HKIE-YMC & CPDC OVERSEA DELEGATION 2017 TO ICELAND

CLIMATE CHANGE THE HAPPENING

THE HONG KONG INSTITUTION OF ENGINEERS
香港工程師學會

Young Members Committee
青年會員事務委員會

THE HONG KONG INSTITUTION OF ENGINEERS
YOUNG MEMBERS COMMITTEE
CONTINUING PROFESSIONAL DEVELOPMENT COMMITTEE

OVERSEAS DELEGATION 2017 TO ICELAND

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We engineers in Hong Kong have always been in a position to contribute to the society, either by means of providing professional services or giving our views for the betterment of the local community as well as the world. China's grand "Belt and Road" initiative promotes connectivity in infrastructure; enhance trade relations as well as industrial co-operation among countries along the proposed Belt and Road routes. It provides promising opportunities for engineers, in particular the younger ones, to participate in and contribute to the rise of civilisation at an international level.

Iceland is a smart choice for the delegation. It is a beautiful country rich in natural resources as well as a pioneer in renewable energy. Iceland is also on the frontline of combating climate change which leads to melting glaciers and rising of sea level. With the theme "Climate Change: the Happening", the delegation aims to broaden the horizons of our young members on the social and cultural aspects and to help them gain insight into the latest engineering practices in Iceland through the intensive programme and meaningful exchanges with professionals in the industrial sector and different institutes.

Taking this opportunity, I would like to express my heartfelt congratulations to the HKIE Young Members Committee for having another successful delegation, and all the delegates for their accomplishments. The teamwork of the YMC overseas delegation, under the leadership of Ir Ambrose Chan, has been well demonstrated and is particularly impressive. Let's work together for a healthier living for mankind and build Hong Kong into a liveable, competitive and sustainable Asia's world city.

Ir Joseph K H CHOI
President
The Hong Kong Institution of Engineers

With a sub-arctic climate, an area of almost 100 times bigger, while the population is less than 5% of that of Hong Kong, Iceland is indeed a very different place. But something that we have in common is the need to face the challenge of climate change. It makes perfect sense that YMC chose this country as their destination for this year's overseas delegation. I am sure the delegates have gained a lot of insights from organizing and undertaking this visit, and the subsequent sharing with other members will in turn enhance their understanding of Iceland and the theme of climate change. As the good effort this year draws to an end, the experience gained will definitely benefit future delegations.

Ir CHAN Chi Chiu, SBS
Immediate Past President
The Hong Kong Institution of Engineers

It is my privilege to be one of the Advisors for the YMC Overseas Delegation 2017 to Iceland and I would like to take this opportunity to congratulate all organizers and participants of this year's visit to Iceland.

The YMC Overseas Delegation is one of our Institution's most important events. Its team was formed in the autumn of 2016, and the 16 delegates, who didn't know one another beforehand and came from various engineering backgrounds, organized this impressive trip in just a few months. It defies belief that everything was planned so quickly, which speaks volumes on the delegates' and our members' dedication and can-do attitude towards the trip. It is an extraordinary journey whose value is not limited to the visit itself and I am convinced these budding engineers will become the pillars of society in the near future and nurture our community with their talents and hard work.

The theme of this year is "Climate Change: the Happening", and the three areas of study comprise "Climate Change: A Global Challenge", "Hong Kong Story: Engineers' Responsibility" and "Towards a fossil fuel-free city". Given Iceland's unique geographical location and environmental conditions, there are loads of great technological measures and communal provisions that our young engineers could benefit from. With over 85% renewable resources utilized for primary energy usage in Iceland, the locals have a strong incentive to combat with the increasing pressures from climate change. I am pleased to know that our young engineers were greatly inspired by the trip, with invaluable experiences of technical visits gained in the Geothermal and Hydropower Plants, Icelandic Institutions, Companies and Agencies. I look forward to hearing their sharing on their observations and insights from their delegation and expertise they met.

Finally, I would like to make a special mention to the Delegation Manager, Ir Ambrose CHEN and his team. Together, they have supported the delegates and have paved the way for their success. I look forward to joining the Delegation on one of their future programs and wish them continued success and rewarding journeys ahead.

Ir Thomas K C CHAN
Senior Vice President
The Hong Kong Institution of Engineers

Once again, I would like to express my heartfelt congratulations to the YMC for having another successfully organised Overseas Delegation to Iceland. With the theme "Climate Change: the Happening", Iceland is an ideal destination as the country well-known for renewable in electricity and heat.

Iceland is one of the top 30 Greenest countries in the world. She has considerable renewable energy resources, especially geothermal energy and hydropower resources to provide adequately all of Iceland's electricity and around 85% of the nation's total primary energy consumption. Given that, Iceland was still hit hard by the climate change impacts. It reported that the glacial runoff increases had been observed in historical records. Optimisation design on future climate conditions has been taken into account by their engineers.

Through this trip, our young engineers had an opportunity to gain valuable insight and broadened their engineering knowledge from the Iceland's counterparts on the current problems of climate change. With Iceland as an excellent example to find out the vital role of engineers in the global fight against it. The valuable experience gained through this trip learning and sharing process of this Delegation will be beneficial to their professional career. The trip also makes good reference to the Delegation to find out how Hong Kong could be developed to achieve total sustainability for our future.

I am most impressed by the concerted effort, and enthusiasm of each team member took part in the preparation and the execution of this trip. The itinerary was packed to utilise the Delegation exploration to the local engineer societies.

I wish to congratulate the success of the Delegation team with the leadership of Ir Ambrose Chen. The effort by the Delegation team is definitely the key leading to this successful trip.

Ir Dr Philco N K WONG
Vice President
The Hong Kong Institution of Engineers

It is my privilege to be one of the advisors for the HKIE Young Members Committee overseas delegation to Iceland and I would like to express my heartfelt congratulations to the HKIE-YMC for the successful and rewarding organisation of the delegation to Iceland this year.

Climate change is a threatening and urgent issue that requires the world's effort to adapt to it. The Paris Agreement was treated as a big step forward, as the world's finally united to deal with the problematic climate change. We engineers are obliged to combat the climate change issues and should be prepared to help alleviating the global warming phenomenon. It is therefore truly heartening to note that the HKIE-YMC had chosen climate change as the theme for this year's overseas delegation and to remind us once again the world climate's risk and challenges ahead, and more importantly, what we could do, through our profession, to help.

I congratulate the HKIE-YMC for the successful organisation of this delegation and Ir Ambrose CHEN for the leadership. And I trust that this delegation will contribute to the sustainable development of all delegates and the HKIE-YMC.

Ir Ringo S M YU
Vice President
The Hong Kong Institution of Engineers

I have had the privilege and honour to have been invited to be one of the delegation advisors for the HKIE-YMC Overseas Delegation for many years, and I have found it most enjoyable.

I always support this event as I believe in the philosophy of "seeing is believing", there is so much we can learn from seeing projects overseas. The opportunity to experience foreign culture is also most valuable. Such valuable experience, both technical and cultural, will definitely add to the exposure and experience of the delegates and will become useful in developing their career.

Iceland is a remote country from Hong Kong, and probably has the most diverse characteristics. They have vast expenses of land, plentiful resources, and a relatively small population, which makes it much easier for them to pursue the ideals of preserving nature and causing minimal harm to the environment. However, that does not mean that they do it at the expense of technical development. As the delegates have found out themselves, there had been a lot of successful technical development, some of which, if appropriate, may be applied to Hong Kong.

I therefore envy those who have joined the delegation and saw these projects with their own eyes. I only hope that they will share the knowledge with other members of the Institution so that we can all learn from it.

I take this opportunity to congratulate Delegation Manager, Ambrose Chen, for his able leadership, and all other delegates for excellent teamwork, and I look forward to seeing future delegations equally being successful.

Ir Edmund K H Leung, SBS OBE J.P.
Past President
The Hong Kong Institution of Engineers

Iceland is a land of plenty. It is a country blessed with beautiful landscape and friendly people, rich biodiversity and abundance of natural resources; particularly thermal energy not only for power generation but also for piloting an hydrogen economy. I had the pleasure of visiting this lovely country last year with Electrical Division of the HKIE and I was delighted to know it was the destination for this year's YMC overseas visit.

The foot print of this YMC Delegation covers academic institutions, professional engineering agencies, thermal power plants, energy authority, environmental agency and green building council. Apart from exchanging of experience and acquiring knowledge, the delegation had fulfilled the mission as the ambassador of the Hong Kong Institution of Engineers cultivating professional dialogue and goodwill among the peoples of Iceland and Hong Kong.

I therefore wish to congratulate the Chairman and the delegation members for their achievement and look forward to reading the Delegation Report with great interest.

Ir Dr Otto L T Poon, BBS, OBE
Past President
The Hong Kong Institution of Engineers

My sincere congratulations on the success of the delegation to Iceland. There are many different goals participants reach during the trip. I am sure that it is worth it all for your input and participation. Everything from making the visit as scheduled and widening the knowledge of climate change are achievements that deserve to be noticed and celebrated. Knowing that your achievements are life-long benefit and can be shared with others. It is exactly what the YMC annual visit intends to bring.

Best wishes for your continued success.

Ir Dr KOON Chi-ming
Chairman of the Continuing Professional Development Committee
The Hong Kong Institution of Engineers

Chairman's Message

I am writing to congratulate the success of the YMC Overseas Delegation 2017 to Iceland.

Iceland, an isolated island in the northwest Atlantic. It is one of the most sparsely populated countries, but it is more famous for its incredible sceneries. This fantasy land formed by glaciers, volcanoes, waterfalls, aurora and the strange terrain around, is the theatre of a lot of beautiful legends.

When I heard of Iceland, a snow-covered desert island immediately appeared in my mind. Though, as I deepened my understanding towards it, I exclaimed how fantastic can this piece of land be, as its existence is almost beyond imagination. Iceland is like a lost world mixed with snow and flames.

Many Icelanders believe "Everything has its soul and beauty". In their fantastic nature, it is believed that there is a living creature - Elf, which is the patron saint of their home. These "Huldufólk" (Invisible Resident) are the indigenous inhabitants and hidden in everywhere of Iceland. This kind of unique spirit and special beliefs of Icelanders depicts their respect to the environment, and the way to live out the beautiful harmony between human and nature. And out of this spirit, it allows this piece of fantasy land and many magical legends and myths to live on until today.

Yet apart from the beautiful legends of elves and witches was the undeniable truth behind - the clash and influence by climate change. The melting ice arouse the attention from fellow delegates in how the Icelanders strived to protect it from global warming.

"Climate Change is already visible in Iceland. Our glaciers are retreating." Mr Sigmundur David GUNNLAUGSSON, Prime Minister of Iceland stated in COP21 Summit Paris, 2015 (GUNNLAUGSSON, 2017). With their experience, the Icelander has proved to the world that fundamental energy transformation can be the basis for sustainable development, even in the context of financial crisis. Almost 100% of the energy for electricity and heating in Iceland are from renewables, which is a big step towards a future with the normal climate and also a key in resolving global energy issues. With the utilization of geothermal energy, the annual carbon dioxide emissions from huge-power-consumption industries, e.g. a data centre with thousands of servers, could be reduced by 500,000 tons (Sina, 2009), compared to conventional thermal power plant using fossil fuel. You shall learn more by reading through this report in details, it is done by our delegates.

It is our great honour to have received supports and advices from our advisors including Ir Joseph K H CHOI, Ir CHAN Chi Chiu, Ir Thomas K C CHAN, Ir Dr Philco N K WONG, Ir Ringo S M YU, Ir Dr Otto L T POON, Ir Edmund K H LEUNG, and Ir Dr C M KOON. They have given us valuable advices and considerable supports throughout the delegation. Moreover, I would like to express my gratitude to the HKIE-Continuing Professional Development Committee and the sponsors. Without their generous financial support, the team would not be able to bring this Delegation to a success. Last but not least, I must express my truthful thanks to all delegates, especially the Delegation Manager, Ir Ambrose CHEN, the Deputy Delegation Managers, Ms Fanny YEUNG and Mr Dick YAN for their works and great effort in organising this Delegation. It was a pity to me for missing the chance to go with the team, but I'm sure they enjoyed this delegation a lot. Congratulations to the team once again and I am looking forward to their sharing on what they have learnt in Iceland.

Ms Candy M Y FUNG
Chairman
Young Members Committee
The Hong Kong Institution of Engineers

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About the HKIE-YMC Delegation

Since 1991, the Young Members Committee of the Hong Kong Institution of Engineers (HKIE-YMC) has been organising delegations to various parts of the world. Each year, a theme will be set for the delegation with the following objectives:-

- To widen the vision and horizon of young engineers;
- To appreciate the latest engineering practices around the globe and assess the applicability of these practices in Hong Kong;
- To promote Hong Kong and its engineering practices; and,
- To enhance the relationship between HKIE and Mainland/Overseas Institutions.

The HKIE-YMC Overseas Delegation is one of the sustainable flagship events, which aims to achieve the above objectives through the organization of the delegation itself as well as a series of seminars/ technical visits held locally in Hong Kong, before and after the delegation. The HKIE-YMC Overseas Delegation also aims to arouse young engineers' potential in leadership and motivates their vision to learn from overseas good practices, from which the delegates can gain knowledge on both technological development as well as responsibility of the engineering profession.

Iceland –
Country of Ice and Fire

With a view to inspire our young engineers and to have them experience the impact of climate change, the YMC choose to visit the Iceland as our destination for this year's Overseas Delegation.

The beautiful scenery in Iceland is no doubt one of the natural wonders on earth. While the mankind is progressing in civilisation and industrialisation, pollutions within had caused serious damage to the world treasure. This delegation to Iceland would bring some "impacts" which are totally different to Hong Kong, and our delegates shall be aspired in taking a lead to fight against climate change.

Moreover, claimed to be 100% renewable in electricity generation, Iceland had been effectively using their natural resources such as geothermal energy as well as hydroelectric energy since long ago. With all the efforts done by both the Icelandic Government and Iceland people, the country ranked 2nd out of 180 countries in environmental performance index in 2016 by Yale University. It is no doubt that Iceland is a role model on way forward to achieve sustainability, choosing Iceland to be our destination certainly gain our delegates and young engineers inspirations on becoming "Fossil Fuel Free" country.

The Theme
“Climate Change : the Happening”

Greenhouse Effect and Climate Change has always been the biggest challenge to mankind since its first recognition in the 80’s. Despite the global claim of work done and the advancement of technologies, there are stills reports indicating a continue rise of temperature, notwithstanding melting glacier in the arctic as well as impacts of climate change the world is suffering since industrialisation.

Since then, the world has been working together to deal with the problem that comes with climate change. The establishment of the Intergovernmental Panel on Climate Change (IPCC) has motivated the world to work hard on dealing with the impacts of climate change through mitigation and adaptation. Recent breakthrough in the Paris agreement was considered a milestone to the global response to the threat of climate change, where the world leaders agreed to keep the global temperature rise within 2oC above pre-industrial levels. However, while we thought that the Paris agreement could be the saviour in the big fight against climate change, the Trump Presidency in the United States had certainly brought some uncertainty within the field of climate change.

Locally, we have been experiencing climate change for hundred years or so. In recent years, we have been experiencing more rainfalls and more extreme weathers. These are observed and interpreted as the consequences of climate change. In response to this, the Hong Kong Government had taken actions and issues a series of action plan, including the latest “Hong Kong’s Climate Action Plan 2030+”, to help against the adverse environment, which also tries to contribute a part in the big topic on climate change.

Riding the success of Paris agreement, and together with a lot of action taken by both global and local governments, it is a good atmosphere to review how mankind progressed to mitigate, as well as to adapt to the impacts of climate change, and in particular, we should review what we, engineers, should possess and, with our technical knowledge, should do to contribute to this fight against climate change.

Area of Study

CLIMATE CHANGE : A GLOBAL CHALLENGE

Climate Change is happening. The rising global temperatures had led to dramatic weather changes across the globe. Some of these changes, such as stronger hurricanes and melting glaciers, are catastrophic, and these phenomena often causes the loss of property and even lives. It was not until very recently that we humans realised that climate change is mainly anthropogenic, due to our use of fossil fuels since the industrial revolution to enhance living standards. Even nowadays, most of the world still rely on these non-renewable resources to fulfil the energy needs of people's livelihoods. Global warming is extremely well-documented and scientifically proven. Yet there are still high-level debate on the confirmation of the impacts of climate change.

In analyzing the evidence of global warming, from the time series of average temperatures, it is evident that there is a robust global warming trend. As we look at agriculture, coastal areas, forests, health, ecology and water systems, there is no doubt our climate is changing and affecting all of these aspects of the earth system.

From the heat wave in Europe and the Iceland's volcanic eruptions, to the environmental changes and extreme weather conditions we could experience in Hong Kong, the world is suffering from the consequences of climate change.

Since the realisation of climate change, the world has been working hard on dealing with it. Experts and stakeholders from different nations came together in the working groups of the Intergovernmental Panel on Climate Change (IPCC), and the annual United Nation Framework Convention on Climate Change (UNFCCC) is established to formulate holistic approaches and actions to combat climate change in a global perspective.

It is apparent that humans are adding carbon dioxide to the atmosphere faster than it can be removed. From the Kyoto Protocol and Rio Agreements in 1992 to the Paris Agreement in 2014, the world is working to reduce carbon and greenhouse gases emissions in order to keep the global temperature rise below 2 degrees Celsius above pre-industrial levels, and to limit temperature increase to 1.5 degrees Celsius. The papers and treatises illustrated astonishing milestones in environmental protection and strengthen countries' adaptations to climate change.

There are currently 3 key directions to combat Climate Change: Mitigation, Adaptation, and Resilience. Mitigation refer to actions that can limit or reverse climate change. Adaptation refer to actions that can withstand the impacts of Climate Change. Resilience refers to the ability for the society to respond to climate change and to quickly recover from the damage of climate change.

Moreover, renewable energy will be discussed, as well as some of the geoengineering technology and solution which were first formed about 30 years ago i.e. Carbon Dioxide Removal, Solar Radiation Management and Earth Cooling Schemes. Putting these into practice could further moderate global warming by large-scale regulation of our Earth's climate system with advanced technology and subsequent response of the ecosphere.

All in all, climate change impacts the world in various ways, and different countries would face different challenges and different solutions shall prevail. It is important that the world join hands to combat climate change. Some of the world issues that affects the humanity fighting climate change will also be reviewed. The world's commitment in both adapting and mitigating climate change remains to be seen in light of recent political changes.

Towards a Fossil Fuel Free City

Energy production emits a large amount of greenhouse gas into the atmosphere, thus contributing to climate change. Hong Kong, being a world class financial center, consumes huge amount of energy to support services from office operation to operating data centers. Therefore, it is important that we understand and use energy in a more efficient way to achieve sustainability.

Currently, Hong Kong relies largely on fossil fuels for its energy. More than 50% of electricity are produced using fossil fuels. To reduce the impact of climate change and to reduce the use of fossil fuels, the Government has been working with the power companies in order to reduce carbon emission. Iceland, on the other hand, is able to make good use of its abundant natural geothermal energy resources and can claim to be a “fossil fuel free country”. It is therefore important to review their policy on the implementation of renewable energy, from which Hong Kong can learn and obtain inspiration.

The team also looked into the implication of the proposed change of fuel mix in Hong Kong, with the assistance of various non-fossil fuel energy (e.g. Nuclear, Waste-to-energy etc.). It is interesting to review whether the actions taken could help Hong Kong to become fossil fuel-free city.

Energy demand in buildings is an important yet difficult topic in terms of sustainable buildings. In Hong Kong, 90% of the electricity generated are delivered to buildings, most of which is used for air-conditioning. Therefore, it is important that we look into sustainable building design using technologies such as intelligent building design and the initiative to change users’ behaviour. it is also interesting to look into whether schemes like BEAM+ could encourage the building industry in Hong Kong and Iceland to apply sustainable design in their projects and hence improve energy efficiency in their buildings.

