it is essential for optimizing maintenance (for example, through RCM) to collect failure information in a structured manner for systematic analysis. Studies show that 88% of the failures reported in EAM systems do not include a failure code (either no code at all or a generic code such as “miscellaneous”), thus rendering the entire system almost useless.



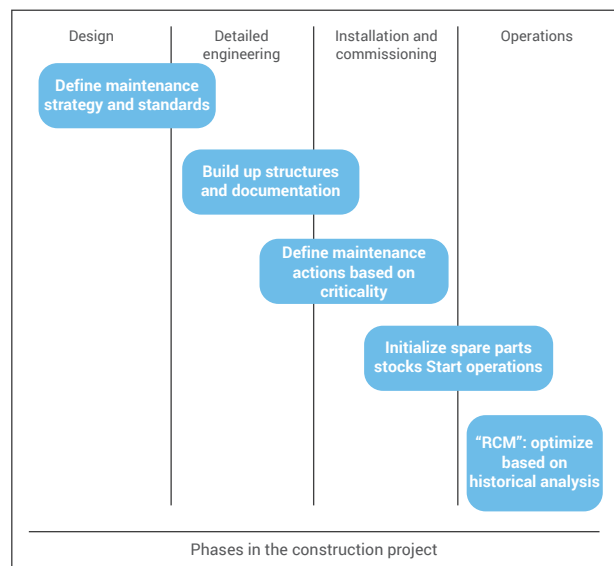
Finally, most EAM solutions still rely on printed papers, manual inputs by a junior technician or system clerk, just like in 1980.

Learning from experience

Based on a long experience all over the world and lessons learned during the rapid, and massive Chinese infrastructure built-up of the past 20 years, Siveco has developed innovative Smart O&M solutions (a term coined to differentiate from the traditional CMMS/EAM) integrating modern technologies such as mobility, 3D Building Information Models (BIM) and Connected Objects for the benefits of O&M teams. The company has also devised practical guidelines for the design, implementation, and long-term stewardship of Smart O&M projects.

- First of all, Smart O&M requirements must be incorporated in construction budgets, and ideally be included in the EPC tender, in order to pass the data preparation responsibility to the construction team, ensuring a smooth transfer of technical documentation from construction to operation and enforcing good maintenance practice from day one. This early-stage approach also allows smooth integration with control systems (DCS/SCADA).

The figure below summarizes the Siveco approach for maintenance preparation during a construction project based on the utilization of the Smart O&M.



- For the design of the Smart O&M system itself, focus on the gaps observed in traditional IT/EAM projects using the ISO 55000 Asset Management standard as a frame of reference. Use ISO 55000 to drive the project and avoid the complexification or confusion often seen with IT or administrative projects.

- Finally, focus on people, technicians, and decision-makers, rather than processes or technology. This is easily achieved by using modern user interfaces, such as mobile solutions (eliminating the need for paper and tedious manual inputs) and large touchscreens (making otherwise hidden O&M information highly visible and tangible to decision-makers). This cannot be improvised and must be supported by the chosen software.



bluebee® is Siveco's mobile solution "for the worker of tomorrow."

Recent energy projects have benefited from Siveco's Smart O&M approach in Asia:



Chonburi Clean Energy (Thailand)

Chonburi Clean Energy (CCE), a joint venture of Suez, Glow Energy, and WHA Utilities and Power, is the first industrial waste-to-energy facility in Southeast Asia to meet European emission standards. The plant is getting attention in the Thai utility market as a showcase for maintenance preparation during the construction phase, with its Smart O&M system ready before start-up. CCE is the first company to use the bluebee® mobile app in Thai.

Raffles City Chongqing District Cooling Plant (China)

A subsidiary of SP Group, Shirui Energy, designed, built, owns, and now operates the advanced energy-efficient cooling system of Raffles City Chongqing, an iconic real estate project. Siveco provides cloud-based lifecycle support for the facilities. Technicians used bluebee® mobile for commissioning and for day-to-day maintenance management since start-up.

Hanas New Energy (China)

Hanas New Energy owns and operates the largest LNG plant in China. Siveco has supported the plant with its maintenance needs from the construction stage, working alongside the EPC and contractors. The Smart O&M solution provides support for continuous performance improvement in spite of the LNG plant's high staff turnover.

Ranhill Powertron II (Malaysia)

The 190 MW, combined-cycle power plant, was built by China National Electric Engineering Company (CNEEC). Siveco led a collaborative project to ensure maintenance readiness. According to the client, Siveco's role was "critical, considering the very different working practices between Chinese construction firms and overseas power plant operators like us."

Algerian Mega-Project

The Algerian government has launched a massive investment program, with around 12 GW of capacity (combined-cycle gas turbine power plants) added to the grid between 2015 and 2020. For all projects, Siveco China has delivered the maintenance system, including data preparation services, in cooperation with Turkish and Korean EPC companies, before the plants start up.

Yingde Gases

Asia's largest industrial gas producer, Yingde Gases, selected Siveco to implement an ISO 55000-compliant Maintenance and Reliability management system unified across 100+ plants of heterogeneous background (older assets, recent acquisitions, modern plants, etc.). All O&M staff carry out their daily work with the mobile app, and touchscreens, at plant and group level, make performance improvement visible to all stakeholders.

Other Siveco infrastructure clients in the region include Brunei's Department of Electrical Services, Beijing Environment, Bukit Asam, Capital Water, CNOOC, COSCO Terminals, Fushun Mining, Engie, Everbright, Hyundai E&C, Samsung C&T, Shell, Suez NWS, etc. Siveco also works with multisite manufacturers such as Arkema, Baosteel, Essilor, Daramic, International Paper, Imerys, Mane, etc. that operate plants across Southeast Asia.

Conclusion

The early-stage Smart O&M approach devised by Siveco to ensure maintenance readiness has a proven track record of over 850 projects in Asia. Ideally funded by construction Capex, the project generates direct savings as early as the O&M handover process (reduced labor, avoided delays and data losses). The solution supports commissioning activities, makes accurate plant documentation accessible by O&M teams, and ensures maintenance readiness from day one. Last but not least, the Smart O&M successfully closes the "ISO 55000 feedback loop" between plant technicians and top managers, thanks to the innovative use of mobility and decision-support tools running on large touchscreens.



Siveco China (www.sivecochina.com/en) is a pioneer in the development of Smart Technologies for Operation & Maintenance, with a focus on mobile solutions "for the worker of tomorrow." Siveco helps facilities owners, in particular, energy and environmental utilities, to optimize assets lifecycle and ensure regulatory compliance. Siveco has its Asian headquarter and R&D center in Shanghai. It is the only company in Asia to be ISO9001-certified for this scope of business.