On top of energy, Carbon Capture and Storage (CCS) technology is an emerging research field. Carbon from energy production processes can be captured and stored underground, thus reducing the carbon dioxide concentration in the atmosphere and slow down climate change. Iceland, which mostly utilises non-fossil fuel energy, still suffers from carbon and sulphur emissions from geothermal energy production. Such technology is crucial as we can reduce greenhouse gas at source for the same amount of energy produced.

From the inspiration we gain from Iceland and the studies on both supply and demand side, we hope to contribute in the effort towards minimising the impacts of climate change.

Hong Kong Story: Engineers' Responsibility

Locally, climate change has been affecting us by way of extreme weather conditions such as more frequent and more severe storm surge and the rising sea level. This affects not only our society, but also us as individuals. Various areas of impact are investigated and discussed in our study to obtain comprehensive information of Hong Kong's current situation, such as physical infrastructure, business and industry, and human health. The impacts of climate change is all-encompassing, and as such, both public and private sectors should take an active role in implementing measures to fight against climate change.

Regarding Hong Kong's effort in combating climate change, mitigation aims to reduce climate change via the reduction of greenhouse gas emissions, which is mainly caused by the consumption of fossil fuels. Adaptation measures involve infrastructural works to adapt Hong Kong's built environment to cater for increased risks due to climate change. Moreover, our city is also working on climate resilience by strengthening social responsiveness to climate risks, such as filling knowledge gaps and encouraging research and development, education, public engagement and community awareness, and increasing emergency preparedness and public involvement.

We the people of Hong Kong have international obligations under the United Nations (UN) cooperation framework on climate change. Representatives from the Administration had joined the Conferences of Parties to the Convention and the Protocol. Hong Kong has been formulating her policies to contribute to the global effort in combating against climate change. As a modern developed city, Hong Kong is adopting a more aggressive carbon reduction target and contributes to the national efforts in tackling climate change.

Engineers need to take a prominent role to address the climate change issues. To seek answers to the question "what engineers should possess, and what should engineers do to combat climate change", we interviewed experts from four selected fields to be our interviewees: environmental leaders; policy makers; government officials and engineers and industry leaders. We believe that the worldview of these experts from various fields would be beneficial to engineers in Hong Kong and provide us with a precious chance to discuss what we have done, what we can even do more of and how we can do better for humankind.

Composition of Delegates

To perpetuate our tradition of Overseas Delegation, all registered young members who applied the delegation would have to go through selection interviews with our delegation advisors in between October and November 2016. In late November 2016, the delegation team was formed, comprising sixteen delegates who came from various engineering disciplines, including Building structural, Civil, Electrical, Electronics, Environmental, Logistics and Transportation and Mechanical engineering. They work in varies sectors in the local engineering professions, ranging from Government Departments, utilities, consultants etc.

The delegation team in essence represents the overall young engineer community in Hong Kong.

Ir Ambrose CHEN Hao Ting

Delegation Manager
Mechanical Engineering

Graduated from Imperial College London, Ambrose pursues his career as a professional mechanical engineer in Government Departments, including the Electrical and Mechanical Services Department and the Environmental Protection Department (EPD). He is currently working in the EPD as enforcement agent on air pollution in relation to vehicular pollution, in particular diesel commercial vehicle and vehicle idling issues.

Ambrose also plays a very active role in local professional services. He is currently the Deputy Chairman of the Young Members Committee of the HKIE, and has served on various task forces and professional young groups. Through these tasks and duties, Ambrose hopes to promote engineering to a wider range of people and to uplift the professional image of engineering in Hong Kong.

Through this delegation, Ambrose hopes that the delegation team would experience the impact of climate change from the tip of the earth, and to bring back the impacts to young engineers in Hong Kong so that we could all together fight the climate change and save our planet earth.

Ms. Fanny YEUNG Hiu Fan

Deputy Delegation Manager
Electronic & Communications Engineering

Fanny obtained her Bachelor Degree of Engineering in Electronic and Communications Engineering from The University of Hong Kong. She joined PCCW as a Graduate Trainee and then promoted to Trainee Engineer. She is now working at Wireless Engineering Department for Planning and Design for the Mobile Core IP Network and is responsible for mobile network integration projects.

Climate change has recently aroused the public's attention and we should take action towards it. She would like to take this precious chance to explore Mitigation & Adaptation Measures and Renewable Energy Application in Iceland, and study their applicability in Hong Kong.

Mr. Dick YAN Fu Ho

Deputy Delegation Manager
Electrical Engineering

Dick obtained his Bachelor Degree in Electrical Engineering at the Hong Kong Polytechnic University. He is an officer of the Drainage Services Department, responsible for operation and maintenance of sewage treatment infrastructure for the Government of Hong Kong. Recognising that climate change imposes challenges to Hong Kong as a coastal city, he is going to bring back overseas experiences to serve the community.

Like a box of chocolate, engineers' work is only seen when people poke into their boxes. He would like to take this delegation to nurture a critical mass of people as future leaders of the trade.

Ms. Hidy YAN Tsz Tung

Secretary
Mechanical Engineering

Hidy obtained her Bachelor Degree in Mechanical and Automation Engineering from Chinese University of Hong Kong. She is currently working as an Engineer in the WSP | Parsons Brinckerhoff. Her duties include engineering designs and consultancy services in healthcare solutions and residential development. She is expected to achieve her Master Degree in Energy and Environment in summer 2017, and she sees this delegation as a crucial enrichment for both technical dimensions and personal qualities. Energy reserves and promotion of sustainable lifestyle is no doubt a recent hot topic for construction and environmental protection. She looks forward to develop my career in engineering designs, sustainability and energy conservation in future.

Ms. Kahl CHEUNG Kar Man

Treasurer
Mechanical Engineering

Kahl obtained her Bachelor Degree in Mechanical Engineering at the Hong Kong University of Science and Technology in 2016 and will be an Assistant Building Services Engineer at Gammon Construction Limited. Before working at Gammon, she has worked as an intern for various engineering sectors, including utility, contractor and the government, mainly responsible for product development, fatigue analysis, engineering design in water treatment works and reviewing the effectiveness of existing road noise mitigation measures. Being the major party contributed to carbon emission, Kahl treated the delegation to Iceland as a precious opportunity to learn and reflect. She believes engineers are here to build a better world.

Ms. Rachel NG Hoi Ching

Local Liaison Officer
Civil Engineering

Rachel graduated from the University of Toronto with her Bachelor Degree in Civil Engineering along with an Environmental Engineering and an Engineering Business Minor. She is currently employed as Graduate Engineer in AECOM's Water and Urban Development business line. She is involved in projects including Development of Anderson Road Quarry Site and Hong Kong International Airport Terminal 2 Expansion. She believes that engineers help to create a more livable world for human without jeopardizing the environment for other livings. Therefore, this delegation will allow her to have a clear vision on global warming and bring this into her work.

Ms. Winnie LAI Man Ying

Local Liaison Officer
Civil Engineering

Winnie obtained her Master Degree in Civil Engineering at Imperial College London, U.K., in 2016. She is currently working as a Graduate Engineering at AECOM in Hong Kong office. She works under the team of Global Long Span and Specialty Bridges which has projects worldwide such as Hong Kong, Turkey, Singapore, etc. Her duties include proposals and tender designs. This delegation will not only expand her international perspective but enrich her engineering development.

Ms. Sueann LEE Sheung Yan

Publication Officer
Environmental Engineering

Sueann obtained her Bachelor Degree in Environmental Engineering at MIT and her Master Degrees in Environmental Engineering at Stanford University. She has worked in both the environmental and civil engineering disciplines in the past. She is now working as an Assistant Resident Engineer supervising an infrastructure construction project. Sueann is passionate about environmental issues, one of which is climate change. Climate change poses a serious challenge to coastal communities such as Hong Kong and warrants stronger efforts from everyone. Sueann wants to work towards bringing engineers and the public into a bigger role to help address climate change.

Mr. Samson LEUNG Siu Ho

Publication Officer
Logistics and Transportation

Samson received his Bachelor of Engineering in Industrial Engineering and Logistics Management from the Hong Kong University of Science and Technology. Upon his graduation, he joined Hong Kong Logistics Technology & Systems Limited as a Graduate Engineer and his duties are mainly logistics planning, including process re-engineering, operation optimisation, functional layout and traffic flow design, etc.
He believes the delegation will provide him with invaluable knowledge and experience in his engineering exposure.

Mr. Ivan WONG Ho Cheung

Logistics Officers
Transportation Systems Engineering

Ivan obtained his Bachelor Degree in Transportation Systems Engineering from the Hong Kong Polytechnic University. Upon his graduation, he joined AECOM and currently works as a Graduate Engineer in transport planning and traffic engineering.
With a vision to deliver a better world, Ivan sees the importance of bringing sustainability to the community. As one of the delegates, he would like to explore solutions for this fast-changing world and more importantly, to recognize the social responsibility of a young engineer in the fight against the world's most complex challenge – Climate Change.

Mr. Fred CHOW Kin Hang

Publication Officer
Mechanical Engineering

Fred graduated from the Hong Kong University of Science and Technology with Bachelor Degree in Civil and Structural Engineering. Fred processed vital design, site supervision and coordination experience in water main rehabilitation and marine viaduct construction.

Fred currently involves in the District Cooling System in Kai Tak Development, which is one of the large-scale energy saving projects in Hong Kong. He believes that Engineers could provide a balanced design solution in order to achieve sustainable development and to meet the challenges of climate change. Through the delegation, Fred hopes to get an insight of energy policies and advanced technologies being developed in Iceland.

Ms. Cally CHUNG Ming Wai

Logistics Officers
Industrial Engineering and Engineering Management

Cally graduated from the City University of Hong Kong with Bachelor Degree in Industrial Engineering and Engineering Management. She currently works as a Graduate Engineer in the Hong Kong Logistics Technology & Systems Limited and involves in projects of logistics consulting, supply chain optimization and operation improvement. In the delegation, she expects to get more insights on the Hong Kong's environmental improvements, especially in the logistics and transportation discipline, and share green message to others to fight against climate change.

Ms. Maggie CHAN Man Fung

Logistics Officers
Structural Engineering

Maggie received her Master Degree in Structural Engineering from the University of Hong Kong and Bachelor Degree in Civil and Structural Engineering from the University of Science and Technology. She is working as an engineer in AECOM in building (structural) stream and her duties are mainly the engineering design of buildings, including tall residential buildings. She hopes that the buildings in Hong Kong can be built in a more sustainable and energy efficient way. She expects the delegation can widen her horizon and enrich her engineering skill technically especially in energy usage aspect of buildings.

Ms. Cola CHEUNG Man Chi

Overseas Liaison Officer
Civil Engineering

Cola graduated from the Hong Kong University of Science and Technology in Civil and Environmental Engineering. She started her career as a Graduate Engineer in MTR Corporation Limited and joined Engineering Graduate Training Scheme "A", Civil Engineering Discipline, after her graduation. She loves the nature and concerns about climate change. She joins the delegation as she wants to witness the advancement of technology and development of civilization in Iceland. To be responsible to our environment, she tries her best to implement conservation of energy, prevent pollution and reduce the consumption of natural resources when she performs her duties.

Mr. Michael CHAN Man Ho

Overseas Liaison Officer
Civil Engineering

Michael obtained his MSc in Civil Infrastructural Engineering and Management at the Hong Kong University of Science and Technology. He is currently working as an assistant engineer in Black and Veatch Hong Kong Limited. He works under the hydraulics team specializing in the drainage and sewerage division. His role includes conducting assessments associated with drainage and sewerage improvements works with consideration of the effect of climate change.
Michael believes the delegation to Iceland will be an invaluable experience to witness climate change first-hand, also to learn how Iceland is preparing for adaptation to the impacts of climate change.

Ms. Evelyn WAI Yi Kwan

Overseas Liaison Officer
Environmental Engineering

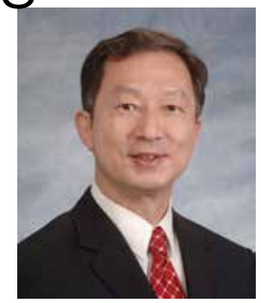
Evelyn obtained her Master Degree in Environmental Management and Engineering at the Hong Kong Polytechnic University in 2015, and is now working in MTR Corporation. She has worked as an environmental consultant, mainly responsible for environmental impact assessment on major infrastructure projects in Hong Kong. She has also obtained knowledge in supply chain sustainability through her previous work in apparel industry. Evelyn hopes to learn and gain experiences through the delegation to Iceland, to understand how the human activities have been affecting the natural environment and what have actually been done to solve the problems. She wants to show her efforts in combating climate change.

Advisors

Ir Joseph K H CHOI
President,
The HKIE

Ir CHOI graduated from the University of Aston, Birmingham, the UK, in Civil Engineering. He has over 44 years of multi-dimensional and multi-functional experience across contracting and client organisations in Hong Kong, Chinese Mainland, Taiwan, Macau and overseas.

Ir CHOI is a Fellow of the Hong Kong Institution of Engineers ("HKIE"). He is also the Chairman of the Administration Board, and an ex-officio member of the Planning Committee of the HKIE. Besides, Ir CHOI is also the Vice Chairman of Council of China's Foreign Trade of the China Council for the Promotion of International Trade, a member of the Engineers Registration Board, and a Fellow and Council Member of the Hong Kong Institution of Highways and Transportation.



Ir CHAN Chi Chiu,
Immediate Past President,
The HKIE

Ir CHAN, graduated from the University of Hong Kong, is a veteran professional civil engineer with experience in government departments including the then Highways Office and Drainage Division of the HKSAR Government, Water Supplies Department and Civil Engineering and Development Department.
Ir CHAN is very active in professional and community services. He is currently an Honorary Fellow of the Chartered Institution of Water and Environmental Management and an Adjunct Professor of the Department of Civil and Environmental Engineering at the Hong Kong University of Science and Technology.

Ir Thomas K C CHAN
Senior Vice President,
The HKIE

Ir CHAN received his education in Hong Kong and the United Kingdom. He has over 30 years of experience in the field of power and building services engineering. He is currently a Director of WSP | Parsons Brinckerhoff.

Ir CHAN has also been active in various professional and academic community services and has held the office of different engineering and educational institutions. He is currently the Senior Vice President of the Hong Kong Institution of Engineers.

Ir Dr. Philco N K Wong
Vice President,
The HKIE

Ir Dr. WONG is a civil engineer who has over 35 years of experience in large-scale infrastructure projects in Hong Kong, Mainland China and overseas. He is currently the Projects Director of MTR Corporation responsible for new railway projects from design to completion.
Ir Dr. Wong is enthusiastic in participating in professional and community services. He is a Fellow of the Hong Kong Institution of Engineers and the Institution of Civil Engineers in the United Kingdom, and a council member of Construction Industry Council. He is also a visiting professor of Tsinghua University in Beijing, and an adjunct professor of the Hong Kong Polytechnic University.

Ir Ringo S M YU
Vice President,
The HKIE

Ir Ringo YU is the Founder and Managing Director of Fraser Construction Co., Limited. He is a Professional Engineer and Fellow Engineer in the Civil, Geotechnical and Structural Disciplines of the Hong Kong Institution of Engineers. He is the Geotechnical Division Chairman (2010-11) of the HKIE and Vice President of the 68th Council (2015-16) of Hong Kong Construction Association. With over 30 years of experience working for both the consultants and contractors, Ir YU is actively serving the public in different public bodies: Construction Workers Registration Board, the Hong Kong Institution of Engineers and Employee Compensation Assistance Fund Board.

Ir Dr. Otto L T POON, BBS, OBE
Past President,
The HKIE

Ir Dr. Poon is a Chartered Engineer with over 50 years of E&M engineering experience. He is the Founder and Chairman of ATAL Engineering Group.
Over the years, he has been participating in public services both to the community and the engineering profession. He is a Past President of the Hong Kong Institution of Engineers, and Life President of Hong Kong Federation of Electrical and Mechanical Contractors.
Presently, he serves as the Chairperson of Lift and Escalator Safety Advisory Committee, Member of Governing Council of Hong Kong Quality Assurance Agency, and Director of the Hong Kong Green Building Council.

Ir Edmund K H LEUNG, SBS, OBE, JP
Past President,
The HKIE

Ir LEUNG, graduated from the University of Hong Kong in Mechanical Engineering, is a professional engineer with broad-based experience.
He has been active in public services, and has extensive involvements in engineering and education sectors. He is presently the Chairman of the Process Review Panel for the Financial Reporting Council and Deputy Chairman of The Hong Kong Institute of Directors. He had also served as the President of the Hong Kong Institution of Engineers.
He was conferred an OBE in 1996, appointed Justice of Peace in 1997, and awarded a Silver Bauhinia Star in 2009.

Ir Dr. C M KOON
Chairman, CPDC,
The HKIE

Ir Dr KOON has more than 35 years of experience in the building construction industry. He is a Fellow of the Hong Kong Institution of Engineers and a chartered engineer of UK institutions. He was the Chairman of Technical Committees for the Code of Practices on Foundations, Precast Concrete Construction, Loadings, Site Safety Supervision and Guidelines for Bamboo Scaffolds.
Ir Dr KOON also actively participates in community services. He is the Chairman of the Community Services Committee of the Hong Kong Institution of Engineers, and a member of the Engineers Registration Board.

Our Delegation Journey

18-24 March
Delegation Itinerary

- Day 1: Golden Circle Tour
- Day 2: Ice Cave Tour
- Day 3: Visit to University of Iceland
- Day 3: Visit to Orkugarður National Energy Authority
- Day 3: Northern Light Tour
- Day 4: Visit to Mannvit Engineering
- Day 4: Visit to Hellsheidi Geothermal Power Station
- Day 5: Visit to Ljófagoss Hydropower Station
- Day 5: Visit to Umhverfisstofnun Environment Agency
- Day 6: Visit to Icelandic Green Building Council
- Day 6: Visit to Blue Lagoon

Reykjavik

Ljósafossstöð Power Station

Geysir

Gullfoss Falls

Friðheimar

Blue Lagoon

Hellisheiðarvirkjun Geothermal Power Station

Skógafoss Waterfall

Reynisfjara black beach

Ice Caving

Jökulsárlón

Crystal Beach

Day 1: Golden Circle Tour

To appreciate natural resources available in Iceland and experience the impact of climate change in Iceland, our team participated in the Golden Circle tour and visited several renowned spots, namely the Friðheimar Greenhouse Cultivation Centre, Golden Waterfall, Geysir Geothermal Area and Thingvellir National Park.

Friðheimar Greenhouse Cultivation Centre

Despite the extreme cold climate in Iceland, the Friðheimar Greenhouse Cultivation Centre produces tomatoes all-year round using geothermal energy. The annual production of tomatoes is about 300 tons, which is about 18% of Iceland's total tomato consumption. The artificial lighting is powered by nearby hydroelectric and geothermal power stations. The visit deepened our understanding of utilization of renewable resources to assist daily life.

Golden Circle - Gullfoss Waterfall, Geysir and Thingvellir National Park

The Gullfoss Waterfall is an iconic waterfall in Iceland, which is fed by Iceland´s second biggest glacier, the Langjökull. The water plummets down 32 meters in two stages into a rugged canyon whose walls reach up to 70 meters in height. On a sunny day, a shimmering rainbow can be seen over the falls.

There are different sizes of geysers in Iceland. The Geysir and Strokkur are two famous attractions in the Golden Circle tour. The Geysir erupt sporadically, but when it does, it ejects a jet of steaming water, between 60-80 m high. The Strokkur which is located near the Geysir erupts frequently every 4-8 minutes. It is one of the very few natural geysers that erupts regularly with the steaming sprouting water going up to about 20 metres.

Thingvellir National Park is the most important site in Iceland in terms of history, culture and geology as it has the largest natural lake and tectonic plate boundaries of the Mid-Atlantic Ridge. The Thingvellir area is part of a fissure zone running through Iceland, being situated on the tectonic plate boundaries of the Mid-Atlantic Ridge.

The impact of climate change in Iceland is currently escalating. If the fragile ecosystem continues to be damaged by climatic stresses, the stunning natural landscapes will vanish soon. To protect these magnificent views, it is time for us to take action and fight against climate change.

Day 2: Ice Cave Tour

To further experience the climate as well as the beauty of Iceland, we participated in the Ice Cave tour in southern Iceland.

Skógafoss Waterfall

With an intimidating 60-meter drop, Skógafoss is one of Iceland's biggest and most famous waterfalls. Millions of gallons of glacier water melt to create a roaring flow all year long. Skógafoss is especially unique because its waters came directly from two glaciers, cascading over the sheer cliff. The mist was quite powerful when we got closer to the waterfall.

Reynisfjara black beach and basalt columns

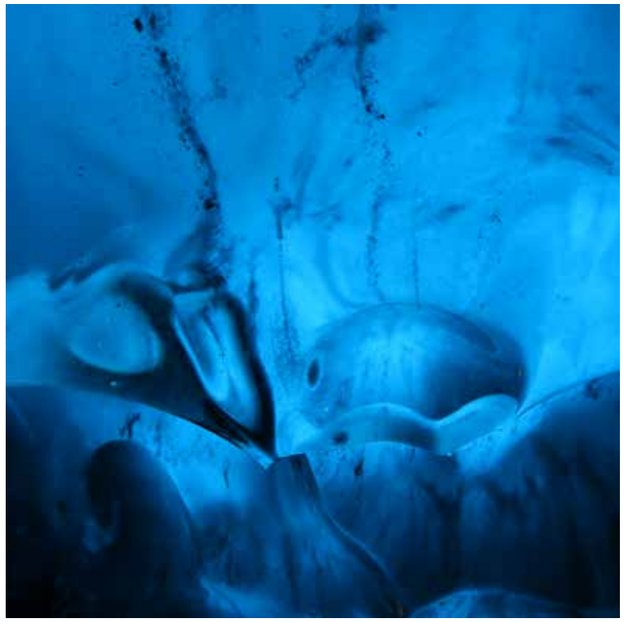
Reynisfjara presented a very different atmosphere and views compared with other beaches. Instead of a sandy colored beach, a black and white landscape greeted us, with the black color owing to the volcanic origins of the sand. At the moment we arrived, the wind was strong and the snow was heavy. The rough sea looked ferocious with its roaring waves, and the basalt columns were astonishing. The overall view was dramatic. Unfortunately we could not spend as much time as we liked because the wintry, icy gale was so strong that we felt we were almost being blown away.

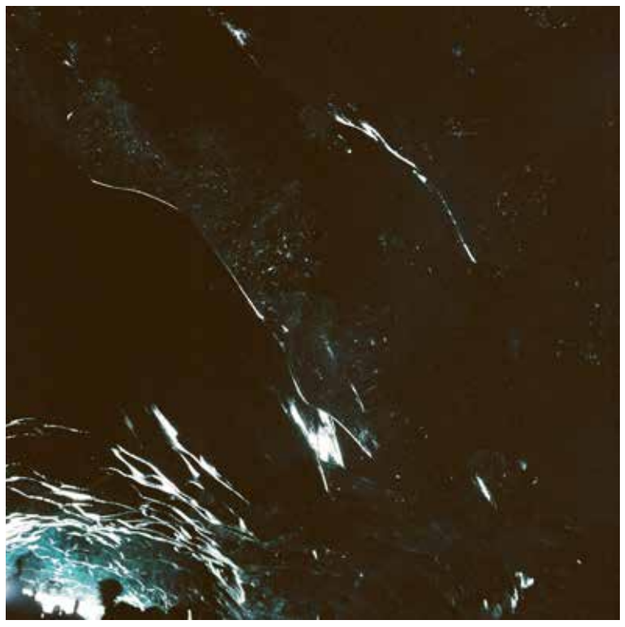
Jökulsárlón Glacier Lagoon and Crystal Beach

Jökulsárlón was a large glacial lake that was developed after the glacier started receding from the edge of the Atlantic Ocean. The lake had grown because of melting of the glaciers and had increased fourfold since in the 1970s. It recently became the deepest lake in Iceland. The icebergs came in two shades -- milky white and bright blue. When the ice fragmented from the lagoon and start flowing into the ocean, many of them would be pushed back onto the beach by the waves. These fragments varied in size and were incredibly crystal clear. They were amazing especially in stark contrast with the black sand of the beach.

Ice Caving

Chewing the way through rocks and ice by 4x4 trucks was part of the adventure when we visited the spectacular ice cave. Once we entered the ice cave we saw that the cave could be considered one of the wonders of the world and it was simply a once-in-a-lifetime experience. The icicles were hanging down to our shoulders and it was like standing under a frozen blue ocean. We stood there just enjoying the silence. The ice caves were natural structures that come and go with the seasons. They were born in the summer from the massive pressure of glacial melt-water and could only be accessed in the winter when they emptied. This is why the caves are never the same.





Day 3: University of Iceland

The first technical visit of the delegation was on the 21th March 2017 where the group took a trip to the University of Iceland. The institution had kindly arranged four speakers to share their research and areas of expertise, which was predominantly on the process of reducing carbon emissions as well as energy.

The first speaker, Professor Sigurdur Reynir Gislason, presented his research on the Carbfix project, which relates to the capture and storage of carbon. The essence of Carbfix is to store CO2 underground to minimise adverse impact to the environment. The conventional method of Carbfix is to separate CO2 from natural gas then compress it into a Utsira Formation Layer, where the CO2 would subsequently adhere to the bottom of a clay layer due to its buoyancy. However, this CO2 trapping method requires approximately 1million years to effectively eliminate the CO2 level. A modified method was developed to capture CO2, which involves addition of water with CO2. The CO2 and water reacts with a commonly found rock layer, basalt, forming solid crystals. Meanwhile, H2S can also be injected in the process to enhance the reaction. Since the removal H2S is a rather costly process, the modified Carbfix 2 is a process that kills two birds with one stone.

The second speaker, Professor Sigurður Magnús Garðarssonbriefly, introduced the Carbon Recycling International (CRI), an Icelandic renewable methanol company. It uses an innovative methanol technology, Emissions-to-Liquids (TM), which involves the direct conversion of carbon dioxide into methanol and purification of industrial flue gas by water electrolysers. The production cycle is designed to be zero carbon emission and environmentally friendly. The methanol produced have a wide range of applications, including fuel for vehicles, and Iceland currently has a small fleet of methanol-fuelled vehicles.

The third and fourth speaker, Professor Brynhildur Davidsdottir and Ms Gudbjorj H. Oskarsdottir, both presented their research on energy. Their research look into climate change at a global scale, including development of sustainability indicators of energy systems, development of system dynamics models of energy systems in Iceland and comparison of the energy systems with other low carbon systems. The session ended with presentation on the mitigation and adaptation measures for climate change and the speaker discussed the blue-green growth in Nordic countries.

The fruitful exchange with University of Iceland had enable the group to understand more on the mitigation and adaptation measures that Iceland is adopting in combating climate change.

Day 3: Orkustofnun National Energy Authority

The second technical visit was to the Orkustofnun National Energy Authority on the afternoon of 21st March. The Orkustofnun National Energy Authority is a government agency under the Ministry of Industries and Innovation. Its responsibilities mainly include legislative advice on energy issues, licensing of energy development and regulation of electrical systems.

Five speakers were arranged for the presentation. Skúli Thoroddsen, the legal advisor, first introduced the national role of the organization. He mentioned that the Iceland government has developed a Master Plan for geothermal and hydropower resources in Iceland, stating that all proposed projects shall be evaluated on energy efficiency, economics and environmental impact. The renewable energy master plan process, from proposal stage to licensing and start-up of power plants, was demonstrated in brief.

Jónas Ketilsson, the Senior Manager - Deputy Director General, then continued on the energy development in Iceland. He showed us the current energy use and supply in Iceland, and emphasized the benefits of renewable energy in power sustainability. Particularly, the utilisation of geothermal energy has achieved great economic benefits in district heating.

On electricity regulation, Dr. Silja Rán Sigurðardóttir, the Project Manager of the Electricity Regulation & Economy, shared with us the policy incentives of network regulation and the government's regulation of the electricity market. She also explained the concepts of the conventional Revenue Cap Regulation and the new regulation adopted lately.

It is understood that international cooperation is the key to promoting energy research. The last two speakers, Hjalti Páll Ingólfsson from the GEOTHERMICA project office and Ingimar Guðni Haraldsson, the Deputy Director of UNU-GTP, both shared the global vision of Iceland in geothermal energy development through the engagement in GEOTHERMICA and the United Nations University Geothermal Training Program (UNU-GTP). The former brings together European national geothermal developments while the latter helps developing countries in geothermal capacity building.

Through the sharing sessions, the group had gained better understanding of the energy objectives of the Iceland government. The government has taken a leading role in energy development at both national and international level, and the country has spared no effort in promoting a fossil fuel-free and energy-wise world.

Day 3: Northern Light

The beautiful bright dancing lights of the aurora (sometimes referred to as northern lights) are the collisions between electrically charged particles in the atmosphere. It happens when the gaseous particles in the Earth's atmosphere interacts with charged particles released from the sun's atmosphere. Aurora can appear in various colours, including green, yellow, red, blue and violet. The variation in colour are due to the type of gas particles are colliding. Pale yellowish green, which is produced by the collision of oxygen molecules located about 100km above the earth, is the most common auroral colour.

Aurora are usually seen in the high latitude regions, including the Arctic and Antarctic. Iceland, as a country which is geographically near the Arctic Circle, is one of the most ideal places to watch the aurora. Besides the geographical location, population density is one of the key factors in influencing how easy it is to watch the aurora. Areas that are not affected by light pollution are the best places to watch the aurora. Due to its low population density, as well as its high latitude, Iceland is an ideal place for watching the aurora.

Watching a good aurora show was all about luck. Weather is one of the critical issues. Although the team were frequently checking the weather in Iceland while planning for the tour, plans fall behind changes, and the weather was not good enough for the aurora show when we arrived.

Watching the aurora is just like life. Success is when opportunity meets preparation. If we did not prepare, we would not be able to catch any opportunity.

Day 4: Visit to Mannvit Engineering

We visited Mannvit Engineering on 22 March 2017. It is the largest engineering firm in Iceland where their core fields of services are renewable energy & transmission, industry and oil & gas, and infrastructure. Its headquarters is in Iceland with overseas offices in Norway, United Kingdom, Germany, Greenland, Chile and Hungary. In the beginning, we had a brief presentation about the company such as its leadership in geothermal energy and hydroelectric power. An organization chart was shown and their services were described. It ended with various project references, and the Hellisheidi Geothermal Power Plant which is one of the world's largest geothermal energy plants was shown in detail.

As Mannvit is one of the leaders in geothermal energy, a brief introduction of geothermal energy is given including its advantages, methods of extraction and a description of the geothermal power plant. They introduced the geothermal system in Reykjavik, where 25% of energy consumption is given by geothermal power, and explained how the plant operates there. Not only did they design the plants in Iceland, they also have a geothermal plant in California.

Last but not least, the speakers discussed the company culture. Their lifestyles are steered towards work-life balance and flexible working hours. The Icelandic engineering industry is also briefly introduced -- in Iceland, most people prefer going into software and programming rather than engineering.

Through the visit, we observed the difference in the engineering industry between Hong Kong and Iceland including its specialties and operations. Also, their work-life balance culture is an aspiration for young engineers. Although Hong Kong might not be suitable for application of geothermal energy, it has been an insightful experience and acts as valuable inspiration.

Day 4: Technical Visit to Hellisheidi Geothermal Plant

Being owned by ON Power, the Hellisheidi Geothermal plant provides electricity and hot water for space heating.

The operation of the plant was firstly introduced during the guided visit. Fluid from the drilled boreholes rises under high pressure and passes through the separator where the steam and water are separated. After that, the steam enters the turbine to generate electricity, whereas the water is diverted to a separate system for space heating. The heated water travels 27km to Reykjavik, with the average temperature drop less than 2oC. Water will be stored at high elevations for district heating, such that water flow through the pipelines by gravity, and no further energy is needed.

There are 3 pipes designed for sustainable operation at the plant. The three processes involved are:

1. Cold water extraction – cold water from the ground is extracted and heated for space heating
2. 50/50 liquid and gas extraction – fluid consists of half liquid and half gas is extracted from the ground for space heating and electricity generation
3. Reinjection – extra water generated during plant operation is injected back into the ground to maintain the water content in the ground

After the explanation of the plant operation, the delegates visited the plant room, where the separator and turbines were located. There are 7 turbines in the plant, each with power efficiency of around 90-95%. The Carbfix and Sulfix Projects were also briefly explained, in which 60% of sulfur and 30% carbon dioxide were currently removed from the flue gas and injected into the ground.

After the visit, the delegates gained insights on the geothermal power operation in Iceland. It is a valuable chance to be able to look at the onsite operations since Hong Kong does not have such a facility. The delegates also appreciated the environmental focus of the power company, whose target is 100% injection of emitted pollutants to the ground in the future to reduce the environmental impacts generated by plant operation.

Day 5: Ljofagoss Hydropower Station

The Ljofagoss Hydropower Station is owned by a the Landsvirkjun which is the largest electricity generator in Iceland and renewable energy producer in Europe. The station is located on the river bank of the Ljosifoss waterfall, and the water is piped to its turbine and back out downriver.

At the beginning of the visit, background information of the plant was introduced. The station was developed by 2 phases. The first phase of the station went on line in 1937 in using two turbines with a combined installed capacity of 8.8 MW. A third turbine with a capacity of 5.5 MW was installed in 1944. The technician guided us on a tour of the operation floor and explained the operation of turbines. The turbines run for 24 hours, except perform maintenance and cleaning work. The maintenance work would be performed with the aid of crane and different sizes of engineering tool.

To experience the real working environment in the station, the plant manager brought us to the underground tunnel as to show us the water streamlines and how the site was formed. The freshwater passed through the tunnel to generate electricity and return to the stream. This freshwater power station supply is stable year-around. After the site visit, we went an interactive exhibition centre, which allowed us to have an better overview on the renewable energy in Iceland.

Day 5: The Environment Agency of Iceland - Umhverfisstofnun

The Umhverfisstofnun was formed by merging several agencies of comparable visions in 2003. The role of the Environment Agency is to protect the public welfare of Icelanders by promoting healthy environment, environmental protection and sustainable use of natural resources.

Three presentations were delivered during the visit. The organization structure was first introduced. There were four departments under the Environmental Agency of Iceland, namely, Sustainability, Integration, Nature and Services. Department for Sustainability is responsible for chemicals, consumers and hunting, while Department for Integration was responsible for general inspection, impact assessment and inventory. Department for Nature consisted of air pollution team, conservation area team and ocean and water team, while Department for Services consisted of communication team, information team and operations team.

Following the brief introduction of the organization, they proceeded to their effort in minimising food waste in Iceland, which is also a serious problem for Hong Kong. They presented the campaign they held over the Internet, which gives tips to families about food preservation. For example, they asked people to plan before shopping, recommended proper ways for food storage and suggested ideas for using zip lock bags. Although these tips looked trivial, they were useful to housewives. In the future, they would focus on collaborating with households and restaurants about food waste collection for biodiesel production.

In the end, the agency shared about their views and actions on climate change in Iceland. They are currently preparing a national inventory report to the United Nations Framework Convention on Climate Change. They estimated the emissions as well as planned to reduce the hydrogen sulphide from plants. In addition, they were strengthening international cooperation regarding quality of emission factors. Like tackling other problems, they faced numerous challenges in combating climate change. One of the major headaches was changing consumer behaviour. Some people are ignorant of the damages they make to the environment. It is a long battle against irresponsible consumer behaviour.

Icelanders are increasingly concerned about climate change. Although we are far from Iceland geographically, we are still able to cooperate in protecting our lovely planet and learn from each other about useful green measures.

Day 6: Technical Visit to Icelandic Green Building Council

Our last technical visit in Iceland was the technical sharing with the Icelandic Green Building Council (IGBC) in Reykjavik. The sharing started with an introduction of HKIE, HKIE-YMC, as well as our delegation's background, theme of studies and delegates profile by our manager, Ir Ambrose Chen.

The Managing Director of IGBC, Ms. Þórhildur Fjóla Kristjánsdóttir followed with an introduction of their council and their connections with the Nordic Built Cooperation between Sweden, Norway, Denmark and Iceland in green building development. She explained that the Council is closely collaborating with the Icelandic Government to transform with more green building policies and regulation.

She mentioned that Iceland was starting to promote green building certification and allow more public involvement similar to Norway and the United Kingdom. However, she pointed out that the Building Research Establishment Environmental Assessment Method (BREEAM) from U.K. might not be entirely appropriate for Iceland and they are looking for modification in order to have a more suitable adaptation in Iceland. Compared with the growth in green certification of Hong Kong, we are certainly not lagging behind as we have developed our own Building Environmental Assessment Method (BEAM) right after the U.K.

Fjóla continued to share different green elements of energy consumption in Iceland. Using the examples from Norway, she compared the electric vehicle usage, space heating, heat pump applications and circular economy status between the cities. Fjóla believed Iceland will quickly catch up with the progress in adopting the sustainable measures as Norway. In addition to renewable energy development, she raised that it is difficult for Iceland to develop solar energy due to limited sunlight, but it is good that Iceland is rich in geothermal energy, providing an alternative for cleaner energy.

Through the sharing, we understood Iceland had started to promote green building for schools and national institutions. They had also planned ahead for green city development with reference to Norway. Although they are still facing some challenges in providing financial incentives, they are striving to create a better living environment for their country.

Day 6: Blue Lagoon

To mark the end of the Iceland trip, the Delegation visited the Blue Lagoon Geothermal Spa on the last day. The Blue Lagoon, one of the most visited attractions in Iceland, is recognized as one of the wonders of the world for its unique geothermal gift of nature. Over the years, it has been innovative in harnessing green resources from nature to develop exclusive spa service and products.

The Blue Lagoon is a man-made lagoon sited in an 800-year-old lava field at Grindavík on the Reykjanes Peninsula, southwestern Iceland, where water is fed from the nearby geothermal power plant Svartsengi. The geothermal water comes from 2,000m deep below the ground, where seawater and freshwater combine at extreme temperatures. The water is then obtained through drilling holes at the Svartsengi Geothermal Power Plant to produce hot water and energy for the nearby households.

The geothermal water is fed into the Blue Lagoon for recreational use. The water features a unique composition of mineral rich content - silica, algae and minerals, and is known to be great for the skin. Its appealing colour of blue owes to silica and the way it reflects sunlight. Based on the exclusive features of the geothermal water, silica mud masks and algae masks are provided as natural spa products at the Blue Lagoon.

The group spent a nice afternoon relaxing and enjoying the warm water. Surrounded by astonishing black lava rocks and soaked in fascinating clear steam, the group was amazed by the legacy of nature behind. Eyes closed, you could hardly forget the beauty of the breathtaking scenery. Though all good things must come to an end, the Blue Lagoon definitely marked a memorable ending to this fruitful and fabulous journey.

Local Series

To further study the situation of climate change in Hong Kong, as well as to demonstrate to our young members the works done by Hong Kong on the topic, the HKIE-YMC jointly organised 10 visits and seminars with CPDC, ranging from policy overview, scientific analysis as well as implication of the recent Paris agreement towards the engineering industry etc..

The local series provide our delegates insights on how climate change affects Hong Kong, and how Hong Kong should deal with the situaion.

Moreover, the delegates conducted a series of interviews with some environmental leaders with an aim to seek their views on the ultimate question: “What Hong Kong Engineers should do to combat climate change?”