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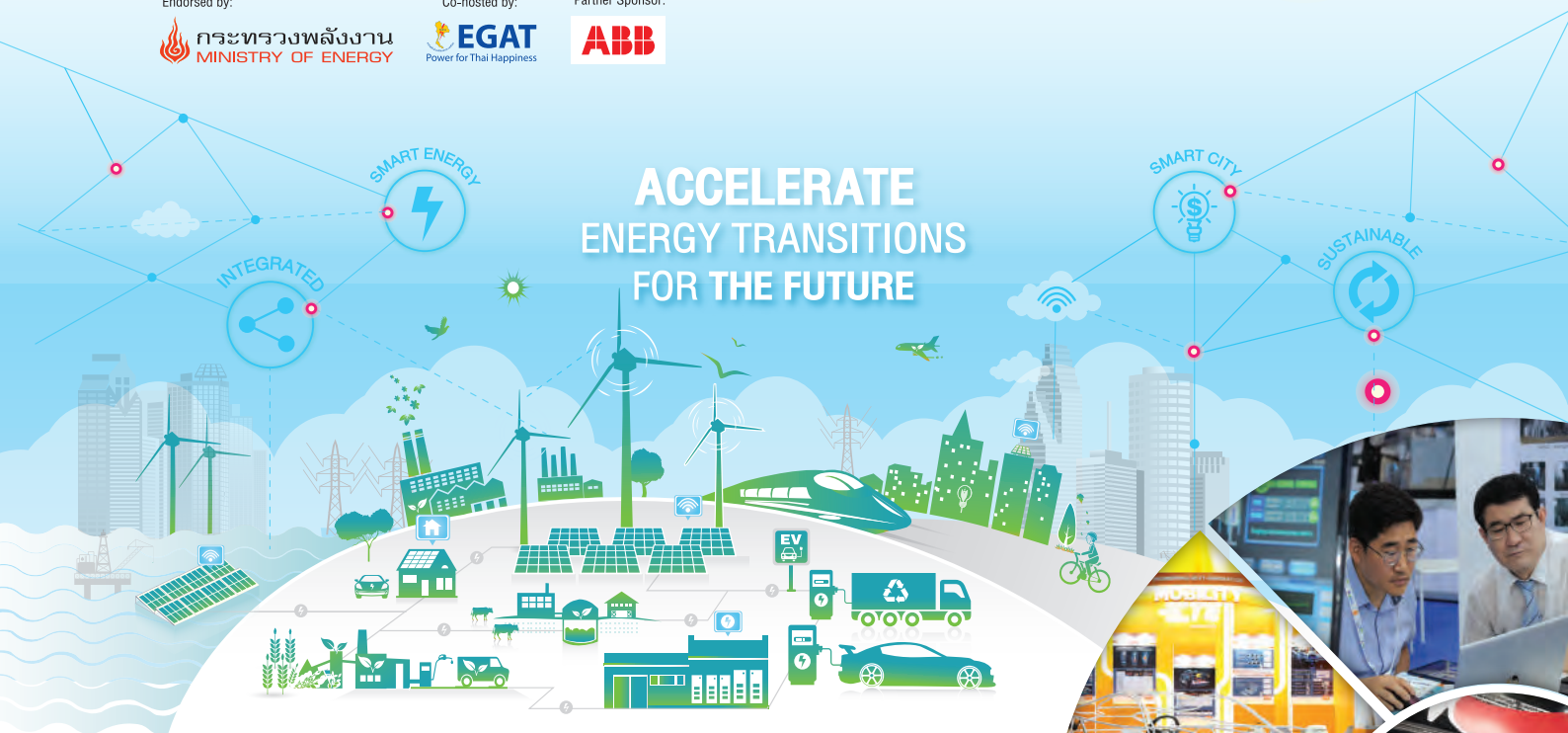


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Make Building Heating More Energy Efficient by Artificial Intelligence

Dr. Tommy Jacobson, LEANHEAT by Danfoss, China

“

LEANHEAT AI APPLIES MACHINE LEARNING AND OPTIMIZATION TO MAKE DISTRICT HEATING MORE EFFICIENT. IT UTILIZES THE DATA THAT CAN BE ACHIEVED FROM A STANDARD PLC CONTROLLED DISTRICT HEATING SUBSTATION, WEATHER FORECAST (INCLUDING SOLAR RADIATION, TEMPERATURE, WIND) AND INDOOR TEMPERATURE MEASUREMENTS.

”

Artificial Intelligence in district heating

Better utilization of existing automation system and hardware improves energy efficiency of district heating by improved process and indoor temperature control. More stable indoor temperature reduces the amount of high and low temperature periods decreasing overheating and improving residential comfort. Furthermore, well controlled indoor temperature allows lower average indoor temperature and heating without sacrificing comfort.

However, enhanced indoor temperature control necessitates better understanding on the current and future behaviour of a building when it is heated, used and exposed on various outdoor conditions. That is better understanding of the building thermodynamics, its residents' behaviour and coming weather.

Theoretically building thermodynamics is well known and can be modelled based on fundamental physics. Unfortunately, every building is unique and complicated structure, its condition changes due to aging and renovations. Accurate description of a building for a physical model would require detailed knowledge of the building structure, modelling work and related resources. Therefore, in practice pure theoretical modelling of building thermodynamics is not feasible for controlling district heating.

The complexity can be overcome by utilizing statistical models based on thermodynamics but complemented by empirical data to take into account the building specific characteristics. Hence, the model is tuned-up by empirical data how the building behaves when it is heated, used and exposed on various outdoor conditions. Machine learning algorithms can be applied to update the model based on real and frequent data, thus increasing the accuracy of the model automatically. This approach based on Artificial Intelligence will ensure high scalability and reduce significantly the amount of necessary metadata.

An accurate, up-to-date and building specific model is only a prerequisite for optimized district heating. The model would be used for simulation of various scenarios to find out the most optimal heating power in the expected future conditions. That is computing the optimal control signals to heat up the building to maintain the set indoor temperature in the forecasted weather. Optimization is based on prioritized targets like energy efficiency, indoor temperature or peak power minimization.

LEANHEAT AI by Danfoss

LEANHEAT AI applies machine learning and optimization to make district heating more efficient. It utilizes the data that can be achieved from a standard PLC controlled district heating substation, weather forecast (including solar radiation, temperature, wind) and indoor temperature measurements. Computation is done in a cloud-based service, which is connected into the substation automation system and other data sources (e.g. weather service and indoor temperature sensors) via internet and Application Programming Interfaces (APIs). The process is fully automated.

The operational efficiency of LEANHEAT AI is evaluated by the capability of a substation to follow LEANHEAT AI control signals and to reach targeted average indoor temperature. Performance is evaluated based on reaching optimization targets like savings in energy, reduced peak loads or improved residential comfort (e.g. number of complaints). **Typical energy savings and peak load reduction in the Nordics have been 10 to 20 %** based on controlling more than 2 300 substations during last three heating seasons.



Low risk, low cost and easy to apply

LEANHEAT AI is compatible with most substation automation systems and hardware. If the substation is already capable to follow heating curve, it can work with LEANHEAT AI. Hardware independence limits the necessary investments to setting up APIs in to substation automation system and indoor sensors.

LEANHEAT AI uses cloud-based computation and Software as a Service (SaaS) model. Cloud-based realization ensures that the customer has up-to-date software version. Computational power and data storage resources are always optimal without any practical limitations for up-scaling. The customer pays for a subscription-based service, and the service can be discontinued annually minimizing the costs if the financials do not meet the target.

LEANHEAT AI in China

LEANHEAT AI has been used in Beijing and Tianjin for two heating seasons (2018-2020). Although there are some fundamental differences in district heating systems in Finland and China, both operational efficiency and performance have been equal to Finnish. Moreover, relatively high variation in indoor temperature typical for push system offers high potential to avoid overheating without comprising residential comfort. Indoor temperature lows due to sudden cold weather can be mitigated by pre-heating as building inertia and usage is known. Heat pricing based on heated area, common in China, ensures that energy savings will benefit directly the investor.