Summary of Local Events

Date	Topic	Speaker
21 January 2017	Technical Visit to Jockey Club Museum of Climate Change (MoCC)	NA
11 Feburary 2017	Technical Visit to the Solar Farm at DSD Siu Ho Wan Sewage Treatment Works	NA
2 March 2017	Seminar on Scientific Overview of Climate Change	Mr. SHAM Fu-cheung, Chief Experimental Officer, Hong Kong Observatory
9 March 2017	Seminar on Policy Overview on Climate Change	Mr. WONG Kam-sing, GBS, JP, Secretary for the Environment, Environment Bureau
11 March 2017	Technical Visit to Hydropower Plant at WSD	NA
14 March 2017	Seminar on Global Policies and Actions on Climate Change	Dr. Jeanne NG, Director – Group Sustainability, CLP Power Hong Kong Limited
10 April 2017	Seminar on The latest Green Building development	Ir Conrad WONG Tin-cheung, BBS, JP, Vice Chairman, Yau Lee Holdings Limited
18 April 2017	Seminar on Paris Agreement and its Implications on the Engineering Industry	Ir Dr Otto POON Lok-to, BBS, OBE, Founder of ATAL Engineering Ltd
26 April 2017	Seminar on Hong Kong 2030+ and Climate Change	Ms. Amy CHEUNG Yi-mei, Assistant Director of Planning/ Territorial, Planning Department
29 April 2017	Technical Visit to T-Park	NA

Scientific Evidence of Climate Change

The local series started with basics on climate change and the latest development on the topic. The delegates and other young members could glance through the definition of climate change, and how it affects our daily lives in both a global and local perspective.

<u>Technical Visit to Jockey Club Museum of Climate Change (MoCC)</u>

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The Jockey Club Museum of Climate Change (MoCC) at the Chinese University of Hong Kong is the territory's first public museum that addresses the issue of climate change. The MoCC displayed valuable specimens, pictures, interactive simulators and multimedia on global warming, with an aim to arouse public awareness of the severe impacts of climate change on individuals and the world.

The museum was divided into four sections, namely, Polar Gallery, Remote Sensing and Environmental Monitoring, Search and Innovation at CUHK and the Hong Kong Jockey Club Green Gallery. Polar Gallery offered a vivid demonstration of marine species, land species and vegetation in the polar regions. The exhibits in Polar Gallery displayed the valuable collection from Dr. Rebecca Lee from the "Three Poles", i.e. the North Pole, the South Pole and Mount Everest. The second station, Remote Sensing and Environmental Monitoring, presented the satellite images, virtual simulations and geographic information of the world's changing atmosphere, ocean and land. Participants can gain a more comprehensive knowledge of the practical impacts of climate change on daily lives. Research and Innovation at CUHK, as the name suggested, showed CUHK's research results including biofuel, photovoltaic solar energy and sustainable urban design. Participants learned about the latest research developments and technological advances in combating climate change. The journey ended at the Hong Kong Jockey Club Green Gallery. The gallery showed some of the major Jockey Club initiatives that inspired the public in pursuing green living.

Mr. Sham stressed the meaning of the Paris Agreement and emphasized the importance of joint effort paid by different countries to achieve the same goal

Climate change is not merely a normal natural phenomenon. There is an inseparable relationship between global warming and human activities. A successful green community could be sustained if everyone commits to green living. Taking part in the technical visit, participants gained a deeper understanding of how climate change affect our daily lives and the importance of fighting against global warming.

<u>Climate Change : a Scientific Overview</u>

The Hong Kong Observatory (HKO) has been studying the causes, the global and local impact and the projection of climate change. The research of HKO formed a strong scientific base for climate change related policies and planning. The delegation team therefore organised a seminar with HKO to present climate change to our young engineers in a scientific perspective.

Mr. Sham Fu-cheung, Chief Experimental Officer of HKO, started the seminar by showing the audience the myriad scientific consensus supporting the presence of climate change. Ocean warming, rising sea levels, higher values of mean temperature, more extreme rainfall resulting directly from the changing climate are physical signals of climate change in Hong Kong. As a part of the world, Hong Kong could not be immune to the impacts of global warming. Mr. Sham continued to highlight the fact that in recent years, Hong Kong has been facing more frequent heat extremes, rainfall events, as well as other extreme weather events under the warming climate. Abnormal weather is expected to be more frequent in the near future. Climate models indicated that Hong Kong will have more hot nights and very hot days, more extremely wet years, and a rise of mean sea level.

In addition, Mr. Sham stressed the meaning of the Paris Agreement and emphasized the importance of joint effort paid by different countries to achieve the same goal – "To keep global temperature below 2 °C relative to pre-industrial levels by the end of this century". Indeed, Hong Kong has an important role to play in this situation. Some mitigation and adaptation measures, such as the demountable flood barrier at Tai O, have shown the government's ambition in fighting climate change.

Hong Kong's Action on Climate Change

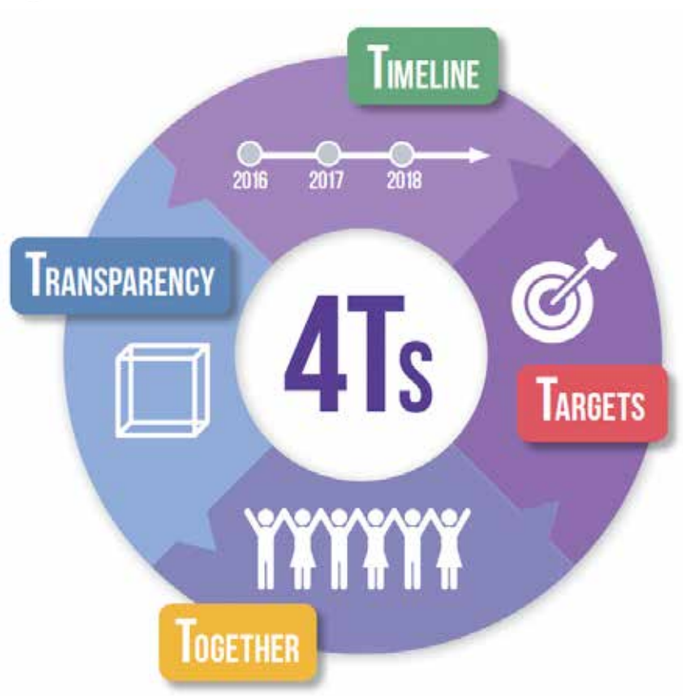
Now with the background of Climate Change, the delegates organised a series of seminars / visits to reveal what Hong Kong has been doing and planning in order to combat climate change. Also, some latest development on green building and sustainability-oriented infrastructure were also introduced.

Climate Change – A Policy Overview

To ride on the milestone of Paris Agreement, the Environment Bureau has announced the "Hong Kong's Climate Action Plan 2030+" to outline the Government's long-term plan in combating climate change and push ahead new carbon emissions reduction target for 2030. The announced carbon reduction plan has set an ambitious carbon intensity target of 65% to 70% reduction by 2030 from 2005 level.

As an introduction, Mr. WONG Kam-sing, Secretary for the Environment, recapped the significance of the Paris Agreement and the role of Hong Kong in it. Hong Kong, as acceded to the Paris Agreement under the obligation of China, has developed the 4Ts, i.e. Timeline, Transparency, Targets and Together, to operationalise its action plans. Beyond the well-defined targets and timelines, a transparent mechanism to track efforts and multilateral collaboration are essential elements to facilitate implementation.

Regarding the action plans, Mr. WONG's presentation mainly focused on 3 key aspects: mitigation, adaptation and resilience. Mitigation includes phasing down coal for electricity generation, optimizing renewable energy, promoting building energy efficiency, and encouraging green transport. Adaptation focused on improving substantial infrastructure works such as drainage and flood management, city planning and conservation of biodiversity in the context of climate change. He also advised that the city should strengthen its community-wide climate-readiness in response to the extreme weather in order to ensure climate resilience.



Beyond the well-defined targets and timelines, a transparent mechanism to track efforts and multilateral collaboration are essential elements to facilitate implementation. (Environmental Bureau, 2017)

At last, Mr. WONG highlighted the importance of public engagement in protection of our planet earth. He encouraged participants to make livability improvements to avoid being a "Big Waster", such that Hong Kong can make a transformation towards low-carbon.

The seminar had provided participants a fruitful overview of the government's vision against climate change, letting participants realise their role in taking the next step.

Hong Kong 2030+ and Climate Change

"Hong Kong 2030+: Towards a Planning Vision and Strategy transcending 2030" (HK2030+) is a consultation study aimed to make Hong Kong a more liveable, and sustainable city through urban planning. As part of the introduction, Ms. Amy CHEUNG, Assistant Director of Planning Department, presented the vision, planning goals, the three conceptual building blocks and the spatial framework of the Hong Kong 2030+. The concept of strategic planning context, which is followed in a hierarchy of global megatrends, regional dimensions and local context, were also presented.

There are a few key challenges that Hong Kong is facing, including scarce developable land, mobility in a compact high density city, need for improving/ building new infrastructure, energy consumption and the impact of climate change. In order to overcome these challenges, Ms. CHEUNG said a smart, green and resilient strategy shall be adopted in the planning initiatives. Thus, the planning directions is focused on creating a livable and green city with the help of infrastructure enhancement on water resources, waste treatment, urban planning and transport planning. She also presented the five key strategic directions in detail.

At the end of the seminar, Ms. CHEUNG stressed that climate change has become a heavily weighted factor when planning and indeed, has imposed some challenges on Hong Kong's planning works. However, challenges always come with opportunities. The co-benefits of taking the mitigation and adaptation measures will help creating a more green and livable city.

The latest Green Building development

COP21 and the Paris climate agreement marked a milestone on the global fight against climate change, it addresses four key areas of temperatures, finance, differentiation between developed and developing countries, and emissions objectives for all participating countries to act on. In Hong Kong, buildings accounted for 90% of the total electricity consumption, and so a move towards green buildings which are environmentally responsible and resource-efficient throughout its life-cycle is essential. Ir Conrad WONG introduced us to several main aspects in green building designs, including thermal comfort, daylighting and lighting that can improve productivity etc., he also emphasised that the Hong Kong Green Building Council has a "30/30" target – 30% absolute reduction in electricity consumption in buildings by 2030.

Building Environmental Assessment Method (BEAM), a voluntary green building assessment scheme developed locally and suitable for compact high-rise cityscape in sub-tropical areas was discussed. BEAM Plus addresses site & material aspects, energy & water use, indoor environmental quality and innovations. Example BEAM Plus-certified buildings are Hong Kong Science Park Phase 3, the Hysan Place and Hang Seng Management College. Conrad further explained how the recent BEAM Plus Neighbourhood Assessment Tool further incorporates community aspects to promote sustainable and green communities. Hong

The HK2030+ aims to create a more sustainable and liveable city (Planning Department, 2016)

Kong also has a green building product accreditation scheme, HK G-PASS. Together with energy benchmarking tools, a comprehensive building assessment system is in place.

Ir WONG presented several case studies on green buildings such as the Holiday Inn Express Hong Kong, SoHo. Some key green features include application of Low-E Glass to block solar heat, use of motorized roller blind system to reduce cooling load, solar hot water collection system, heat pump, peltier headboard for personal cooling, high efficiency equipment such as energy saving fan coil unit and LEDs. An intelligent control system for on-line energy management and monitoring was also used. Energy saving achieved is 59%.

Conrad concluded the seminar with an inspiring message – "green to gold". Sustainability is not just a cost on us, but rather an opportunity with rewards if we put efforts to achieve.

<u>Technical Visit to Hydropower Plant at WSD Tuen Mun Water Treatment Works</u>

The hydropower plant at Water Services Department (WSD) Tuen Mun Water Treatment Works (TMWTW) has a maximum design capacity of 500 kW. It is one of the largest renewable energy projects of WSD in Hong Kong.

The visit began with a briefing session by Mr. Nelson WU, describing the water treatment processes of the plant. Details of electricity generation, as well as renewable energy development of WSD, were then explained by Ir Samuel Kam-Shan CHUNG and Mr. Samuel Ho-Leung HO.

WSD has been implementing various renewable energy systems, including solar panels in catchwater channels at the Wilson Trail and a wave-powered screen cleaner. The participants were particularly interested in the latest Pilot Floating Photovoltaics System in Shek Pik Reservoir, which could produce a rated power output of 100kW.

After that, the participants paid a visit to the hydropower plant. The power plant receives water from Tai Lam Chung Reservoir at a high level (38-61mPD) and when water reaches the TMWTW at a lower level (~20mPD), a sufficient water head could maintain a high water pressure for a stable water flow operation. Part of the raw water will first pass through the isolation valve, then go through the water turbine to generate electricity for the WTW, and enter the water reception tank for treatment afterwards. The rest of the raw water would directly pass through the suction control valve and enter the water reception tank, followed by the normal water treatment processes before discharge. Due to the configuration of the plant, reverse pump turbine was adopted for converting kinetic energy to electrical energy.

The group then visited the hydropower plant room where they could look at the water turbine and the generator. The plant operation was also shown on the monitoring panels. The group also had a guided walk around the TMWTW to understand the water treatment process.

<u>Technical Visit to the Solar Farm at DSD Siu Ho Wan Sewage Treatment Works</u>

The Siu Ho Wan Solar Farm was commissioned on 9 December 2016. It has a footprint of approximately 11,000m2 with 4,237 panels, which makes it the largest solar farm in Hong Kong. The annual electricity generation is approximately 1,100,000kWh. The electricity generated from the solar farm is used for the operation of SHW STW.

The visit began with a briefing session conducted by Ir Francis Yuen from CLP and Mr. David Ho from DSD. They gave an introduction to the project background, the type of photovoltaic (PV) panel used, and the work sequence, followed by a Q&A session. The participants showed much interest and raised some interesting questions to our speakers.

After that, the group was brought to the solar farm exhibition centre where the participants had a chance to have a closer look at the PV panels used in the farm. The panels used is of the polycrystalline, dual-glass frameless type. The solar panels are the first of its type in Hong Kong, with the frameless technology used, the solar panels are claimed to achieve maximum sunlight receiving area. The speakers also introduced other facilities in the room including displays on the solar system operation principle, live videos and readings of the farm and a PV system experiment comparing the efficiency of various types of PV panels.

Finally, the group was brought to the solar farm areas where the speakers guided the participants to have a closer look at the farm and shared more details on the construction, operation and maintenance of the farm.

Technical Visit to T-Park

T-Park is Hong Kong's milestone towards sustainable city, being the very first self-sustained sludge treatment facility in the community. With a treatment capacity of up to 2000 tonnes of sludge per day, the multifunctional facility could also generate electricity, to not only provide in-house services such as desalination, education centre etc., but to feed back electricity to the community through this waste-to-energy technology.

The visit began with an introductory video of T-Park in the T-Theatre which has given our participants an overview of the facility. The main feature of T-Park is that it is a self-sustained facility, with combined advanced technologies for various services, including recreational, educational and ecological.

The group were then guided through T-Hall where they learned about the sludge treatment process through a range of innovative and interactive exhibits. Using sewage sludge collected from 11 major sewage treatment plant as fuel, heat energy produced from the sludge incineration process is recovered and converted into electricity. 2000 tonnes of sludge are burnt at 850°C daily. The result is 90% reduction in size which can ease the loading of Hong Kong's landfill. Highly effective flue gas cleaning system is used to remove particulates and pollutants in the flue gas. There is an advanced desalination plant that is used to purify seawater drawn from the nearby Deep Bay to provide potable and process water while rainwater is collected for non-potable use.

At the T-Gallery, the visitors viewed the operations of the facility through designated windows and a series of real-size models was displayed for the visitors to compare in terms of the scale and complexity.

Last but not least, visitors had the chance to use the environmental-friendly furniture. They were mainly salvaged fenders from the old Wan Chai Ferry Pier that were upcycled. All in all, the T-Park showcased Hong Kong's ambition in becoming a sustainable city.

Climate Change in Engineering Industry

Lastly, to answer the question: “What Engineers should possess to help with sustainable development of the city, and what engineers should do to contribute to the fight against climate change?” The delegation team organised seminars to invite environmental leaders to discuss the world trend on the topic, and what implications those trends might affect the engineering industry, in particular the local ones.

<u>Global Policies and Actions on Climate Change</u>

Economy, environment and social factors are the key elements towards sustainable development. Dr. Jeanne Ng, Director of Group Sustainability of CLP Power Hong Kong Limited (CLP) demonstrated a way to balance those key elements using her company policy and operation as an example. She shared that every policy is singularly dimensioned, such that it could be dangerous when we only focus on promoting a unique policy, and it could failed if we forget about other parameters and lead to unintended consequences. Taking the example of CLP’s product, electricity, it is essential for our daily livelihoods but invisible in public engagement.

She continued with talking about the difficulties in combating climate change and putting carbon reductions into practice in Hong Kong. For example, we lack resources and funding for carbon capture and storage projects, and there is only indirect impact from the policy and regulations. In addition, Jeanne shared about the energy reserves and usage in Hong Kong -- we rely on the import of coal, oil and natural gas in electricity production. She stated that Hong Kong has insufficient land and lack the means to further promote renewable energy. She expected to see some advanced application in solar energy in buildings since it seems to be the most feasible renewable energy that we can harness. She also believed nuclear energy should definitely be used in transition as we move towards adopting renewables in Hong Kong.

“People are in the hearts of the sustainability” said Jeanne. It is important to engage with stakeholders in carrying out any policy, and especially for environmental protection. It is certainly not proactive if we only care about the environment when it starts threatening our health. Everybody needs to be involved in tackling climate change. At the end of the seminar, Jeanne showed her respect and appreciation to the engineering industry for providing solutions to our daily problems.

<u>Paris Agreement and its Implications on the Engineering Industry</u>

Engineers certainly play an important role in climate change, and the Paris Agreement affects the way forward in the fight against climate change, for the world as well as for the engineering industry. In this seminar, Ir Dr. Otto Poon introduced to us the brief outcomes of the Paris Agreement and the current state of affairs.

The seminar consisted of three parts. The first part is about the history of United Nations Framework Convention on Climate Change and the development of global action against Climate Change. Although the Intergovernmental Panel on Climate Change was established in 1989, climate change was not a widely recognised global issue until the very recent COP21. Despite 25 year's effort, according to Ir Dr. Poon, only little progress had been made up to 2014 on climate change. However, a breakthrough was achieved in the 2015 Paris Climate Conference, also known as COP21. 175 countries signed the “Paris Agreement” in the Headquarters of the United Nations on 23 April 2016. It was anticipated by Ir Dr. Poon that the coming decades would be a decade of transition and changes would mainly happen in the energy sectors.

Ir Dr. Poon continued to analyse the current status of climate change. President Obama took great actions to slash carbon emissions with the Clean Power Plan. However, his successor President Trump regarded global warming as a hoax and argued that the Paris Agreement was unfair to the US. On 28 March 2017, President Trump signed an executive order calling on every federal agency to loosen the regulatory reins on fossil fuel industries, a significant declaration of the administration's intent to retreat from promised actions on climate change. Nonetheless, Ir Dr. Poon believes the EU, India and China would continue to abide to their pledges made in COP21.

Locally, Ir Dr. Poon also gave us some insight on Hong Kong's Climate Action Plan 2030+. The Climate Action Plan 2030+ is a report setting out Hong Kong's new carbon emission reduction target and concerted plans for 2030, which incorporates mitigation, adaptation and resilience measures against climate change.

Innovative solutions from engineers are needed to enable further reductions in anthropogenic carbon emissions and to enhance resilience of city infrastructure. At the end of the presentation, Ir Dr. Poon exhorted the participants to make every effort to protect our shared environment.

Mr. WONG Kam-sing, GBS, JP
Secretary for the Environment, Environment Bureau

KS WONG shared his view on several environmental issues. He first shared with us the Hong Kong policy on green transportation. KS pointed out that Hong Kong's unique character makes it available to become a walkable city. Therefore on top of green transportation such a electric cars or cycling, walking should become a more dominant role, and Hong Kong should develop with improved accessibility, connectivity and walkability to achieve this goal. We also discussed the possibility of feed-in tariff. With the renew of the scheme of control with the power companies, KS believed that it is a good opportunity to implement the feed-in-tariff which can overcome the problem of price acceptance gap and complex rental systems, and it will lay the foundations for the development of renewable energy. Lastly, KS urged young engineers to promote awareness of environmental issues. Communication and bridging gaps are always arduous tasks. Engineers could use their professionalism to reach out to all levels of society.

Dr. Jeanne NG
Director – Group Sustainability of CLP Power Hong Kong Limited

Our interview with Dr. Jeanne NG focused on the macro perspective of the local engineering industry as well as our interactions with other industries. Dr. NG acknowledged the great work that Engineers have done to combat climate change and emphasised that engineers have been the professional group that generate excellent solutions. As the problems that humans are facing have increased in complexity, Dr. NG believed that more collaborations and information exchanges among expert groups are needed.

Ir Conrad WONG Tin-cheung, BBS, JP
Vice Chairman of Yau Lee Holdings Limited

Ir Conrad WONG shared with us his view on what is missing in Hong Kong engineering industry. He pointed out the lack of considerations in users' behavioural patterns and mindsets in current engineering designs. Engineers shall think one more step ahead so that their designs can encourage users to reduce their energy consumption.

Ir WONG also acknowledged Engineers as a convincing group with professional knowledge. Engineers shall therefore act as a bridge to link between the public, the stakeholders and the decision makers to facilitate green policies implementations.

Ir Dr Otto POON Lok-to, BBS, OBE,
Founder of ATAL Engineering Ltd.

Ir Dr Otto Poon shared with us the influence of Paris Agreement and his view on the development of environment industries. He opined that the Paris Agreement act as a catalyst to speed up the momentum on green buildings, in particular design and resource efficiency. There are more and more incentive schemes aimed to reduced energy consumption in Hong Kong, which were a much effective measures than legislation and enforcement. Ir Poon concluded the sharing by encouraging the young engineers to always raise our awareness to help developing new technologies, secure water and food supply and protect our shared environment with our own talents voluntarily. From his illustration of Paris Agreement and explanation on Hong Kong's Climate Action Plan 2030+, we shall allow mitigation measures before adaption to combat the adverse effects on climate change, since we should always act before things happen.

Ms. Amy CHEUNG Yi Mei
Assistant Director of Planning / Territorial, Planning Department

Our conversation with Amy CHEUNG was primarily about mainstreaming.
Instead of a leading role, Amy was responsible for assisting Environmental Bureau to achieve the carbon reduction target in terms of compacting global warming. Amy mentioned that there was inseparable relations between planners and engineers in Hong Kong. Ranging from feasibility study to execution, engineers took principal part in urban planning. Amy admitted that climate change was one of the key factors when she was working on Hong Kong 2030+. Towards the end of the interview, Patrick specified his views on resilience and the relation between climate change and city's resiliency to extreme weather. Both of our interviewers stated that the impacts of territorial development strategies were not instant. In society where people look for immediate results, policies taking the long view never penetrate easily. So as to popularize the idea of environmental protection, engineers are duty bound. They need more cohesion and collaboration to work hand in hand to promote public dialogue on the key environmental issues.

Mr. LAM Chiu-ying, SBS

Mr. C Y LAM was generous to share with us his views on the connections between Hong Kong history and the approaches that we shall take to fight against climate change. Mr. LAM mentioned that the previous British colonisation had allowed Hong Kong to become a place, where the Chinese and Western culture blended together. This has shaped the open mindsets we have in Hong Kong. He also brought out Hong Kong's weakness of the lack of hinterland, which limited the facilitation of trades comparing to our Mainland China. However, the cultural mix as well as the rapid and enormous amount of information exchange in Hong Kong become our strength, which makes Hong Kong an international financial centre. He stressed that the uniqueness of Hong Kong shall be appreciated and that Hong Kong Engineers shall bear this in mind to develop unique engineering solutions that is tailor made for Hong Kong.

Standing on the Shoulders of Giants

Insights

Climate Change : A Global Challenge

Climate Change as of today

Is the earth's climate changing? Although some people may deny it, extensive studies and scientific assessments show that our earth is facing climate change. Climate varies in space and time, and climate change refer to any significant change in the measures of climate lasting for an extended period of time (E Aguado and J E Burt, 2001). In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer (USEPA, 2016). In the past, the term "global warming" was often used rather than "climate change". Global warming is primarily caused by excessive carbon dioxide (CO_2) in the atmosphere which acts as a blanket, trapping heat and warming the planet(Union of Concerned Scientists, 2011). Yet, "climate change" is more accurate since the atmosphere as a whole does not experience warming; there is more to climate change than an increase in the average temperature.

Some pessimists have even predicted human extinction should climate change continue to affect our planet earth. However, the precise cause was not so clear back in the days. Two United Nations organizations, namely World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP), correspondingly created the Intergovernmental Panel on Climate Change (IPCC). The main objective of the panel is to make use of the available scientific data to assess the impacts from all aspects of climate change, with the view of formulating a strategy in response to impacts.

Current Assessment on the Impacts of Climate Change (IPCC AR5 WGI &WGII)

IPCC has recently published the fifth assessment report (AR5) suggesting the positive correlation and connection between climate change and human activity. The report is subdivided into three main working groups, the Physical Science Basis; Impacts, Adaptation and Vulnerability and Mitigation of Climate Change. The report has distinctly stated that human influence has been the driving force of numerous changes in climate, and it is extremely likely to be a dominant cause of the observed warming since the mid-20th century. (IPCC, 2014)

It stated that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in Greenhouse Gases (GHGs) concentrations and other anthropogenic forcings together. Below are part of the sectoral risks and potential impacts extracted from AR5 WGII:

- **Geological System.** The sea level rise projected throughout the 21st century and beyond will increasingly experience adverse impacts such as submergence, coastal flooding, and coastal erosion towards the marine systems, coastal systems and low-lying areas. Meanwhile, the heat stress, extreme precipitation, water scarcity and other associated changes pose risks in urban areas. These impacts are expected to disproportionately affect the welfare of the poor in rural areas as shirting in production areas across the world.

- **Economic Sectors and Services.** Global economic impacts from climate change are difficult to estimate since impact estimates completed over the past 20 years vary in their coverage and depend on a large number of assumptions. With the limitation due to climate change, losses are more likely than not to be greater. since losses accelerate with greater warming. Estimates vary strongly with the assumed damage function and discount rate.

- **Food Security and Production Systems.** All aspects of food security are potentially affected by climate change, including food access, utilization, and price stability. For the major crops (wheat, rice, and maize) in tropical and temperate regions, climate change without adaptation is projected to negatively impact production by rapidly rising crop demand . Risks to food security are generally greater in low-latitude areas and coastal regions.

- **Human Health and Security.** It is expected to have increases in ill-health in developing countries as compared to a baseline without climate change, such as injury, diseases and death due to intense heat waves and water-borne diseases. These negative impacts would need vulnerability reduction measures. Climate change projected to increase displacement when the population is lack of resources for migration experiences. With the extreme weather and longer-term climate variability, risks of violent conflicts would have amplified with war and violence if there is not any effective adaptation strategy.

- **Livelihoods and Poverty.** Climate-change impacts are expected to exacerbate poverty by creating new poverty pockets in countries with increasing inequality, in both developed and developing countries. High food insecurity and high inequality particularly in Africa would discourage the country development and further bring risk in social protection measures, and disaster management. Policies address poverty and multidimensional inequalities would be international impact and lead to numerous consequences.

Climate Change on Earth

The climate is changing! The phenomenon can be observed clearly from the environmental, meteorological and ecological changes in Iceland and various places on Earth. Typical examples are shown below for- temperature, wind, water and adverse effects in polar region. In the heatwave of summer 2003 in Europe, the temperature rose 20 to 30% higher than the average seasonal temperature. Extreme maximum temperature of 35 to 40°C were repeatedly recorded (UNEP, 2004). Such variation in temperature gradient associated with the extreme high air temperature contributes directly to the deaths due to cardiovascular and respiratory disease, particularly among elderly people.

In North America, the fire in Fort McMurray, Canada lasted for over one month and spread across around 600,000 hectares in May 2016. Over 2400 structures were destroyed. This was the largest evacuation in Albertan history and has displaced more than ten thousand people. The rapid fire growth was largely due to global warming. High temperature of 32.8°C were recorded and the humidity was only 12% as there was less accumulated snow from the previous winter. The wind speed was also found to be high with at 72km/h.

In southern United States, the flooding in Louisiana in August 2016 was the worst natural disaster in the U.S.A. since Hurricane Sandy in 2012 (Guardian, 2016). Climate change driven by human activities have increased the likelihood of torrential downpours which triggered ruinous floods in southern Louisiana. Gallons of water flooded into Louisiana in a week on 8 August 2016 which killed 13 people and flooded 60,000 properties including the governor's mansion (NOAA, 2012).

The most critical indication of climate change can be found in the polar regions. Over the past 30 years, the annual average sea-ice extent of the Arctic area has decreased by about 8% which is equivalent to the area of Norway, Sweden and Denmark combined. The melting trend is accelerating. Sea-ice extent in the summer has declined and dramatically became thinner in recent decades. In addition, precipitation has greatly increased over the past century. Much of it being in the form of rainfall. Meanwhile, the snow cover extent has declined by about 10% over the past 30 years; model projections have suggested that it will decrease an additional 10-20% before the end of this century. The reduction was notably significant in Scandinavia and Northwest Russia. Arctic temperature has risen about twice the rate as elsewhere in the world in the past few decades (ACIA, 2004). The average annual temperature as compared to 1990 is projected to increase 3-5^{o}C over land areas and up to 7^{o}C over the oceans by 2090. Winter temperature is projected to rise significantly more, with the increases of 4-7^{o}C over the land areas and 7-10^{o}C over the oceans (ACIA, 2004). The above are just some of the many indicators that climate change is undoubtedly happening.

Climate Change in Iceland

Climate change has affected Iceland a great deal, the most significant phenomena of which are the loss of glaciers. Covering about 11% of the total land area, changes in glacier runoff are one of the most important consequences of future climate changes in Iceland. The picturesque Snæfellsjökull ice cap is the only ice cap that can be seen from Reykjavík. It has persisted for many centuries, at least since Iceland was settled in the ninth century AD. However, recent measurements have showed that the ice cap, which has an average thickness of less than 50m, has thinned by approximately 13m in the last decade (Linkov and Bridges, 2010). With the current rate of thinning, it is expected that the ice cap would disappear within the century. Modeling in mass balance and ice dynamic of the Langjökull and Hofsjökull ice caps and the southern part of the Vatnajökull ice cap in Iceland reveal that these glaciers may essentially disappear over the next 100-200 years (Helgi Björnsson and Finnur Pálsson, 2008). Runoff from these glaciers is projected to increase by about 30% with respect to the present runoff by 2030 (T Jóhannesson, 2006). The peak runoff is expected to occur in the latter part of the 21st century.

The emission of greenhouse gases also cause adverse impact to Iceland's fishing industry. Being the 12th largest fishing nation in the world, fisheries in Iceland account for 15% of GDP and 75% of the nation's goods exports. The marine sector is one of the main economic sectors and the backbone of export activities in Iceland although its relative importance has diminished over the past four decades. In 2008, shift in the abundance of fisheries has been found in shares' decreases in exports than manufacturing products, and constituted 36.7% of all exports (Ministry for the Environment of Iceland, 2010). The potential effect of climate change on ocean circulation is of great concern. Since fishing industry is important to Iceland, a small change could substantially affect fish stocks in the seas around the country. The distribution of fish stocks and the location of spawning grounds are all dependent on currents and the ocean temperature.

Climate change has been considered to be one of the greatest threats in human history. The changes could be found in abnormal mean temperature records as well as extreme weather. Just as climate varies with space and time, so does climate change. We should not deny the changes that are happening now, but face it with a brave face.

Our Past and Present

From the 3rd to 14th of June 1992, a major United Nations conference, the Earth Summit, was held in Rio de Janeiro. Not only did the summit turned governments' attention to the importance of climate change, but also established a number of crucial documents and signatures of legally binding agreements.

Rio Declaration and Agenda 21 were amongst the documents established. Both documents are non-binding action plans for the UN, organizations and governments around the world to be executed regarding sustainable development, especially in areas where

human activities have an adverse impact on the environment. Similarly, the well-known United Nations Framework Convention on Climate Change (UNFCCC) was signed at the time. The objective is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system (United Nations, 1992). Subsequent to the enforcement of UNFCCC, the Conferences of the Parties (COP) has been holding annual convention meetings to assess the progress made by each party in achieving the objectives of the convention.

The Kyoto Protocol

The third session of UNFCCC (COP3 was hosted in Kyoto in December 1997, in which the Kyoto Protocol was adopted. The protocol has implemented the objective of UNFCCC in combating climate change and is comprised of three mechanism, namely International Emission Trading (IET), Clean Development Mechanism (CDM) and Joint Implementation (JI). The IET, also known as the carbon market, is the highlight of the protocol as each committed country has assigned amount units (AAUs) as their allowable emissions. IET allows countries with low emissions to trade their excess emission capacities to others with higher emission rates. Meanwhile, the CDM involves implementation of emission-reduction projects in developing countries contribute to their sustainable development, while earning the implementing countries emission reduction credits to count towards meeting their Kyoto Protocol targets. JI enables developed countries to earn emission reduction credits by carrying out emission reduction or removal enhancement projects in other developed countries (UNFCCC, 2014).

However, there are drawbacks to the protocol, the first being the common but differentiated responsibilities principle where the AAUs are assigned based on the status of the country (i.e. developing country and developed country). Although the United States. signed the protocol, the U.S. senate expressed disapproval of the protocol which could seriously harm the economy of U.S.. The protocol was widely seen as ineffective.

Before the 21st COP meeting (COP21) in 2015, there had been little progress in achieving the objectives of the UNFCCC. Fortunately, a breakthrough occurred at the COP21 thanks to the findings of the AR5 as well as the strong commitment from EU and the committed participation of U.S.A. and Mainland China. The Paris Agreement, unlike other agreements before, sets out definitive targets for the participated countries which are:

1. to hold the increase of global average temperature to well-below 2^{o}C above the industrial levels and
2. to pursue efforts in limiting the temperature increase to 1.5^{o}C above pre-industrial levels.

Most of the participating countries (including the biggest GHG emitters the U.S.A. and China) have vowed to make Intended Nationally Determined Contributions (INDC) on carbon reduction. Following the decisive milestone established in COP21, the latest COP22 held in Marrakech in 2016 furthered collaborations and discussions of COP21's implementation plans and actions.

With the growing aspiration to reduce carbon emission, mandatory accounting and reporting of greenhouse gas (GHG) will be carried out in all major economies. Businesses will feel an increasing pressure to reduce the carbon intensity from their productions of goods, energy consumptions and transport services etc. to tailor actions to meet the unique carbon reduction requirement of their nation. This, in effect, has stimulated the global market for innovative, energy-efficient and low carbon technologies that cut down on the GHG emissions. Meanwhile, for the local perspective, Hong Kong has developed a unique report "The Hong Kong's Climate Action Plan 2030+ Report", which sets out a list of mitigation, adaptation and resilience measures to meet Hong Kong's emission reduction targets.

Climate Engineering

According to The Royal Society of London, an independent academy of the UK dedicated to promote excellence in science (2009), the definition of climate engineering, also referred to as geoengineering, is "… the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change". It is a relatively new concept that began about 30 years ago. These technologies target different areas of the climate system as they are varied in mechanics, costs and feasibility. They are usually divided into two categories: greenhouse gases removal and solar radiation management.

Carbon Dioxide Removal

Carbon dioxide is released into the atmosphere by both natural processes, such as respiration, as well as human activities, such as deforestation (CCSA, 2017). However, it is remarkable that the carbon dioxide concentration in the atmosphere had increased by over one third since the Industrial Revolution. According to NASA's measurement in December 2016, the current rate of carbon dioxide in the atmosphere is 405.25 parts per million (ppm) (NASA, 2017). Previous fluctuation of the concentration would only reach approximately 380 ppm at its highest; yet, we have been consistently over that peak amount and have no sign of plateauing or decreasing. Reducing CO2 emissions is considered one of the main challenges of this century. In order to stop the increase of CO2, one can directly stop the sources from emitting more gases. One of the methods is Carbon Capture and Storage (CCS) it is a technology that can capture up to 90% of the carbon dioxide emissions produced from the use of fossil fuels in electricity generation

Iceland has also set an ambitious goal which Iceland should aim at that net GHG emissions shall drop by 50-75% from net 1990 level by the year 2050

and industrial processes, preventing the carbon dioxide from entering the atmosphere (Lackner, 2016). The process consists of three parts: capturing the carbon dioxide, transporting the carbon dioxide, and securely storing the carbon dioxide underground. Currently, there are 8 operational commercial-scale CCS plants globally which are located in the U.S.A., Norway, Canada, and Algeria. Also, with 14 operating or under construction large-scale integrated CCS projects, the total CO2 storage capacity is over 33 million tonnes a year.

Similarly, in Iceland, Reykjavik Energy, the University of Iceland, Columbia University and CNRS have collaborated on a project named CarbFix in 2007 (Orkuveita Reykjavikur, 2017). Its main intention is to lock away carbon dioxide by reacting it with basaltic rocks . The procedure is described as injecting the captured gas into the earth again, where they were originated with laboratory based experiments, study of natural analogues and geochemical modeling. In 2016, 95% of the injected 250 tonnes of CO2 were solidified into calcite within 2 years using 25 tonnes of water per tonne of CO2. CarbFix is not the ultimate solution to climate change but rather a new tool in the fight against global warming as it is trying to get rid of excess CO2. The International Energy Agency has furthermore estimated that carbon capture and storage is crucial if the world is to limit the temperature increase (Generating Renewable Energy Business Enterprise, 2016). Such project provides a safe and efficient way to permanently immobilize CO2 where basalts and water sources are located near CO2 sources and thus contributing to reducing greenhouse gas emissions

Solar Radiation Management and Earth Cooling Schemes

There are debate in the society on whether the sun's activity and the relevant solar energy out are a source of global warming. However, by analysing the layers of the earth's atmosphere will result that this cannot be the case, as the upper atmosphere is cooling while the lower parts are warming (Solar Radiation Management Governance Initiative, 2017).

Such variation in temperature illustrated that GHG are trapping the heat in the lower parts. In order to decrease the earth's temperature, various methods can be applied. The effects of greenhouse gases can be offset by causing the Earth to absorb less solar radiation such as deflecting the sunlight away from the Earth and increasing the reflectivity (albedo) of the atmosphere or the Earth's surface. Some methods that are more efficient include the use of pale-coloured roofing material and the growth of high-albedo crops. Marine cloud brightening is the use of tiny droplets of seawater injected into clouds which increases cloud reflectivity. Similarly, reflective aerosols in the stratosphere and space sunshade are some techniques that can be considered.

Challenges, Risks and Limitations

Geoengineering is often not considered as a substitute for emission controls but as an "accompanying strategy" (Lights, 2013). This is mainly because of the geoengineering options being theoretical and unproven. Many factors such as the costs, benefits and risks are still to be determined. For example, the stratospheric aerosol might delay the generation of the ozone layer and caused adverse health impacts (Allen, 2015). Moreover, no technology have been fully developed at a scale that significantly affects the global climate.

Our Future

Climate change is a global issue; not one nation in the world is immune to the impacts of this phenomenon. Each country has its role to fight against climate change; however, measures taken to combat against climate change cannot be successful without international engagement and effort. In fact, it is not surprising to see that there was a lot of national dialogue, conferences and mitigation measures. They were conducted and taken worldwide, showing the determination of nations in this uphill battle against climate change. Undoubtedly, the measures and strategies designed and planned by the countries will shape our living environment and will consequently decide what our future planet become.

In the following sections, national measures and policies with regards to combating climate change in Iceland and some global politics and governance issues affecting the global climate change strategy will be explored.