Operational efficiency, energy efficiency and residential comfort

An example of operational efficiency of a site in Tianjin is illustrated in Fig. 1. The daily averaged actual secondary side supply temperature is compared to the LEANHEAT AI optimized set-point and actual indoor temperature to the targeted one. During 26th of December 2018 to 11th of February 2019 the substation and indoor temperatures followed LEANHEAT AI control well within 1°C.

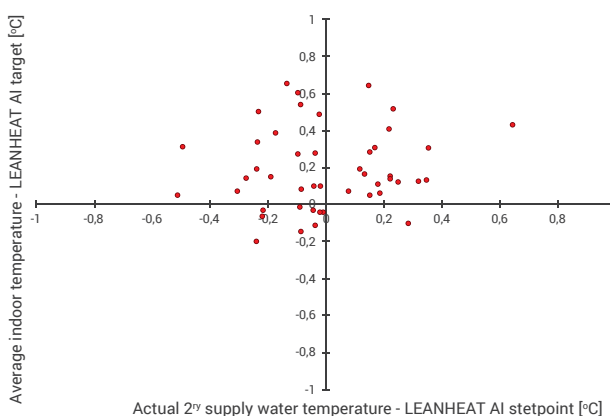


Fig. 1. Daily average indoor and supply water temperature discrepancies

Excellent operational efficiency is confirmed by indoor temperature stability measured by standard deviation. In all cases the standard deviation was less 0.6°C, indicating that 95% of time the indoor temperature was within $\pm 0.6^\circ\text{C}$ of target value. In most sites the supply water temperature followed set-point within $\pm 5\%$ basically all the time.

The operational efficiency and indoor temperature stability indicate further potential to decrease average indoor temperature up to 2°C, which indicate further energy saving potential more than 15%. The realized energy saving during heating season 2018-2019 compared to the weather compensated historical data (2017-2018) was more than 10% but typically more than 15% in almost all sites. The limited comparison to the similar reference sites indicated similar energy saving.

Further development and discussion

LEANHEAT AI was originally aimed to optimize set-point for standard PID controlled supply temperature of a heat exchanger. However, there is no theoretical restriction to limit heat exchangers. In China there is an increasing demand for more automated and optimal heating by single circuit gas boilers. For LEANHEAT AI it is straightforward to compute optimal set-point for gas boiler supply water temperature. Besides energy savings, benefits will arise by peak load management and resulting additional heating capacity of the gas boiler.

Enhanced building level control is another trend in China that Leanheat is following by piloting optimized control for building level entry in Beijing. Significantly improved energy efficiency, indoor temperature stability and balancing are expected by LEANHEAT AI optimized motorized control valve or mixing loop of a building.

The awareness and acceptance of SaaS models necessitate further training and communication. SaaS reliefs district heating company of maintaining and updating continuously evolving AI software and to focus on their core competence instead of software development and data-analysis. Volume based annual operational cost can be adjusted according to demand and expectations that minimize the risk of irrevocable poor investments.

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The Potential of District Energy and Waste Heat Recovery in Asia Pacific

By Kristina Lygnerud, IVL Swedish Environmental Research Institute

“

WHEN IT IS NO LONGER POSSIBLE TO USE FOSSIL FUELS, WHEN INCINERATION OF BIOFUELS IS NOT DESIRABLE AND THE COST OF CARBON IS PROPERLY REFLECTING THE CLIMATE CRISIS, THEN THE URBAN WASTE HEAT SOURCE WILL BE OF SIGNIFICANT VALUE.

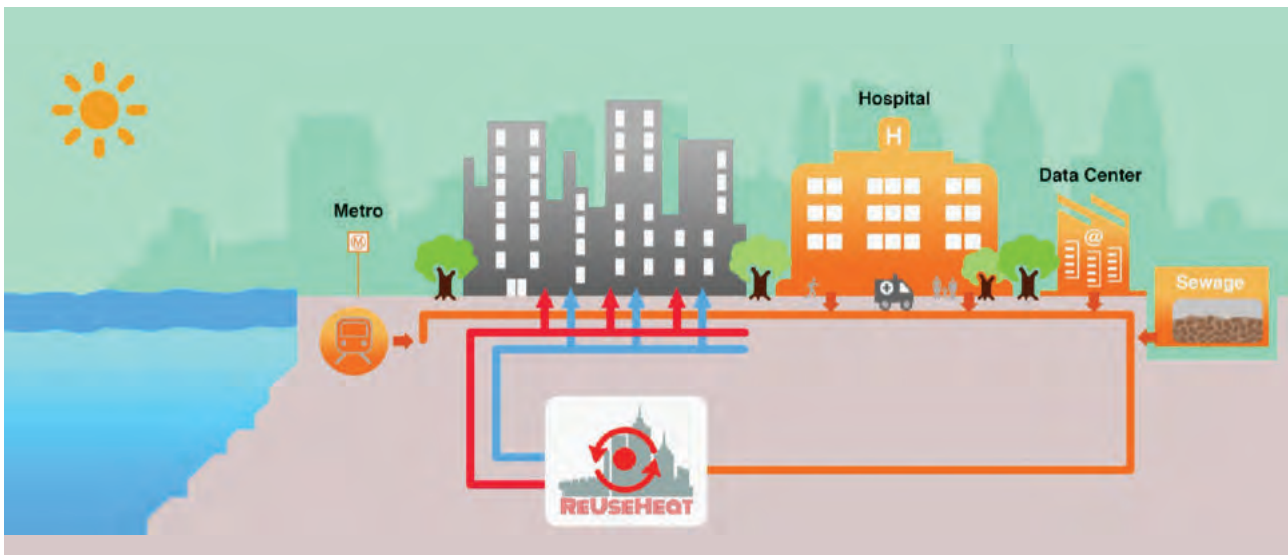
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We experience an increased urbanization world-wide. This means that there will be an increasing number of densely populated areas where people live, work and consume energy. It is known that there is a heat density problem in urban areas, with higher temperatures than the surrounding areas [1, 2]. Heat is generated by people using infrastructures like subway and waste water systems. Heat is generated by data centers and heat is generated by the service sector like hospitals, schools and offices. There is available heat in cities and it could be put into use [3].

That cities brood unhatched heat resources is a surprisingly well-kept secret. Waste heat from industrial sectors has been on the radar for decades even though small volumes of the available heat is recovered in district heating systems. World champions for doing so are two countries with cold climate: Sweden and Russia [4]. It is not until recently, however, that the discussion about urban waste

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heat and its recovery has surfaced. In an ongoing project under the International Energy Agency (the TS2 project on low temperature heat recovery implementation) a trend to recover urban waste heat across Europe but also in places like Canada and China has been proved by identifying more than 150 implementations. The unhatched urban waste heat golden egg must have a significant role to play in the future energy system. When it is no longer possible to use fossil fuels, when incineration of biofuels is not desirable (the biofuels will be used to generate other, more valuable resources) and the cost of carbon is properly reflecting the climate crisis then the urban waste heat source will be of significant value. At that time, cities should be able to heat themselves, making use of the heat generated by the people in them. There are currently research projects addressing urban waste heat recovery. One example is the Reuseheat project (financed by the European Commission in its H2020 framework) in which urban heat recovery is demonstrated in the context of sewage systems, subway systems, service sector buildings (hospital) and computer centers. Such projects are important to increase the maturity of the urban waste heat recovery solutions (for more information please view www.reuseheat.eu). Even though it is now possible to recover urban waste heat this is far from being a well-established technology.