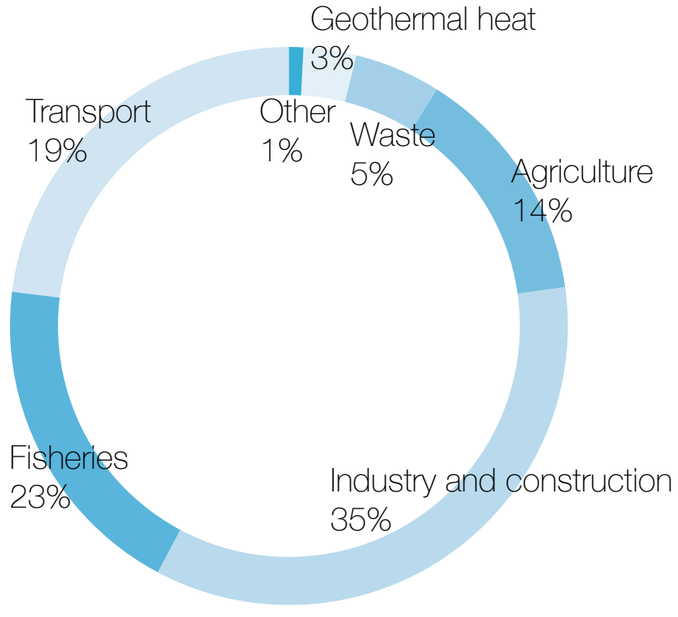
Iceland climate change policies and measures

Iceland, the destination country in this delegation, is one of the proactive countries in mitigating climate change. A series of measures and long term strategies against climate change have been planned and defined by the Icelandic government. After signing the Kyoto Protocol in 1992, Iceland has made her best endeavor to find ways to fulfill its obligation, including policies to limit the national GHGs emission not to increase for more than 10% above 1990's level, as well prohibit the emission of additional CO2 from new industry established after 1990 (Ministry for the Environment, 2007). Iceland has also set an ambitious goal with a target to reduce Iceland's net GHG emissions by 50-75% from net 1990 levels by the year 2050, by looking for emission reduction potential in different sectors (Ministry for the Environment, 2007).

Unlike other countries where most of the emissions are from energy production, nearly all of Icelandic stationary energy production come from renewable resources; thus, there is little room for them to have emission reduction in this area. On the other hand, it is found that the transportation in the territories has great potential to have significant emission reduction in contrast to other sectors such as industrial and energy productions. Referring to different potential sectors, Icelandic government has taken various measures and implemented new environmental policies to achieve emission reduction.

<u>Energy Production</u>

Although there is little room for emission reduction in energy production sectors, due to the high utilisation of renewable energy resources for energy production (nearly 100%), Iceland continues to study the feasibility of pumping CO2 from geothermal power plants back into the earth. At the same time, Iceland openly shares



Emissions in 2004, by sector (Ministry for the Environment, 2007)

its knowledge in utilisation of renewable energy resources, exportation of the technology and know-how in that field to other parts of the world which are supported by the Icelandic government.

Transportation

Transportation is the sector with the greatest potential in emission reduction as compared to other sectors. The Icelandic government uses economic incentives to encourage the community to purchase climate-friendly motor vehicles and use climate-friendly fuels. These automobiles are equipped with engines utilizing methane or electricity to a substantial degree instead of gasoline or diesel fuel. With an excise tax that is ISK 240,000 (approximately HKD 18,500) less than that of conventional vehicles, Icelanders have more incentive to purchase such environmentally-friendly vehicles.

Apart from providing incentives, the government will put more effort in educating buyers about CO2 emissions from motor vehicles and the effects of those emissions on the climate. Also, they will continue to promote public tranportation as a alternative means of travel.

Fishing vessels are still using fossil fuel; therefore, there is potential for emission reduction by saving fuel. Indeed, various fishing companies have examined the possibility of equipping their ships with Icelandic energy-saving devices based on information technology and active participation by the ship's captain. Furthermore, governmental agencies are keen to support research and development projects in fields related to fuel savings and climate-friendly improvements for fishing vessels.

Industrial

Most of the pollutants in the industrial sector are from aluminium smelters. Fluorocarbon is the major pollutant. To control fluorocarbon emission from aluminium smelters to a substantial degree, the government has set a target and presented it in the Climate Change Strategy of 2002, specifying that fluorocarbon emissions should not exceed 0.14 tonnes of carbon equivalents per tonnes of aluminum produced. Consequently the target has been achieved in both of the aluminum smelters in operation in Iceland. Furthermore, rules will be set concerning the assignment of emissions allocations to industrial companies and the companies will be required to obtain emission reduction units if they exceed allocation limits.

Waste handling

The government has also observed it would be possible to reduce the volume of organic wastes sent to landfills and further utilise the tapping of methane from landfills. Accordingly, a national plan for the handling of waste has been launched, aiming at reducing the disposal of organic waste. On the other hand, SORPA, an organization handling solid waste disposal and management in Iceland, collects methane from landfill. The gas collected will be supplied to methane-powered automobiles and also for electricity production.

Carbon sequestration

Other than emission reduction measures, carbon sequestration measures is also taken as well. For example, additional subsidy of ISK 450 million (about HKD 3 million) to land reclamation and afforestation projects were allocated to increase the sequestration of carbon from the atmospheres, and to promote research into the subject.

Research and development

To gain further insight and viable solution to achieve emission reduction, the government had been working with institutions and private sectors to make effort in the research and development of emission reduction technologies.

The above measures along with the associated research were summarized and submitted by The Ministry for the Environment to the Science and Technology Policy Council (Ministry for the Environment, 2007). Meanwhile, a variety of work has been done on matters related to hydrogen. For example, the Ministry of Industry and Commerce launched the Forum for Environment-Friendly Fuel,

which has submitted two interim reports on how to increase the use of this climate-friendly fuel. Furthermore, Iceland has also decided to join the EU's collective effort to reduce emission across the region by 40% on 1990 levels by 2030. The precise commitment of Iceland has yet to be decided. Indeed, the Icelandic government has demonstrated that a country can not only have strive for emission reduction in its own territories, but can also get involved in other regions.

Climate Change in the world

Combating climate change demands international collaboration and engagement. It is not only environmental protection and natural science, but also global economy, world politics and social views, which affect a country's perspective in mitigating climate change. In the past year, the global political environment has experienced dramatic changes. This makes the attitude toward climate change issues more unpredictable for several nations, which may bring uncertainties and opportunities to this long fight.

Brexit

Referring to the result of the Brexit referendum last year, the United Kingdom has voted to quit the European Union soon (Authority of the House of Lords, European Union Committee, 2017). The withdrawal of the UK from the EU would definitely impact the UK and EU in many fields.

Due to Brexit, the global economy and politics are inevitably affected. Meanwhile the domestic environmental policy of the UK is causing the public to raise concern. Before Brexit, the environmental legislation in the UK, was heavily influenced by EU law. Following the Great Repeal Bill, the governmental departments of the UK, such as the Department for Environment, Food and Rural Affairs, have to repatriate and replace their policy accordingly (Authority of the House of Lords, European Union Committee, 2017). It is very difficult to tell if the existing environmental and climate change policy will be fully preserved through the Great Repeal Bill or not, causing many uncertainties. On the other hand, the UK is leaving the EU, not Europe. Its environment will remain inextricably linked to the environment of Europe. In many areas, such as species conservation and air and water quality, it will be vital for the UK and the EU to continue to co-operate in order to protect the shared European environment, whether terrestrial, marine, or atmospheric (Authority of the House of Lords, European Union Committee, 2017). Thus, how those operations will keep functioning in a well coordinated manner would need to be further studied .

Under the unstable political circumstances among countries in Europe, more time for further discussion will be needed to clarify how the UK and the EU will continue to coordinate to make positive contribution to combat climate change.

Donald Trump's Presidency

Being one of the biggest carbon emitter among the developed countries, the engagement of the United States is important to achieve significant carbon emission reduction. During Barack Obama's Presidency, dozens of measures had been put in place to mitigate climate change. For example, the Clean Power Plan was established to slash carbon emissions, while the Global Climate Change initiative and the Green Climate Fund were part of an international pledge to transfer $100 Billion of climate cash a year from rich countries to poor ones by 2020 (Otto Poon, 2017). However, the United State's position seems to have changed with Donald Trump's presidency. During his election campaign, Donald Trump had shown his strong stance in denying climate change. He does not accept the scientific evidence that climate change is real, claiming that the idea of global warming is a "hoax" and that he would dismantle the Paris Agreement if he became the president (Rebecca Harrington, 2017). Eventually, he was elected, making the signatories of the Paris Agreement worry what actions US will take to mitigate climate change in the future. How the world could possibly urge Trump to stick to policies by Obama is surely going to be the focus for the governmental leaders, environmental leaders and green groups. A possible consequence of Trump's presidency is the cancellation of the U.S. agreement on COP21 which would break off the public commitment on the Intended Nationally Determined Contributions (INDC). As part of his aimed energy policy, Trump mentioned that he would cancel U.S. funding for UN climate change projects and involvement in the Paris Agreement. Since Trump pledged to expand industrial development in the states as well as to cut the energy budget, it would not be possible for the U.S. to pull out any more coal-fired power plants or reduce carbon emissions.

Recently, it seems that Trump is going to realize the commitments made during his campaign. He signed an executive order to unravel Obama's Climate Action Plan to curb global warming. There are no clue as to what direction President Trump will take for environmental policy in the future (Martin Pengelly and agencies, 2017). It is still unclear where exactly the US stands in actions and relations to the Paris Agreement. Trump announced that US will withdraw from the Paris Accord on 1 June 2017 and they will negotiate for the best endeavors. He claimed that the withdrawal was decided due to economic concerns for the US. When the time comes for US's withdrawal from the Paris Agreement, such a radical change of direction would send a worrying signal to the community of nation, and possibly weaken their resolve to combat climate change.

Trump's Presidency would brought uncertainty to the community nations, and weaken their resolve to combat climate change
(Photo sorce: http://static3.businessinsider.com/image/569e63d98d3eae806e3ba8ff-1190-625/bill-nye-has-a-great-response-to-trumps-outrageous-statements-about-climate-change.jpg)

Mainland China is now taking the role of world leader on climate change.
(Photo source: https://psmag.com/news/china-climate-change)

Mainland China's Leading Role

In 2014, presidents Barack Obama and Xi Jinping announced plans for a cut in GHG emissions of close to one-third over the next two decades, and in 2016, both have ratified the Paris climate change agreement in Hangzhou. Being the developing and developed country with largest carbon emissions in the world respectively, the U.S. - Mainland China leadership was crucial to how the Paris agreement took shape in the first place (Griffiths, 2017).

However, Trump's actions mentioned above would let Mainland China take the position of world leader on climate change. Nevertheless, Mainland China has shown her commitment. Mainland China has committed to reducing carbon intensity by 40-45% in 2020 compared with 2005 levels and will reach the peak of carbon emissions by 2030 or even earlier (Mathiesen, 2017). Also, Mainland China would take steps to move away from coal and also motivate other partner, particularly those countries in the Asia Pacific region, to follow suit. For example, Mainland China recently halted the construction of 103 new coal-fired power plants, and its energy agency at the start of the year announced plans to pour more than $360 billion USD into renewable energy by the end of the decade. In addition, Mainland China will take major action to introduce an emissions trading scheme this year, a means of controlling pollution via economic incentives (Dearden, 2017). Moreover, Mainland China invested more than $88 billion USD in clean energy in 2016, according to Bloomberg New Energy Finance. One of the examples is that a Mainland China car manufacturer, Geely, which developed the low carbon emission vehicle, uses methanol as fuel. The corporation has invested $45.5 million USD to Iceland's Carbon Recycling International, a leading company in methanol technology. The investment will enable carbon recycling to expand into Mainland China as well as into Europe (Xinhua, 2015). Meanwhile, Hong Kong, being part of China, has already established its own action plan - "Hong Kong's Climate Action Plan 2030+", which stated clearly Hong Kong's new carbon emissions reduction targets for 2030 and the concerted plans to meet it (Environment Bureau, 2017).

Fighting against climate change is not an easy task. No one would be able to win in this battle by themselves only, no single discipline of knowledge can have the universal solution to this situation, and no particular nation can take actions just for its own good and turn a blind eye to other countries. Collaboration is undoubtedly the key to the problem. We all live on the same planet and the only solution is that we have to work together, applying knowledge from a wide variety of disciplines to generate innovative solutions, coordinating with different nations to commit to their contribution, and educating our next generation to adopt a greener lifestyle in order to combat and mitigate climate change shoulder to shoulder.

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Towards a Fossil Fuel Free City

Climate Action in Hong Kong

Climate change has captured the world's attention. Countries are now working together to reduce carbon emissions with the Paris Agreement in place. As the Agreement has been extended to Hong Kong, Hong Kong has committed to play a role in the world's carbon reduction.

The main cause of climate change is the excessive intensity of carbon emissions. In Hong Kong, the carbon emissions per capita was about 6.2 tonnes in 2014 and local electricity generation takes up about 70% of it. In order to improve the current situation, Hong Kong has set an ambitious goal to reduce its carbon intensity by 65-70% by 2030 using 2005 as the base, which is equivalent to a reduction of 3.3-3.8 tonnes per capita (Environmental Bureau, 2017).

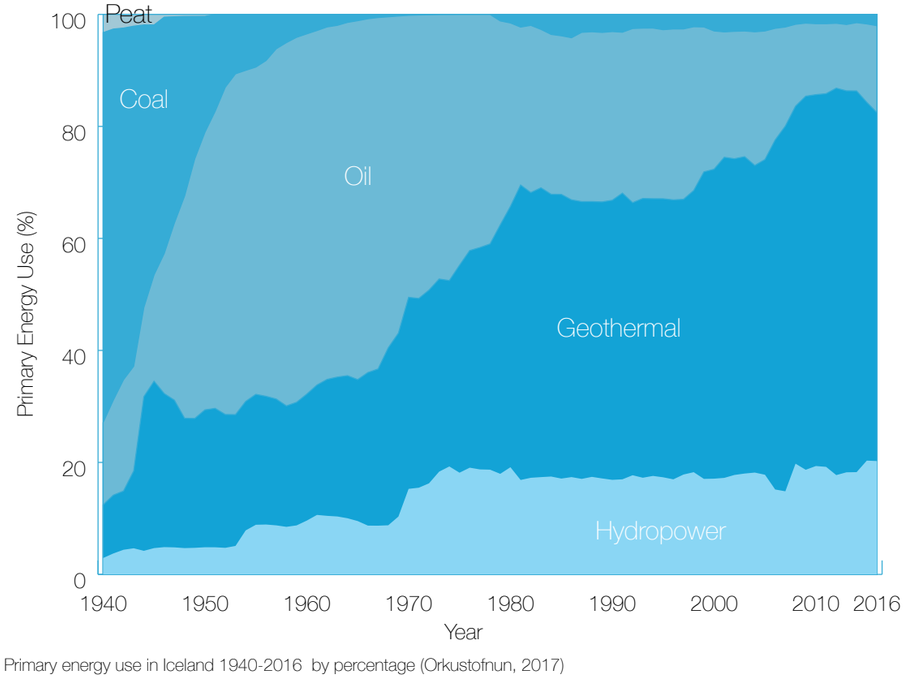
As a young engineer in Hong Kong, we are obliged to help achieve the above target. Through our delegation, we aim to gain insight from Iceland on how they reduce reliance on fossil fuels to reduce carbon emissions. By looking into the energy story of Iceland, we hope to see how Hong Kong can learn from it and apply shared principles, leading to a less fossil fuel city.

Iceland's Energy Story

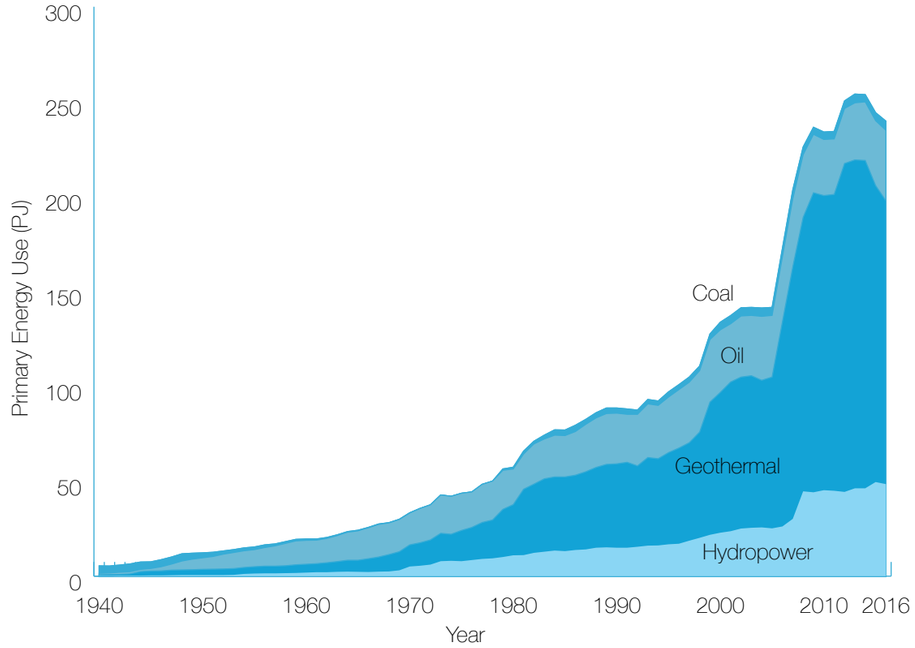
Iceland has abundant renewable energy resources due to its unique geology. Located at one of the most tectonically active places with high concentration of volcanoes and hot springs, Iceland takes full advantage of its geological nature in deriving clean and renewable geothermal energy. With plentiful waterfalls and glacier rivers, Iceland is also capable of harnessing hydropower for useful energy purposes.

Iceland's Energy Profile

In 1940, the primary use of the renewable energy was just about 10% of the total energy consumption in Iceland. Over the years, the use of renewable energy has increased significantly to over 80% of overall energy use today.



Primary energy use in Iceland 1940-2016 by percentage (Orkustofnun, 2017)



Primary energy use in Iceland 1940-2016 (Orkustofnun National Energy Authority, 2017)

In 2016, Iceland's primary energy use was about 240PJ. Among all, renewable energy took up 82% of the share, of which 62% comes from geothermal energy and 20% from hydropower. Coal and oil, the conventional fossil fuels, only constitute the remaining 18% (Orkustofnun National Energy Authority, 2017).

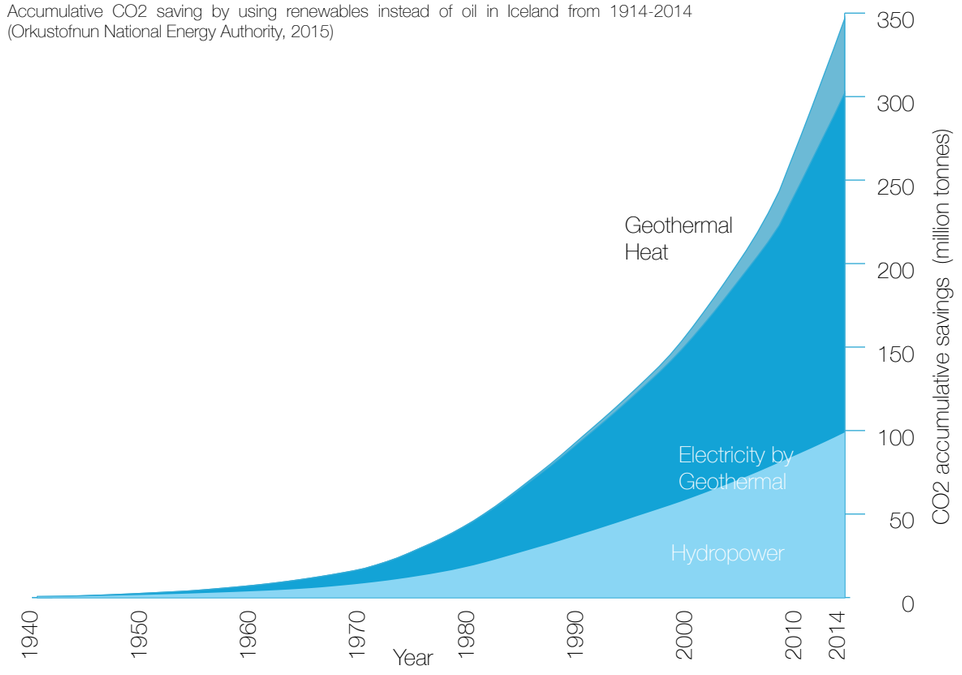
With advanced geothermal energy development, Iceland has fully utilised its gift of nature in geothermal district heating, which is the largest constituent of the direct use of geothermal energy. Of the final heat use, more than 80% of the total heat is generated by geothermal energy which benefits nearly 90% of households today. Apart from district heating, geothermal energy is the second large contributor to the electricity production. It generates 26.6% of the total electricity in Iceland (Orkustofnun National Energy Authority, 2017).