What is well established is the business idea based on recovering waste heat from combined heat and power generation or produced heat by means of incineration which is then distributed through a city-wide distribution system. In Europe, the conventional kind of district energy is increasingly seen as an important mean in the combat of climate change. Sweden is a good example where the district energy companies are coming close to having fossil free production. Main drivers in the Swedish transition have been air quality issues and increasing awareness about climate impact. District energy solutions could provide, at least, partial

solutions to both questions also in the Asia-Pacific. There is already, for example, district heating in China, South Korea, Japan, Mongolia and Kazakhstan and district cooling is available in, for example, Hong Kong, Singapore, Malaysia, the Philippines and Australia. Indeed, one of the largest district heating system in the world is located in Beijing. In Asia-Pacific, the district energy fuel mix resorted to is, however, still dominated by fossil fuels [5].

District energy has great potential to substantially contribute to the climate mitigation world-wide. The lowest hanging fruit is a shift from fossil to renewable heat sources. A fruit somewhat higher up in the tree is the waste heat recovery from industrial activity whereas the urban waste heat recovery still necessitates a ladder to be harvested. In Europe, the transition has taken decades being triggered by oil crises, new practices such as waste incineration (rather than landfill) and by a growing awareness about climate urgency. In Asia-Pacific, it should be possible to leapfrog the development steps taken in Europe. Why going from fossils to bio to urban heat? Go straight for the urban waste heat recovery solution! Some of the largest cities in the world are found in the Asia-Pacific (e.g. in China, India, Bangladesh and Pakistan) providing substantial heat supply that could be used for both heating and cooling purposes. One of the main challenges world-wide is not to provide heating but to achieve sustainable cooling solutions [6] which is possible by transforming waste heat into cooling (using absorption chillers for example). In an increasingly digital era, it is becoming possible to unlock knowledge and transfer it from one part of the world to another. In combination with an increased awareness of the climate threat we need to implement what we know and we need to do it now! The 2050 goals will not be realized if we start acting in year 2049, we need to start today. On that note, I was happy to identify urban waste heat recovery initiatives in several Chinese locations at the Asia-Pacific Forum on Low Carbon Development in

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www.reuseheat.eu
www.iea-dhc-org [search for TS2]

Changsha in October 2019. The energy needed for heating and cooling in the growing cities is there. The technology to harvest the sources exists. There is money readily available to invest in green energy solutions. So why is the change slow? The main barrier is likely that of switching from current business models still generating revenue to business models that support the climatic conditions we want for the next generation, in 2050. To cling on to existing business models is not a phenomenon unique to the energy sector and it simply reflects economic rationality as we know it. The risk of loss is, by a rational man/woman, mitigated by pursuing the known pathway. However, in a situation of crisis, the risk exposure changes. Being exposed to the risk of climate change it is time to support the hatching of the golden egg of urban waste heat recovery.



Kristina Lygnerud

Kristina Lygnerud has a PhD in Industrial and Financial Economics from Göteborg University. She works as energy department manager at the Swedish Environment Institute (IVL) and as assistant professor at the University of Halmstad.



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Renewables in Cities 2019 Global Status Report

By REN21



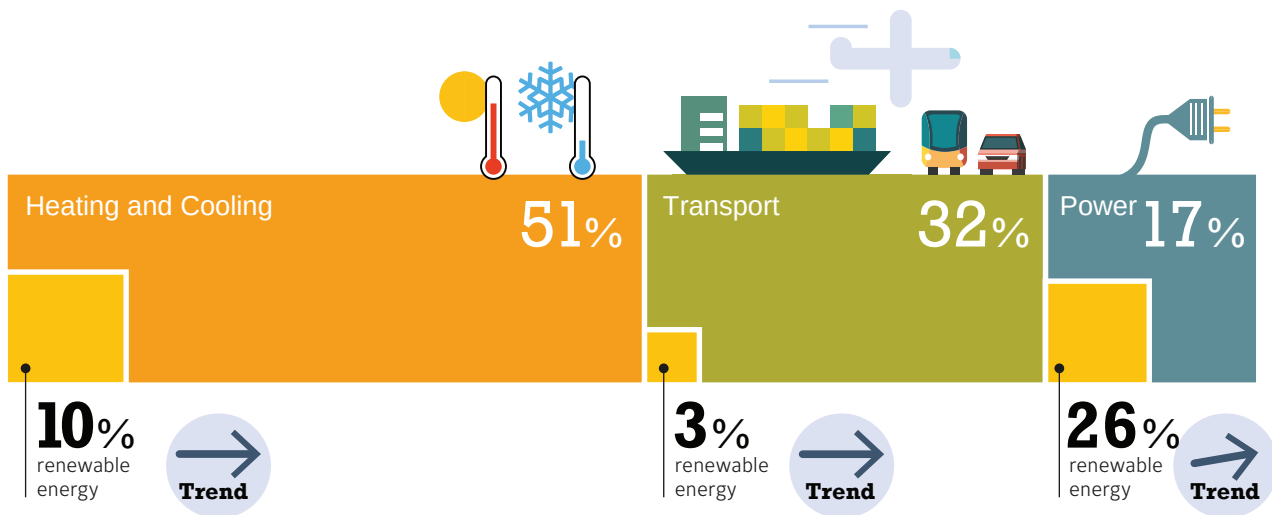
ELECTRICITY ACCOUNTS FOR ONLY 17% OF WORLDWIDE FINAL ENERGY DEMAND, SO THERE IS AN URGENT NEED TO DECARBONIZE HEATING, COOLING AND TRANSPORT, WHICH TOGETHER ACCOUNT FOR THE REMAINING 83% OF ENERGY DEMAND.



■ CITIES IN THE RENEWABLE ENERGY TRANSITION

Cities are directly responsible for around two-thirds of global final energy use as well as for significant indirect consumption of energy that is embodied in materials, products and other goods. Due largely to this energy use, cities account for an estimated 75% of global carbon dioxide (CO₂) emissions.

In addition, cities account for 55% of the global population and for more than 80% of global gross domestic product. Thus, shifting to renewable energy in cities is critical to decarbonising the global energy system. At the same time, cities offer a lever to advance the transition towards renewable energy in all end-use sectors, not only in power but also in heating and cooling as well as in transport. While renewables are making great strides in the power sector, where they now supply more than a quarter of the world's electricity, this alone is not sufficient to achieve the energy transition that is needed to limit overall emissions. Electricity accounts for only 17% of worldwide final energy demand, so there is an urgent need to decarbonize heating, cooling and transport, which together account for the remaining 83% of energy demand (see figure 1).

FIGURE 1. Renewable Energy in Total Final Energy Consumption, by Sector, 2016

Note: Data should not be compared with previous editions of the Renewables Global Status Report. Electricity also supplies final energy demand in the heating and cooling sector (7.1% in 2016), and transport sector (1.1% in 2016).

Source: Based on OECD/IEA.

REN21 RENEWABLES IN CITY 2019 GLOBAL STATUS REPORT

Renewable energy offers cities the opportunity to achieve a wide range of objectives. Through their various roles, including urban planning and the provision of numerous services, cities are well-positioned to increase the use of renewable energy in their own activities and to support the deployment of renewables more broadly, while simultaneously achieving local objectives such as reducing air pollution to improve public health, mitigating climate change, supporting the local economy and building resilient infrastructure.

City governments around the world have set renewable energy targets. To achieve these targets, cities are using a variety of options at their disposal, including the use of their own purchasing power and the creation of local policies to encourage greater public and private uptake of renewables. Some cities have used their close ties to the community to engage residents, businesses and other local stakeholders. Many have served as trendsetters, influencing and advocating for increased support for renewables at the state/provincial and national levels, and joining together in national and global city networks to exchange ideas and help drive renewable energy and climate action around the world.

Despite their many points of leverage, cities can face key challenges in their efforts to pursue ambitious energy and climate strategies. In many cases, municipal efforts are hampered by policies and regulations at higher levels of government. A lack of co-ordination among city departments also can impede progress. A city's ability to advance a renewable energy agenda depends heavily on local characteristics, including population density, the prevailing energy access rate, the size of the tax base, the rate of economic growth, the local administrative capacity, legal authority and the municipal government's ability to access external financing.

DRIVERS

Efforts to accelerate renewable energy deployment at the city level are driven by a range of social, political, economic and environmental objectives. Through the uptake of renewables, cities have the opportunity to create more liveable urban areas, enabling a better quality of life.

Drivers for renewable energy uptake include:

- **Fighting local air pollution:** Renewable energy can reduce urban air pollution, which is among the greatest environmental threats to health and well-being.
- **Mitigating and adapting to climate change:** Not only are cities significant contributors to climate change through local greenhouse gas emissions, they also are vulnerable to its impacts, such as storms, fires and sea-level rise, which threaten public safety and urban infrastructure.
- **Reducing municipal energy costs:** Renewables offer cities the potential to limit exposure to volatile fossil fuel prices and to more easily control their energy expenses.
- **Supporting economic development:** Increased deployment of renewable energy can attract new industries and provide opportunities to develop new businesses models that result in additional jobs and local income.
- **Promoting a stable and secure energy supply:** Increasing the share of energy services provided by renewables can improve the energy security and autonomy of cities, making them less reliant on external sources.
- **Energy access:** Distributed renewable energy technologies can provide access to modern energy services for the millions of urban residents who continue to lack access.

■ URBAN POLICY LANDSCAPE

To achieve their targets in the power, heating and cooling, and transport sectors, city governments are enacting policies to encourage investment in renewables directly and to drive investments in key enabling infrastructure.

TARGETS

Thousands of cities and local governments have adopted renewable energy-specific targets, and more than 400 cities worldwide have targets for 100% renewable energy. In addition, nearly 10,000 cities have adopted targets to reduce their greenhouse gas emissions, which, even if not directly emphasising renewables, would necessitate a shift away from fossil fuels and indirectly support scaling up renewable energy and improving energy efficiency.

Renewable energy targets adopted at the city level are often aspirational (i.e., non-binding) and lack enforcement provisions. Once adopted, however, such targets often gain a momentum of their own, enabling city governments to not only achieve their aspirations but exceed them. To support targets, many city governments have started to build in accountability mechanisms, introducing interim goals and reporting requirements.

City-level targets help to provide long-term certainty to local investors, better ensuring that public investments are better aligned with the city's vision and making it easier to mobilise financing. They also play an important role in shaping city planning and permitting. With the support of city networks, targets also have helped to forge new coalitions among private companies, civil society organisations and citizens to push for increased renewable energy deployment.

RENEWABLE ENERGY POLICIES

To meet their renewable energy targets, local governments are introducing an ever-wider array of support policies and measures, setting into motion new projects, investments and business models. Supportive policy is particularly important at the city level because urban areas frequently have tighter planning restrictions, higher land costs and more stringent inspection requirements than do non-urban areas. Policy also can help to increase public support among citizens and other stakeholders.

Most city-level targets and policies are focused on the power sector. However, where they exist, policies in the heating, cooling and transport sectors have played a key role in advancing renewable energy at the local level, particularly in buildings. Innovative policies also have stimulated support for the deployment of technologies and infrastructure – such as electric vehicles (EVs) and charging networks – that have the potential to enable higher penetration of renewable energy in these sectors.

Renewable energy policies can be designed to apply strictly to municipal government operations or to apply city-wide. Many cities proceed in stages, first focusing on government

operations and later expanding their policies to encourage deployment more broadly.

The main policy instruments used by cities can be broken down into four key categories:

- **Procurement and direct investment**, which include renewable energy purchases and direct investments in renewable energy technologies by municipal governments, as well as municipal support for investment in enabling infrastructure in urban areas.
- **Mandates and obligations**, which include technology-specific ordinances and building codes, some of which are stricter than national- or state-level regulations. A growing number of cities around the world are using mandates and building codes (particularly for new and public buildings) to help drive economies of scale and push down costs for citizens and businesses while spurring competition and local job creation. Enforcement remains a major challenge in many cities, however, particularly in rapidly growing cities in Asia, Africa, and Latin America.
- **Fiscal and financial incentives**, which include grants, rebates and tax exemptions to encourage (as well as fees and levies to discourage) specific behaviours and investment choices, in cities that have at least some control over taxation and other areas of public policy.
- **Enabling policies and urban planning/zoning**, which can help to improve the environment in which citizens and businesses operate (for example, by facilitating the emergence of new business models such as solar leasing or community-funded projects). Cities are enacting policies to reduce administrative, permitting and inspection-related barriers to renewable energy investment and are creating supportive zoning and other laws. Some cities are helping to establish bulk buying programmes (for example, for EVs, solar PV and solar thermal systems).

There also is a growing focus on the provision of infrastructure that could enable increased use of renewable energy in the heating, cooling and transport sectors. This includes district thermal networks, EV charging infrastructure and electrically powered public transit systems, all of which could allow cities to achieve higher shares of renewable energy.

Because no single policy option will successfully mobilise change across all urban residents and businesses, city governments increasingly are using various combinations of policy types, creating integrated approaches in an effort to steer the market towards cleaner and more renewable choices.

■ MARKETS

Urban deployment and use of renewable energy are increasing rapidly in response to growing recognition of associated benefits, attractive economics, new business models and support policies at various levels of government.

Although comprehensive data on renewable energy in urban markets are lacking, cities are increasingly purchasing renewable energy generation and investing in renewable technologies in the power, heating, cooling, and transport sectors. In addition, city actors are advancing the deployment of enabling technologies and infrastructure to ease the integration of rising shares of renewables into the energy system and to facilitate the interconnection of the power, heating and cooling, and transport sectors.

■ POWER

City governments and other urban actors are increasing their consumption of renewable electricity, and many have become renewable electricity producers.

Urban consumption of renewable electricity is increasing through a variety of mechanisms, including power purchase agreements (PPAs) with third-party producers. In addition, the modularity and scalability of renewable energy has provided city actors – including municipal governments, residents and businesses – with opportunities to become decentralised electricity producers, primarily through the use of on-site solar PV systems. By developing biogas projects (such as at local landfill sites and wastewater treatment plants), some cities are generating electricity (and heat) while greatly reducing local greenhouse gas emissions.

In addition, because most public lighting is concentrated in cities, where it can account for as much as 40% of a municipality's electricity budget, many city governments are embracing solar-powered street lights, which provide cost-effective and reliable solutions to public lighting needs. In 2017, global sales of solar street lighting reached a cumulative 3.8 million units.