Hydropower is the major source of electricity generation that produces 73.3% of the country's electricity. Of electricity consumed in 2015, a significant proportion of about 75% was used in the aluminum industry (Orkustofnun National Energy Authority, 2015). Since Iceland has developed a significant power-intensive industry in aluminum smelting, the use of electricity in aluminum production has topped all other uses.

Through the use of renewable energy, Iceland successfully achieved an accumulative carbon dioxide (CO_2) reduction of around 350 million tonnes in 2014. With the increase in renewable energy use, Iceland has also increased its CO_2 savings with a promising trend. Among all, hydropower contributes the most by reducing about 200 million tonnes of CO_2 while geothermal power plants and district heating contribute the rest (Orkustofnun National Energy Authority, 2015).

Yet, Iceland still relies on imported fossil fuels when it comes to the transport sector. Petroleum products are mostly used in transportation for cars, aircrafts, and fishing vessels which takes up nearly 90% of the total fuel use and approximately one-third of

Accumulative CO2 saving by using renewables instead of oil in Iceland from 1914-2014 (Orkustofnun National Energy Authority, 2015)



the CO2 emission in Iceland (Orkustofnun National Energy Authority, 2017). With the goal to pursue 100% clean energy in the future, Iceland has planned to phase out fossil fuels progressively by resorting to potential alternatives such as hydrogen fuel and electricity.

Iceland's Step towards Fossil Fuel Free - the Master Plan

Iceland began to harness their power of nature in the 1940s. It got about 75% of its energy from coal until the oil crisis in the 1970s, which put forward its advancement of overall energy development (Aldred, 2008). Due to the increase in cost of coal and oil, the Icelandic government has changed its focus to hydropower and geothermal development in meeting the high energy demand for space heating and electricity generation. Since such a transformation, Iceland has reaped both economic and environmental benefits of harnessing renewable energy and has developed its goal in leading to a fossil fuel free country.

Iceland recognises the importance of renewable energy promotion in the country's success. The Icelandic government has taken a leading role in support of renewable energy development. Energy policies and strategies have been set out to govern renewable energy development to encourage better energy utilisation (Ministry of Industries and Innovation, 2009). These mainly include: renewable energy to substitute imported energy, and to encourage the use of cleaner fuels for transport and fishing, reduction of fossil fuels to achieve carbon neutrality, as well as formulation of the Master Plan for better utilisation of renewable energy resources.

The Master Plan was issued to oversee geothermal and hydropower development in Iceland. It outlines the evaluation of energy efficiency, economic viability and environmental impact of different energy options. Along with the goal of minimising the use of fossil fuels, Iceland has endeavoured to maximise the use of renewable energy resources without jeopardising nature. This lays solid groundwork for Iceland in stepping towards a fossil fuel free country.

Hong Kong's Energy Story

Unlike Iceland, Hong Kong does not have indigenous primary energy resources, and therefore relies heavily on fossil fuels. Of the "fuel mix" for electricity generation, coal takes up about 50% of the share; while the rest is almost equally shared by natural gas and non-fossil fuels including imported nuclear power and little renewable energy. Wind energy, solar energy and waste-to-energy generally constitute the limited prospect for renewable energy use in Hong Kong. Up to the 2030 planning horizon, Hong Kong can only utilise up to about 3-4% of the realisable renewable energy potential (Environmental Bureau, 2017).

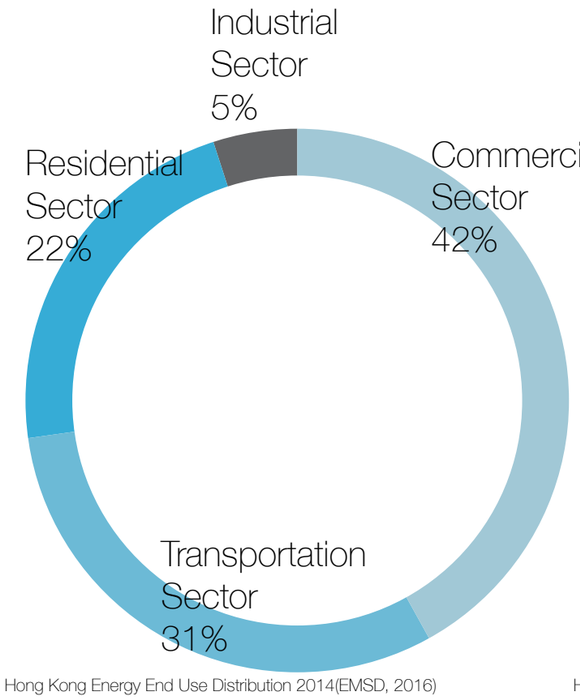
Hong Kong's Energy Profile

According to the Hong Kong Energy End-use Data by the Electrical and Mechanical Services Department (EMSD), Hong Kong consumed 289,160TJ (~290PJ) of energy in 2014. 42% of energy was consumed in the commercial sector, 31% in transportation, 22% in households and the remaining 5% for industrial uses. In terms of fuel types, electricity, oil and coal products, town gas and liquefied petroleum gas (LPG) respectively took up 55%, 28% and 18% of the energy consumed in 2014 (EMSD, 2016).

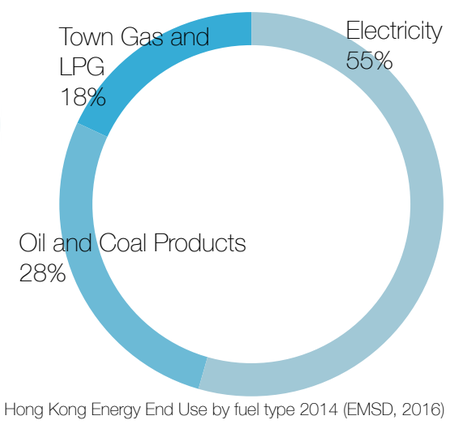
Buildings, which the city is packed of, take up 90% of the total electricity in Hong Kong. The large electricity demand is due to the commercial and residential sectors covering a wide use of electrical appliances and equipment. By categories, air conditioning is the largest component (30%) of the electricity usage. Lighting, which comes next, consumes about 15% of the city's electricity (EMSD, 2016).

Coal and oil products are the second major contributor to Hong Kong's energy end-use. Being the major fuel source for transportation in Hong Kong, about 90% of the oil products, in the form of petrol and diesel, are consumed in both vehicular (80%) and marine (10%) transport. Since Hong Kong has a busy transportation system, the demand for coal and oil remains very high due to heavy road traffic. Town gas and LPG, being the least consumed fuel type, is mainly used for cooking, water heating and transportation (EMSD, 2016).

Seeing that about 70% of the city's carbon emissions arise from electricity generation, the Hong Kong government has turned to natural gas, a cleaner alternative, to phase down coal in electricity generation. It is



Hong Kong Energy End Use Distribution 2014(EMSD, 2016)



Hong Kong Energy End Use by fuel type 2014 (EMSD, 2016)

aimed to achieve a better fuel mix by 2020, that 50% of the electricity will be generated by natural gas, 25% are generated by coal and the rest are generated by non-fossil fuel, and therefore, it is estimated that, by 2020, the carbon intensity in Hong Kong can be reduced by 50-60% compared to 2005 (Environment Bureau, 2017).

Also, more than 30% of Hong Kong's energy is used to support the transportation sector. There are about 652,000 vehicles in Hong Kong, of which 75% are private vehicles. The remaining 25% consists of goods vehicles and other commercial vehicles. To solve the problem, the government has been implementing a series of actions to reduce the emission of vehicles in Hong Kong, including the phasing out of pre-EURO VI diesel commercial vehicles and replace them by newer, cleaner vehicles, setting the lifetime for newly registered diesel commercial vehicles etc. On the other hand, the Transport and Housing Bureau (THB) has started to promote greener transportation mode such as promote the use of public transport with railway as backbone (THB, 2014), promote walking culture and rely less on motorised transport (HKSARG, 2017) etc.

Could Iceland's Solutions be Applied to Hong Kong?

Due to geographical constraints, geothermal and hydropower energy would not be applicable in Hong Kong. To utilise geothermal energy, heat inside the earth's crust has to be extracted from the deep hot zones to near the surface. This is often associated with volcano activities and earthquakes. Since Hong Kong is not tectonically active, there are no available geothermal energy sources for power generation (EMSD, 2002).

As for hydropower energy, the water resources in Hong Kong are not feasible for developing large hydro and exhaustive structures have to be constructed for a holistic hydropower system (EMSD, 2002). Considering the cost-effectiveness and ecological constraints, large hydropower development is unlikely to be practical in Hong Kong.

Though other renewable energy such as wind energy, solar energy and waste-to-energy are in use in Hong Kong, they have unsteady supply and can only take up limited realisable renewable potential in the future. Hong Kong does not have the competence to aim for fossil fuel free like Iceland and therefore can only stride towards a fossil fuel less city. Still, there are lots of ways that Hong Kong could do in promoting a green and sustainable community.

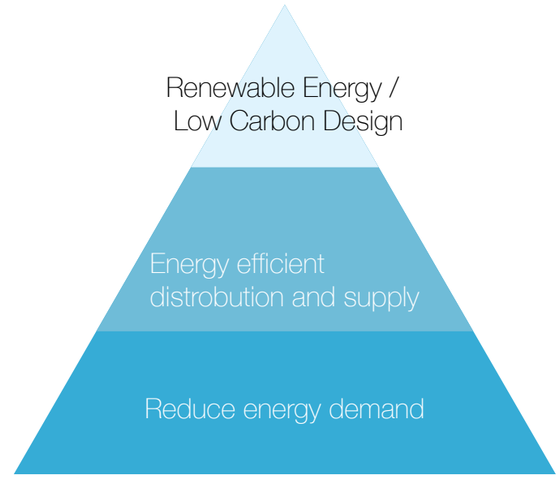
Sustainable Building in Hong Kong

The Low Carbon Design Hierarchy:

Due to the large consumption of electricity in buildings, energy savings in buildings will be the first and foremost step in green energy promotion. The Low Carbon Design Hierarchy, a widely introduced concept in sustainable building design, generally adopts the following 3-tier concepts (Welsh Government, 2012):

- 1st Tier - Demand Reduction. Energy demand could be reduced through effective building design. Passive designs such as natural daylight, passive solar heating, heat recovery ventilation, efficient lighting and appliances help ensure smart use of buildings, and could bring up good habits in energy savings as well (Sustainable Design Collective, 2017).

- 2nd Tier - Energy Efficiency. With the energy demand reduced, energy efficiency could be maximised through selection of suitable building materials and effective management of building environment. The building fabric controls the amount of heat transfer through a building, either by thermal transmittance through the fabric or by infiltration through uncontrolled air movement. The higher the performance of the building component such as windows, roofs, walls and floors to be attained, the higher energy efficiency could be achieved. Good building management also helps minimise energy consumption by effective management of living and working conditions such as temperature, lighting and ventilation (Welsh Government, 2012).



The Low Carbon Design Hierarchy:

- 3rd Tier - Renewable and Low Carbon Technologies. The final step is to adopt renewable and low carbon technologies to meet energy demand. In building design, solar thermal systems and combined heat and power technology are commonly adopted low carbon technologies while photovoltaic panels and wind turbines are widely applied for renewable energy use.

Substainable Building Design

<u>Green Building</u>

Green building refers to a building structure and the application of processes that are ecological and resource-efficient throughout a building's life-cycle: from planning to design, construction, operation, maintenance, renovation and demolition (USEPA, 2016). From the World Green Building Council, the world's view on green building has changed. It is considered as a tool for saving the planet and improving the wellbeing of the future generation (Wong, 2017).

In Hong Kong, the government has committed to build a sustainable future and to ensure our future generation can continue to thrive in a clean and green environment. In response to the high energy consumption in buildings, the Government enacted the Building Energy Efficiency Ordinance (Cap 610) in 2012, which covers newly constructed buildings, buildings carrying retrofitting works and commercial buildings, to enhance building energy efficiency for reduction in greenhouse gas (GHG) emissions. Under the ordinance, the buildings should ensure that the 4 key types of building services installation, including but not limited to air-conditioning installation, lighting installation, electrical installation as well as lift and escalator installation, comply with the design standards of the Building Energy Code (BEC) (EMSD, 2012) from preliminary design to building completion.

<u>BEAM+ Scheme</u>

The Building Environmental Assessment Method (BEAM) provides a single performance label to review the overall quality of a building. It sets a comprehensive standard procedure for an overall building performance assessment covering various aspects including site condition, material usage, energy usage, water usage, indoor and outdoor environmental quality, innovation and addition. With the implementation of BEAM, authoritative guidance could be provided to all stakeholders in building construction and real estate sectors on practices which reduce the adverse environmental impacts of buildings whilst providing a quality building environment (BEAM Society, 2012).

Currently, BEAM is applied to extensive types of buildings,

Core from injection site showing CO2 bearing carbonate minerals within basaltic host rock. (Orkuveita Reykjavikur, 2016)

from planning and operation of new buildings and large-scale infrastructure development, to refurbishment of existing and old buildings. This includes both interior designs and renovation. Also, the BEAM Society has recently launched an assessment overseeing the neighbourhood areas of buildings for sustainable development of a community instead of just a building (BEAM Society, 2016). This provides a more comprehensive performance scale for the assessment of all structures in Hong Kong. Although the uptaking of assessment is currently voluntary, it has strengthened the execution of the regulatory ordinances and allows further studies to be made on the necessary criteria for buildings' construction projects. In such a way, the BEAM assessment shall be able to enhance the city's livability by transforming the city into a greener built environment.

District Cooling System

Since air conditioning is the largest component of electricity usage in Hong Kong, it is important to study how energy demand from air conditioning could be reduced. From extensive study since 1998 till the first commissioning of the district cooling system of the Kai Tak Development in Hong Kong, it is estimated that 20% and 35% of electricity could be saved when compared to the individual water-cooled air-conditioning system and traditional air-cooled air-conditioning system respectively (EMSD, 2015). It has been proven that the district cooling system with centralized cooling distribution can provide an ultimate energy saving development in Hong Kong. The government is now exploring the feasibility of proposed district cooling systems in several areas including the topside development of the Hong Kong Boundary Crossing Facilities of the Hong Kong-Zhuhai-Macao Bridge, Tung Chung New Town Extension, as well as Kwu Tung North and other new development areas (Environment Bureau, 2017).

During the study on energy supply in Iceland, it is known that the main heat power supply in Iceland relied on coal in the past (Orkustofnun, 2015). With progressive city development, extensive developments in Iceland are now connected to geothermal heat supply, with nearly all of the buildings in the city centre being connected to geothermal-heated water supply.

In view of the success of the heat transferring system in Iceland, the following could also be investigated for better development in Hong Kong:

1. Possible changing from individual cooling system to centralized cooling system in developed district areas
2. Incentives provided for residential and commercial buildings to connect to the newly proposed centralized cooling system
3. Negotiation with private sectors and legislation for centralized cooling system

Yet, the above suggestions only focus on energy reduction, other considerations including financial and managerial factors should be further studied to achieve an enhanced energy delivery system in Hong Kong.

Inspirations from Iceland's Energy Technology

Carbfix Project

Carbfix is a method that captures CO2 and inject them into rocks for permanent storage as minerals. The Carbfix project is still a pilot scheme in Hellisheidi Geothermal Plant in Iceland, and the operator is optimistic that the project could help reinject 100% of CO2 generated by the plant into the ground in future. There is great potential in reducing carbon footprint by further developing this technology in the long run.

Potential of Carbfix

Wherever the source of CO2 is located near basalt formations or with the presence of sufficient water source of either freshwater or seawater, Carbfix could be applied. Basaltic rocks, one of the most common types of rock on Earth, is highly reactive. These rocks could be found in land surface and also the ocean. They are made up of around 25% by weight of iron, calcium and magnesium, which can react with CO2 to form carbonate minerals to permanently immobilize CO2. Carbfix is theoretically applicable to anywhere that fulfills the required conditions.

There is a large potential in the ocean floor for storage of CO2 as it is made of basalt. Using the Iceland analogue, the storage potential of all the ocean ridges is of the order of 100,000-250,000GT CO2. The magnitude is larger than the estimated CO2 emissions generated by burning all fossil fuels on Earth (Snaebjornsdottir et al., 2014; Archer, 2005).

Financial implications of Carbfix is lower than the conventional carbon capture and storage (CCS) method. Taking the Carbfix project at Hellisheidi Geothermal Plant in Iceland as reference, it is estimated that the cost of capturing, transporting, injecting and monitoring in a 30 year lifetime of equipment is around $30/ton. This is only half or even less than the conventional carbon capture and storage required cost, which is $60-130/ton. The cost difference is mainly due to the difference in capturing methods (Orkuveita Reykjavikur, 2016). Conventional method involves expensive extraction of CO2 from power plant emissions through scrubbing - using filters with amines that bind CO2 molecules before pumping into ground. The new Carbfix method allows the plant emissions to be directly pumped into ground as a mixture of CO2, hydrogen sulphide and other gases (Gislason and Oelkers, 2014). A lot of energy is saved from the chemical process to separate CO2 from the gas mixture, and the operation

cost is lower compared to the traditional CCS method.

Applicability in Hong Kong

Since Hong Kong is an offshore city, sufficient seawater and basaltic rocks could be found nearby. This basically satisfies the elemental conditions for Carbfix. Although the development of CCS technology is underway in Hong Kong, it is still worthwhile to look into the potential of Carbfix application since Carbfix performs better, with effective carbon reduction at lower operation cost.

Hong Kong could also conduct the study collaboratively with Mainland China as a regional strategy. There are lots of coal power stations being constructed and expanded in Mainland China each year, and developing Carbfix could help Mainland China reduce its carbon emissions. Studies have found that applying carbon capture and storage as a hub could reduce the overall cost of building the system (Xu and Liu, 2015) and therefore Hong Kong could benefit from the collaboration.

Since there is no financial reward for carbon reduction, power companies usually lack incentives to invest in new methods to reduce carbon emissions. For a business-oriented city like Hong Kong, the government needs to provide more incentives to support innovative new green technologies.

National Level Sustainability Indicators and Assessment

To open up a new index for energy engineering, Iceland has developed a sustainable energy indicator for comprehensive assessment of the local energy system. By integrated model development, different energy solutions are modelled and evaluated to achieve the goal of energy sustainability.

Sustainable Indicator of Energy System

Iceland aims to establish an international standard of energy system that could be applicable to anywhere in the world. The sustainable indicators will allow energy users to identify how their energy systems could contribute to long-term sustainability. This generally covers the life-cycle assessment and the cost-benefit assessment of the environmental impacts brought by the energy development. The testing of the sustainability indicators are currently conducted on geothermal development (Shortfall, Davidsdottir and Axelsson, 2015).

Modelling Energy Transitions

System dynamics models are under development in countries such as Iceland, Japan and New Zealand, aiming to help countries in CO2 reduction. The models compare how different energy systems could achieve low carbon or carbon neutrality in consideration of cost-effectiveness and environmental impacts (International Energy Agency and Nordic Energy Research Nordic Council of Ministers, 2016). Dynamic interactions among energy demand, energy price, supply sectors and infrastructure will be considered while policy assessment will be performed to study the needs of change in energy strategies.