■ HEATING AND COOLING

Solar thermal, bio-heat and geothermal technologies are emerging as affordable and reliable options to decarbonise the provision of heating and cooling in urban areas.

Modern renewable technologies can provide thermal energy for water and space heating and cooling, either through the use of isolated or stand-alone systems for individual buildings or via district energy networks. In a growing number of cities, renewables combined with energy efficiency improvements have enabled the development of "net zero" buildings and districts, with greatly reduced energy use and/or carbon emissions.

Isolated and stand-alone renewable energy systems typically include solar thermal systems on building façades and rooftops as well as modern biomass stoves and boilers. Numerous examples exist of solar thermal projects undertaken by city governments and local private investors in cities in Europe, Latin America and elsewhere. In addition, numerous cities use biomass, solar thermal and geothermal energy to produce heat for district heating systems (and in many cases, electricity as well).



■ TRANSPORT

In a growing number of cities, efforts to advance the use of renewables in transport are expanding from a focus on liquid biofuels to include electric vehicles as well as biomethane and hydrogen-powered vehicles.

Urban transport represented around 40% of the energy used in the transport sector in 2015 and contributed an estimated 37% of transport-related CO₂ emissions. Due to its heavy reliance on diesel, petrol and other fossil fuels, road transport is often the largest source of local air pollution in urban centres around the world.

City governments have developed a wide range of strategies to reduce the need for vehicular transport while also supporting the development of a cleaner and more sustainable transport system. Electricity use in urban transport is expanding beyond light rail, trains and metros to include public fleets, passenger cars and other forms of electric mobility. Some cities are actively coupling the electrification of their metros, trams and public fleets with the procurement of renewable electricity and/or the scale-up of renewable power capacity.

In response to increasingly restrictive regulations governing road transport in urban centres (for example, low-emission zones and diesel bans), city actors are exploring renewable alternatives. These include the use of electricity, biomethane and hydrogen produced from renewable electricity to fuel buses, municipal and private fleets (such as waste collection trucks and delivery vehicles) and private vehicles.

■ MOBILISING FINANCE AND ENABLING BUSINESS MODELS

More and more city governments are developing urban renewable energy projects. However, many challenges remain, such as the lack of their own funds and of access to external funds.

Municipal governments are increasing the flow of capital into renewable energy and other enabling technologies in two main ways. The first is by allocating their own municipal funds and/or borrowing funds for renewable energy-related projects. Bonds (municipal bonds as well as green bonds), public private partnerships, land value capture and dedicated funds from development finance institutions and green banks help municipal governments narrow the gap between the municipality's own available funds and what is needed to scale up renewables.

Some cities are trying to address the financing gap by increasing their reliance on the private sector. However, direct public investment continues to play a vital and catalytic role – particularly in the financing of enabling infrastructure – and it can be instrumental in mobilising additional finance at scale. The use of these and other sources of finance varies widely from city to city, and the exact numbers are not known.

The second means of increasing capital for renewable energy and related projects is the provision of municipal support for innovative business models that help create the conditions for citizens, local businesses and other actors to invest. Such business models include power purchase agreements, leasing (solar leasing, bus leasing and EV sharing), pay-as-you-go, peer-to-peer energy sharing and the development of energy service companies. City efforts to support innovative business models are more prevalent in some regions of the world than others.

However, challenges remain to increasing finance for urban renewable energy projects, such as a municipality's lack of its own funds and of access to external finance, investor perceptions of risks and low returns, bankability, institutional capacity and inertia, as well as information gaps.

■ CITIZEN AND COMMUNITY ENGAGEMENT

Citizen engagement is emerging as an important means for gaining public support for and sustaining momentum in the energy transition, as well as for driving more-ambitious goals at the national level.

Around the world, citizens are playing an increasingly active role in advancing renewable energy deployment. City residents can contribute in many different ways, including by choosing renewable energy tariffs, switching to green suppliers, and becoming prosumers by installing their own systems or by participating in one of the growing number of community energy projects emerging in and around urban areas.

Although frequently associated with northern European countries, such as Denmark and Germany, community renewable energy projects also exist in other regions and countries, including Australia, Canada, Japan, Thailand and the United States, and emerging in many places around the world. City administrations are supporting these initiatives through, for example, fiscal and financial incentives and feed-in tariffs, which enable residents and businesses to generate their own electricity and sell it to the grid.

Cities in Europe, North America and Australia are experiencing higher levels of citizen involvement and investment than other regions, due in part to the existence of more supportive market rules and enabling regulations. However, efforts are under way to reform market rules to allow for more citizen and prosumer engagement in Africa, Latin America and many parts of Asia and the Pacific.

See the full report and endnotes online at www.ren21.net/cities



REN21: RENEWABLES NOW!

REN21 is the only global renewable energy community of actors from science, governments, NGOs and industry. We provide up-to-date facts, figures and peer-reviewed analysis of global developments in technology, policies and markets to decision-makers. Our goal: encourage and enable them to make the transition to renewable energy happen - now.





Recent APUEA Activities

By Asia Pacific Urban Energy Association (APUEA)



DURING 2019, APUEA HOSTED AND SUPPORTED NOT LESS THAN 13 URBAN ENERGY EVENTS IN THE REGION. EVENTS WERE HELD IN BANGKOK, CHANGSHA, HONG KONG, MANILA, NEW DELHI, PENANG, SEOUL, SINGAPORE, AND XIAN.



INDIA

India Smart Utility Week 2020

🕒 3 - 7 March 2020
📍 New Delhi, India

APUEA participated in the annual international conference and exhibition, India Smart Utility Week, held between March 3 and 7 in 2020. On March 6, APUEA co-hosted a deep dive workshop on district energy in India in collaboration with India Smart Grid Forum (ISGF). The workshop aimed to unlock the potential of district energy, especially district cooling, in India. The workshop consisted of three panel discussions on the following topics:

1. District Energy Developments in India and Globally
2. Integrated Energy Applications: Smart Grids – Peak Load Shaving - Energy Storage – Demand Side Response (DSR)
3. Developing, Financing, and Managing Sustainable Energy/District Energy

The workshop concluded that district cooling could play a vital role in meeting the growing demand for cooling in India due to its high efficiency, low environmental impact, and the ability to reduce peak loads and integrate more renewable electricity into the power grid. There are many challenges to overcome but also huge opportunities in the Indian cooling market. There is a great need to communicate the benefits of district cooling but also to inspire stakeholders to take part in the opportunities that will arise. There is a need for a top-down approach, and to include District Cooling in the overall energy planning both on a regional and national level.



The workshop included speakers from the following organisations:

- **Mikael Jakobsson**, Asia Pacific Urban Energy Association (APUEA)
- **Peter Lundberg**, Asia Pacific Urban Energy Association (APUEA)
- **Rahul Tongia**, India Smart Grid Forum (ISGF)
- **R.R. Mehta**, India Smart Grid Forum (ISGF)
- **Teruhisa Oi**, Asian Development Bank (ADB)
- **Harshul Khanna**, Johnson Controls
- **Sanjay Dube**, International Institute for Energy Conservation (IIEC)
- **Anant Joshi**, International Institute for Energy Conservation (IIEC)
- **Jignesh Rawat**, Danfoss
- **Disha Sharma**, International Energy Agency (IEA)
- **Prameet Gupta**, Tabreed
- **Markus Wypior**, GIZ
- **Akshay Mangal**, Broad Group
- **Benjamin Hickman**, UN Environment – District Energy in Cities Initiative
- **Rajeev Sharma**, Gujarat International Finance Tec-City



The International Workshop on Energy Efficient Cooling

🕒 **12 - 13 December 2019**
 📍 **New Delhi, India**

On December 12-13, APUEA's Head of Operations Peter Lundberg was invited to participate and speak during the International Workshop on Energy Efficient Cooling arranged by the Bureau of Energy Efficiency (BEE), International Energy Agency (IEA), and the SEAD initiative. The focus of the workshop was to give the latest updates and engage discussions on efficient cooling and how to meet the rapidly growing demand for space cooling and cold chains in India through innovation, new technologies, business models, and policies. On December 12, during the efficient cooling session,

Peter made a presentation on the potential of district cooling as a vital solution to meet the rapidly growing cooling demand in India and the Asia Pacific region. During the session, Peter also participated in a panel discussion that was moderated by Dr. Winfried Damm from GIZ. Other panelists in the session were: Rajesh Bansal from BSES Rajdhani Power Limited, Mahesh Patankar from RAP, Caroline Stignor from Rise - IEA (HPT-TCP), and Benjamin Hickman from UNEP - District Energy in Cities Initiative.



SOUTH KOREA

KIREC Seoul 2019

🕒 **23 - 25 October 2019**
 📍 **Seoul, South Korea**

APUEA participated at the 8th International Renewable Energy Conference, KIREC Seoul 2019, 23-25 October 2019. The conference was a high-level forum for decision- and policymakers to meet and exchange ideas and knowledge on renewable energy and developments, both national and regional. The conference consisted of high-level plenary sessions and interactive parallel sessions that provided many opportunities to network with energy professionals from all over the world.

On October 24, APUEA's Head of Operations, Peter Lundberg, gave a keynote speech and participated in a panel discussion in the session "Policies to Support Renewable Uptake in Heating and Cooling". The session focused on how policy can best promote renewable heating and cooling, addressing the following questions:

1. What types of policy measures can promote renewable solutions for heating and cooling in buildings and the industry, while also complementing energy efficiency measures?
2. What policy measures have proven effective in promoting renewable heating and cooling?
3. What are the specific needs of the industry for heat, and how can policies address this?

The session was moderated by Marit Brommer from the International Geothermal Organization and included the following panelists: Ute Collier from Practical Action, Thorsten Herdan from the German Federal Ministry for Economic Affairs and Energy, Brent Hyde-Smith from ENGIE, and Aditi Sahni from Vivid Economics. The main conclusion from the

session on how to increase the share of renewables in heating and cooling was the need to put a price on carbon emissions. This has been proven in other countries, for example, in Sweden, to be an effective measure to reduce carbon emissions in the heating sector. For cooling, more renewable electricity can effectively be introduced by utilizing district cooling systems.



International Forum on Low Carbon Development for Cities

🕒 2 - 5 September 2019
📍 Seoul, South Korea

During 2-5 September, APUEA participated at the 2nd International Forum on Low Carbon Development for Cities organized by Asian Development Bank (ADB) in Seoul. On 2 September, APUEA's Executive Director, Mikael Jakobsson, shared his insights through two presentations. The first presentation, Multi Energy Systems (MES) and Integrated solutions for diverse consumer demands, aimed to highlight the benefits of integrated energy systems to meet various and variable energy demands. The second presentation, Smart Energy Management System, aimed to introduce the importance for cities to establish an energy management system as a framework to achieve continual improvement of energy performance.



THAILAND

The Future Energy Show

🕒 27 - 28 November 2019
📍 Bangkok, Thailand

On November 27 and November 28, Asia Pacific Urban Energy Association (APUEA) participated at The Future Energy Show Thailand 2019 at the Impact Convention Center in Bangkok, Thailand. On November 27, APUEA's head of operations, Peter Lundberg, held a presentation on the topic "Unlocking the potential of multi-energy systems for sustainable cities in the Asia Pacific." During his presentation, Peter had the opportunity to introduce the managing director, Bruno Lhopiteau of Siveco China, who recently became a new APUEA member.



CHINA

World Economic Forum's International Energy Community

🕒 25 - 27 October 2019
📍 Xiamen, P.R. China

APUEA participated at the World Economic Forum's International Energy Community China that was held in Xiamen from October 25-27 October. On 26 October, APUEA's Executive Director, Mikael Jakobsson, participated a high-level round table discussion together with executives from ABB, China Southern Grid, CNPC, GE, Huaneng, Mitsubishi, Saudi Aramco, Shell, State Grid and others to discuss challenges and opportunities in the Chinese Energy sector. Mr. Jakobsson introduced the role of APUEA being a bridge between cities and other urban energy stakeholders, including investors, solution providers, utilities, planners, academia, among others. The importance of cross-sector collaboration and planning was raised, as well as the importance of knowledge exchange and increased public awareness. Furthermore, the benefits of integrated energy systems were raised, including resilience, energy efficiency, increased share of renewable energies, peak shaving, among many other benefits.



Asia Pacific Forum on Low Carbon Technology

🕒 16 - 18 October 2019

📍 Changsha, P.R. China

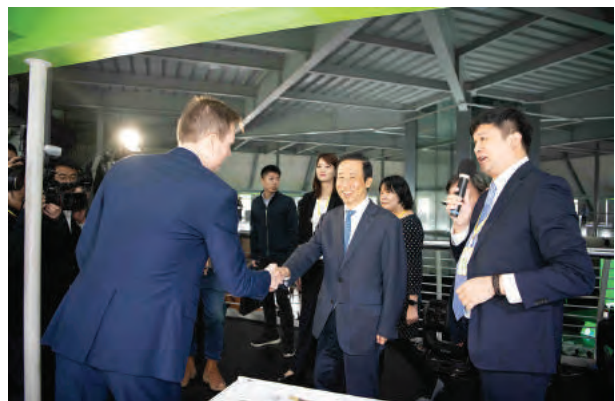
From October 16 to October 18, APUEA participated at the Asia Pacific Forum on Low Carbon Technology in Changsha that was organized by the Asian Development Bank, the Ecology and Environment Department of Hunan, Hunan Innovative Low Carbon Center (HILCC) and Broad Group.

As a part of the Forum during 17-18 October, APUEA co-hosted the "Sino-Asia Pacific Urban Energy Workshop" together with the Asian Development Bank (ADB), the Danish Board of District Heating (DBDH), and IVL Swedish Environmental Research Institute. The theme of the workshop was "Multi-Energy Systems and Future Energy Services" and covered the topics: District Energy 4.0, Distributed Energy, Heat Recovery, O&M, and Asset Management, among others. The workshop featured leading international and national experts from the industry, sharing experiences from real-world cases and enabling an excellent opportunity to share ideas, get intelligence, and discuss relevant topics and business opportunities. The audience included government officials, planning agencies, utility executives, financial and legal experts, planners, developers, design institutes, investors, academia, and domestic and international sector associations. In addition to speaker and business development opportunities, APUEA members could also take part in a trade exhibition to showcase their companies, products, and solutions.

The workshop included speakers from the following organizations:

- **Dr. Xuedu Lu**, Asian Development Bank (ADB)
- **Allen Zhang**, Hunan Innovative Low Carbon Center (HILCC)

- **Peter Lundberg**, Asia Pacific Urban Energy Association (APUEA)
- **Lars Hummelose**, Danish Board of District Heating (DBDH)
- **Kristina Lygnerud**, IVL Swedish Environmental Research Institute
- **Hao Wu**, International Partnership for Energy Efficiency Corporation (IPEEC)
- **Yang Guangyao**, Broad Group
- **Peng Guoping**, Broad Group
- **Elena Markova**, ABB
- **Terry Deng**, Johnson Controls
- **Li Yanshu**, Qingdao Energy Group
- **Wang Chuan**, Fengxi New Energy
- **Eric Shao**, Kamstrup
- **Tommy Jacobson**, Danfoss - Leanheat
- **Peng Zi Yang**, Wärtsilä



MALAYSIA

Asia-Pacific Urban Forum - 7

🕒 15 - 17 October 2019

📍 Penang, Malaysia

APUEA participated at the Asia-Pacific Urban Forum - 7, in Penang 15-17 October 2019. The forum is held every 4-5 years and is the largest regional gathering of urban stakeholders, engaging policymakers from local and national governments, financial institutions, civil society, the academia, the urban training-research community, and private sector to discuss innovative solutions, identify common actions and objectives, and strengthen effective partnerships to achieve sustainable urban development.

On October 6, APUEA co-hosted the Deep Dive Discussion: Sustainable Energy in Cities – Opportunities and Challenges together with the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The goal of the session was to explore the emerging issues, opportunities, and challenges local governments and city planners are facing in enhancing the sustainability of energy generation and use in the urban context. The session also provided opportunities to share international and regional experiences to provide insights into cross-sectoral development of sustainable energy for cities.

Key Discussion Points During the Deep Dive Discussion:

- Cross-sectoral efforts are required to achieve sustainable, resilient, and liveable cities; how do we stimulate cross-sectoral urban planning?
- Digitalisation enables end-user engagement; what’s new in energy services?
- What is the impact of (and solutions for) increasing energy demands in cities as a result of continuous urbanisation in combination with rapid electrification, including EVs?

The Deep Dive Discussion included the following participants:

- **Michael Williamson**, United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)
- **Ksenia Petrichenko**, United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)
- **Mikael Jakobsson**, Asia Pacific Urban Energy Association (APUEA)
- **Teruhisa Oi**, Asian Development Bank (ADB)
- **H.E. Maxim Egorov**, Ministry of Construction, Housing, and Utilities, Russian Federation
- **John Steed**, ABB



Asian Utility Week / POWERGEN Asia

🕒 **3 - 5 September 2019**

📍 **Kuala Lumpur, Malaysia**

On 3-5 September 2019, APUEA participated in the Asian Utility Week / POWERGEN Asia in Kuala Lumpur. The 2019 edition of the event offered a full value-change experience of the utility sector from power generation, distribution, and digital transformation and included 12000 visitors, 450 speakers, 2000 utility reps, and 350 exhibitors. On September 3, APUEA's Head of Operations Peter Lundberg participated as a panelist in the Focus Group on cities as the drivers of energy transition from rooftop solar to smart buildings and lights. The session was moderated by Anthony Arrow from Pinsent Masons. Other panelists included Mohannad Khader from Qatar Cool, Hitendra Shetty from Wartsila Energy, Julian Mialaret from Idinvest Partners, and Warit Taechajinda from PTT.





Event Calendar

16 JUN 2020	<p>🕒 16 - 19 June 2020</p> <p>📍 Manila, Philippines</p> <p>Asia Clean Energy Forum 2020</p> <p>APUEA Activity: Co-host an Urban Energy “Deep Dive Workshop”</p>
AUG 2020	<p>🕒 August 2020</p> <p>📍 Xian, P.R. China</p> <p>Asia Pacific Urban Energy Conference</p> <p>APUEA Activity: Co-hosting together with Fengxi New Energy</p>
16 SEP 2020	<p>🕒 16 - 18 September 2020</p> <p>📍 Bangkok, Thailand</p> <p>ASEAN Sustainable Energy Week</p> <p>APUEA Activity: 1. APUEA Annual General Meeting (Hosting), 2. Smart Energy City Workshop (Co-hosting with Joint Graduate School Energy & Environment), 3. Sustainable Energy in Cities (Hosting)</p>
21 SEP 2020	<p>🕒 21 September 2020</p> <p>📍 Hong Kong</p> <p>Asia Pacific Economical Cooperation (APEC) DHCS Workshop</p> <p>APUEA Activity: Participating</p>
22 SEP 2020	<p>🕒 22 - 24 September 2020</p> <p>📍 Jakarta, Indonesia</p> <p>Enlit Asia 2020</p> <p>APUEA Activity: Supporting Organization</p>
OCT 2020	<p>🕒 October 2020</p> <p>📍 Changsha, P.R. China</p> <p>Asia Pacific Forum on Low Carbon Technology 2020</p> <p>APUEA Activity: Co-hosting workshops and other activities</p>
NOV 2020	<p>🕒 November 2020</p> <p>📍 Chennai, India</p> <p>Asia Pacific Cooling Summit</p> <p>APUEA Activity: Co-hosting Organization</p>



Member Directory

Founding Members



ABB



Engie



Johnson Controls

Members



International District Energy Association (IDEA)



Euroheat & Power (EHP)



Alliance to Save Energy



Qatar Cool



China District Heating Association (CDHA)



Danish Board of District Heating (DBDH)



International Institute for Energy Conservation (IIEC)



Northeast Clean Energy Council (NECEC)



District Energy in Cities Initiative



DEVCCO



Thai ESCO Association



Overseas Environmental Cooperation Center (OECC)



SPX FLOW



Chongqing Renewable Energy Society



Lux Research



Adenergy



Qingdao Energy Group



NXITY



SIVECO China



IVL Swedish Environmental Research Institute



Fengxi New Energy

Partners and Supporting Organizations

- Sustainable Energy for All (SEforALL)
- Asian Development Bank (ADB)
- International Energy Agency (IEA)
- UN Environment

APUEA Registration Form - Membership

We, the under-mentioned organisation / company, hereby apply to become a member of APUEA:

1 ORGANIZATION / COMPANY DETAILS:

Organization name

Marketing name and/or Abbreviation

Street

Postal code City Country

General Phone General Fax

General E-mail Web

Primary Contact: First name Surname

Position Direct Phone E-mail

2 ORGANISATION CATEGORY (please check as appropriate below):

- Association / Federation
- Manufacturer / Equipment Supply
- NGO
- Utility / Operator
- Academic
- Media company - Press / Journalist / Advertisement
- Advisor - Financial / Legal / Banking
- Building Sector
- Consultancy - Engineering / Design / Technical
- Other

Specify:

3 BILLING INFORMATION (if different from above):

Billing Address:

.....

.....

4 MEMBERSHIP CATEGORY (please check as appropriate below):

Member Category	Employees		
	≤ 1,000	1,000 - 10,000	≥ 10,000
Active Member	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Allied Member	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Affiliate Member	<input type="radio"/>		

5 PAYMENT METHOD:

-  Bank Transfer
-  Credit Card
-  Paypal

Please indicate preferred payment method. Payment instructions will be provided following confirmation of membership.

Please complete the form, and send a scanned version to membership@apuea.org