Integrated System Dynamic Model

Based on the above, through developing an energy transition model which illustrates the impacts of assessed energy systems on sustainability, proposed energy solutions could be modelled towards carbon neutrality and energy security. Technically, a robust integrated system dynamics model coupled with decision-support tools could be developed to enable multi-dimensional assessment of complex energy systems.

Applicability in Hong Kong

Hong Kong can also study the sustainable indicator of energy systems, to see its applicability in Hong Kong and make appropriate adjustments based on the city's energy characteristics. The integrated system is also a good tool for providing a holistic view of the energy system at both supply and demand levels, so as to understand the deficiency of the current systems for future improvement.

Hydrogen Economy in Iceland

Iceland is a pioneer of hydrogen fuelling. Hydrogen is created from electrolysis using electricity, thus serving

as an energy carrier. Since Iceland's electricity production originates from abundant geothermal and hydropower energy sources, the economic and environmental cost of hydrogen production in Iceland is relatively low. With such an advantage, Iceland has aimed to transform into the world's first hydrogen economy in 2050 (Icelandic New Energy, 2008). A hydrogen economy is a hypothetical economy in which the energy required for transportation and electricity is derived from hydrogen. The vision is to replace the gas combustion engines of all vehicles and vessels with electric motors running on hydrogen fuel cells (Salameh, 2009).

To achieve this target, Iceland has been doing various pilot schemes on the applicability of hydrogen fuel on buses, cars and fishing boats. The leading programmes launched included the Ecological City Transport System (ECTOS) project and the Sustainable Marine and Road Transport (SMART) – H2 project which examined and evaluated the performance of hydrogen as a fuel for transportation. The results were promising and hydrogen development is set to be one of the energy trends in the future (Icelandic New Energy, 2008).

Applicability in Hong Kong

In Iceland, hydrogen is mainly produced by electrolysers and is considered a clean fuel provided that the electricity used in hydrogen production is generated from sustainable sources without the emission of greenhouse gases. As discussed in previous sections, Hong Kong would still largely depend on producing electricity via fossil fuels and therefore, the production of hydrogen in an environmentally friendly way will not be feasible.

In order to implement hydrogen fuelling in Hong Kong, there are also a number of safety issues that need to be tackled. The EMSD conducted in 2009 a study for implementation of Natural Gas / Liquified Petroleum Gas Buses and Heavy Duty Vehicles in Hong Kong (EMSD, 2009), and the study concluded that due to the explosive nature and the supply stability, it is difficult to introduce such vehicles until we provide adequate and sufficient fuel supply network and storage. However, the installation of the network and storage will face huge challenges due to the close proximity of neighbourhoods, in particular in urban areas. The same result applies to hydrogen fuel -- the government would face large opposition from the local community to install explosive facilities in their neighbourhood.

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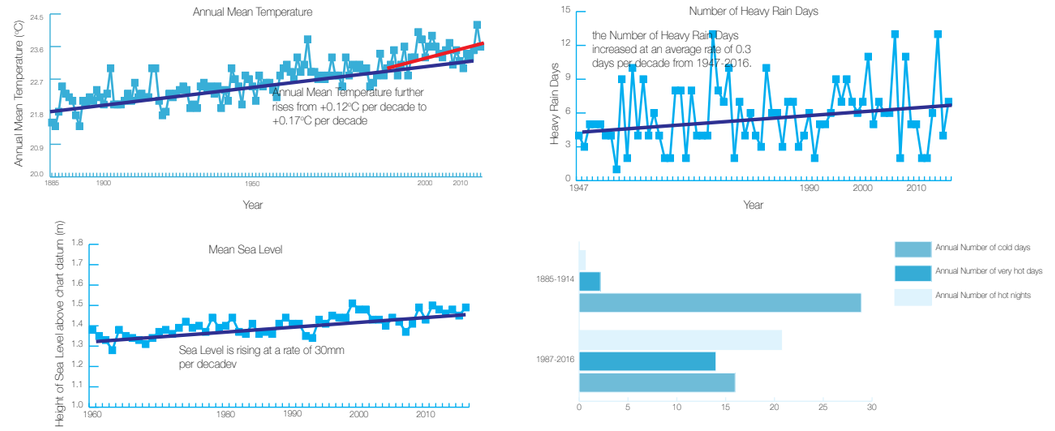
Hong Kong Story: Engineers' Responsibility

Climate Change in Hong Kong

Hong Kong has been experiencing more extreme weather events in the recent decades. Annual mean temperature keeps increasing with an average rise of 0.12°C per decade from 1885 to 2016 (Hong Kong Observatory, 2016), in which rate of increase in average temperature accelerated dramatically in the latter half of the 20th century, reaching 0.15°C per decade during 1987-2016. The rainfall and sea level are also in a similar situation. The annual number of heavy rain days (days with hourly rainfall greater than 30 mm) increased at an average rate of 0.3 days per decade from 1947 to 2016 while the mean sea level in Victoria Harbour rose at a rate of 31 mm per decade during 1954-2016. The rise of mean sea level had not only increased the frequency of flooding, but also caused more severe storm surge. When the high winds pile up sea water against the coast, the sea level would be higher than normal. Also, as the pressure is relatively low at the centre of tropical cyclone, the sea level would be sucked up (Sham, 2017). The Typhoon Hagupit in 2008 is one of the significant examples showing that climate change exists and is affectinwg our daily life. From the below graphs of increasing temperature, heavy rainfall and rising sea level, it is apparent that climate change's impact on Hong Kong is becoming more serious (Hong Kong Observatory, 2016).

Climate change knows no borders and has been affecting us in a lot of ways, such as built environment and business, food resources, human health and safety and biodiversity. The impact could entail environmental, social and economic issues.

- **Built environment & business**. The increased heavy rain, thunderstorm or other extreme weather events lead to increase in the risk of flooding, landslides and lightning strikes and bring damages to buildings



Climate change impact to Hong Kong become more serious (HKO, 2017)

and infrastructure. Thus, the number of claims for buildings' damages or injuries/ deaths will increase. To minimize the loss due to climate change, it is important to buy insurance and have good risk management to prepare for any incidents. However, the emergency preparation may increase the financial burden to small and medium-sized enterprises in Hong Kong.

- **Food resources.** Climate change will lead to insecure food supply. As more than 90% of Hong Kong food is imported from around the world, the global food crisis will push up Hong Kong's food price and threaten its food security (Council of Sustainable Development, 2011). According to a report released jointly by the Chinese Academy of Agricultural Sciences and some other organisations, by 2050, food production in the Mainland would drop by 14%-23% under the effect of climate change, resulting in a shortage of food supply (Chinese Academy of Agricultural Sciences, 2008). Moreover, a study in the journal Nature has found that climate-change-driven droughts and heat waves have reduced harvests by between 9 per cent and 10 per cent globally (Lesk, Rowhani & Ramankutty, 2016).

- **Human health and safety.** The higher temperature encourages the transmission of vector-borne diseases, especially for the diseases carried by mosquitoes. When the temperature is kept warm, the vectors will be more active and have higher aa increasing trend in recent decades. For example, according to a research published by the Collaborating Centre for Oxford University and Chinese University of Hong Kong for Disaster and Medical Humanitarian Response (CCOUC) and the Chinese University of Hong Kong, the number of dengue fever cases in Hong Kong has been on a rise in the last five years, from 30 cases in 2011 to 114 cases in 2015 which is a 280% increase (Chan, Hung, Lau & NG, 2016) . Moreover, as the number of very hot days is higher, the chances of having heat stroke during outdoor work is higher.

- **Biodiversity.** The climate change forces the flora and fauna to adapt to the new environment by shifting habitat, changing life cycles, or the development of new physical traits. Some vulnerable species that are sensitive to climate change are difficult to survive under such harsh environment and hence they will probably become endangered (Johnston, 2017). The species distribution pattern is changing and may lead to unbalanced biodiversity.

As climate change gets worse, the increasing negative impact prompted Hong Kong to be concerned about the existing situation. On the other hand, this could led to some opportunities and we find ways to alleviate the risks generated by climate change.

- **Job opportunities.** New opportunities that spur low carbon growth are rising in the market. Green technologies and products such as renewable energy, electric vehicles (EVs) as well as energy efficient and green consumer products have emerged in large numbers in the market in recent years. To support this fast development, it is necessary to create more job opportunities in green business and allocate appropriate people to the corresponding position. Professionals that provide green solutions are on demand, in particular during the planning to implementation stage of a project. Also, they could monitor continuously the projects and ensure that they are executed sustainably. Creation of such job opportunities plays an important role in promoting Hong Kong to be an environmentally-friendly and smart city.

- **Increase public awareness.** The public is now more aware of what constitutes an environmentally-friendly living style and are willing to do more to protect our environment and fight against climate change. The government and some companies would hold different activities to promote climate change and raise public's green awareness. For example, the Jockey Club Museum of Climate Change (MoCC) which is jointly organized by the Chinese University of Hong Kong and the Hong Kong Jockey Club offers an interactive and multimedia exhibition showcasing valuable collections and information about climate change (MoCC, 2017). The public could know more the climate change by education and public engagement activities, for example, from reading government publication such as Hong Kong Climate Action Plan 2030+ published by Environment Bureau.

Climate change is caused by humans and thus we have the responsibility to tackle it. To stop the exacerbation of climate change impacts, it is a must for us to take action immediately.

Hong Kong in Climate Change

As a Special Administrative Region of Mainland China, Hong Kong does not assume independent obligations under the international sovereign-based United Nations cooperation regime over climate change. Representatives from Hong Kong joined the Conferences of Parties to the Conventions and the Protocol in the past, and were part of the Chinese Delegation. Our greenhouse gas emissions inventory, as well as reports on our actions derived from our mitigation and adaptation strategies, is to form part of the national communications to the United Nations (Environmental Bureau, 2010).

The fight against climate change in Hong Kong

Same as other parts of the globe. Hong Kong has been suffering from the impact of climate change in the last century, and the Hong Kong Government has been putting effort to remediate the impacts. Our first time to explicitly state the crisis and measures to global warming in the Policy Address was in the year of 2007/08. The Chief Executive announced that Hong Kong will honour its pledge and seek to achieve a reduction in energy intensity of at least 25% by 2030 with 2005 as the base year (HKSARG, 2007).

To further reduce greenhouse gas emissions, Hong Kong has taken vigorous actions in recent years. For example, at the end of 2016, an inter-departmental committee chaired by the Chief Secretary for Administration submitted a report proposing to adopt measures of mitigation, adaptation and resilience to combat climate change, with a view to reducing the carbon intensity in Hong Kong from the 2005 level by 65% to 70% by 2030 (Legislative Council, 2016). Furthermore, the Working Group on Infrastructure under Climate Change has been established to coordinate efforts among works departments to combat climate change, including updating infrastructure design standards and comprehensively reviewing the resilience of the existing infrastructure (Environment Bureau, 2017). Besides, the Environment Bureau expanded the scope of the Mandatory Energy Efficiency Labelling Scheme to cover more electrical appliances and promote low-carbon living in the community. Moreover, the new Scheme of Control Agreements with the two power companies not only improved the regulatory arrangements, but also enhanced the public awareness on energy efficiency and promote the development of renewable energy (HKSARG, 2017).

The Environment Bureau, has also published various plans to address climate change, including "A Clean Air Plan for Hong Kong", "Hong Kong Blueprint for Sustainable Use of Resources 2013-2022", "Energy Saving Plan for Hong Kong's Built Environment 2015~2025+", and "Hong Kong Climate Change Report 2015"; and the latest "Hong Kong's Climate Action Plan 2030+" (Environment Bureau, 2017). These documents lay out our environmental protection policies, strategies and targets. Additionally, the plans have detailed the gaps and challenges with a view to engaging the community and connecting to the globe.

Hong Kong & Climate Change - beyond 2030

The Government also extend the scope to develop sustainability from town planning level, "Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030"(Hong Kong 2030+), is a strategic study released in 2016 to update the territorial development strategy of Hong Kong, which is built on the foundations of Hong Kong 2030 and has revisited the planning strategy and spatial development directions beyond 2030. A key to achieving the planning goals proposed under Hong Kong 2030+ is to formulate a smart, green and resilient city strategy.

The Hong Kong's Climate Action Plan 2030+ report, responds to the Paris Agreement, sets out Hong Kong's new carbon emissions reduction target for 2030 and the concerted plans for meeting it. The report covers an extensive range of initiatives for the Government, business and community, creating economic and social opportunities. The 4Ts, namely Timeline, Targets, Transparency and Together, feature in operational framework for Hong Kong on climate change. In other words, setting targets with timelines to ensure the transparency of metrics to track result together is the key in operationalising the Paris Agreement in Hong Kong.

Mitigation, Adaptation and Resilience

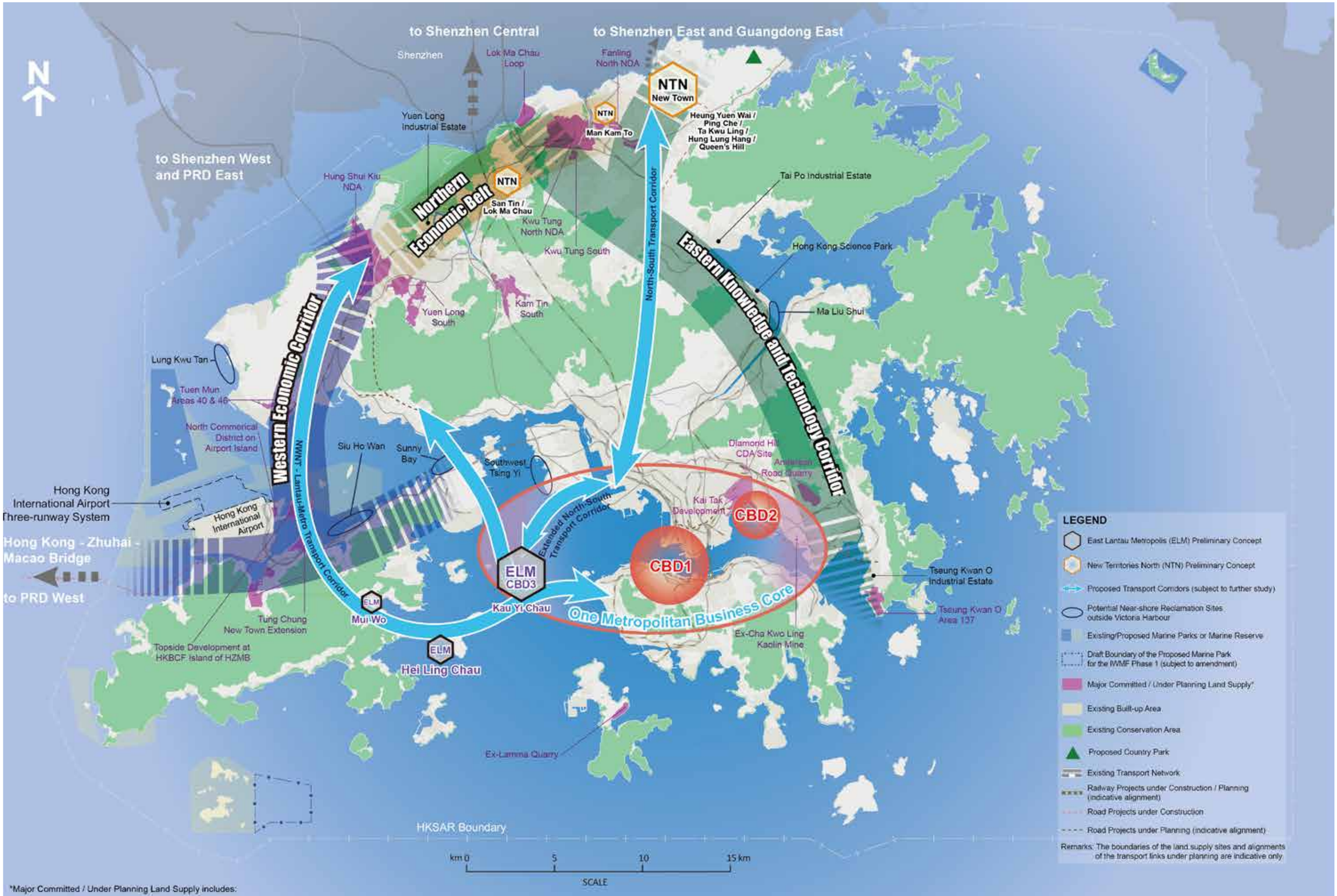
Mitigation

In the Climate Change Action Plan 2030+ (Environment Bureau, 2017), the Hong Kong government outlined an overall operational framework for climate change - the 4Ts (Timeline, Targets, Together and Transparency). Setting targets with timelines, ensuring there are transparent metrics to track results, and for everyone to work together summarises the essential elements of what the Paris Agreement calls upon the world to do. These are certainly important policies that will drive appropriate measures targeting climate change efficiently. The key part is to follow up on the 4Ts, working together to meet the targets.

<u>Incentivizing mitigation measures</u>

In order to keep a sustainable momentum in carrying out mitigation and adaptation measures against climate change, providing the proper incentives had emerged as one of the key factors in the fight against climate change.

The electricity pricing system in Iceland provide good ground for promote better energy efficiency and renewable energy



*Major Committed / Under Planning Land Supply includes:

Kai Tak Development, North Commercial District on Airport Island, Tung Chung New Town Extension, Topside Development at HKBCF Island of HZMB, Yuen Long South, Hung Shui Kiu NDA, Kam Tin South, Lok Ma Chau Loop, Kwu Tung North NDA, Fanling North NDA, Anderson Road Quarry, Diamond Hill CDA Site, Ex-Lamma Quarry, Ex-Cha Kwo Ling Kaolin Mine, Tuen Mun Areas 40 & 46, Kwu Tung South and Tseung Kwan O Area 137

Hong Kong 2030+ aims to formulate a smart, green and resilient city strategy (PlanD, 2016)

While all citizens have a moral obligation and all private firms have a corporate social responsibility to contribute towards lowering carbon emissions, as well as adapting to future climate change, in a target-oriented society that we are in, there must be incentives in place to drive the effort further. The government must take a leadership role, and must work together with the private sector to implement mitigation and adaptation measures.

Energy supply

To reduce carbon emissions, the first thing would be to look at the source, by addressing carbon emissions from energy supply. Iceland's primary mitigation measure to reduce carbon emissions is its extensive use of renewable energy for electricity generation and other energy uses such as space heating. Although Hong Kong lacked the primary energy resource, Hong Kong is seeking other ways to mitigate greenhouse gas emissions from the energy supply side, by changing its fuel mix ratio (Environment Bureau, 2017). In this regard, what Hong Kong is doing is quite similar to what Iceland did almost a century ago, as it switched from predominantly fossil-fuel based (peat and imported coal) to mostly renewable energy from geothermal power and hydropower. The focus of Hong Kong is currently more on a lower carbon intensity fuel mix (natural gas being a fossil fuel with lower carbon intensity than coal) than large scale implementation of renewable energy like Iceland. Although Hong Kong does not have the abundant geothermal and hydropower resources that Iceland has, we have much more potential for improvement in carbon emissions by way of changing our energy production when compared to Iceland, who is already almost completely run on renewables and thus have less that they can do to further decrease emissions. The Hong Kong government has taken some steps to establish leadership in renewable energy implementation, such as the hydropower plant at Tuen Mun Water Treatment Works, the solar farm at Siu Ho Wan Sewage Treatment Works, photovoltaic panels on government buildings, and waste-to-energy at T-Park. These are mostly pilot-scale plants but a good first step to lead Hong Kong towards more renewables.

The energy market in both Iceland and Hong Kong are highly regulated and this is the means by which we can drive broader shifts towards greener energy. Iceland provided a good example with the electricity pricing system, whereby they have recently replaced the conventional Revenue Cap Regulation and the new electricity price regulation that allow for some degree of competition and customer choice, in order to promote better energy efficiency and renewable energy. This system is similar to but more complex than Hong Kong's current revenue cap regulation, helping to encourage incorporating renewable energy or other more advanced energy technology. In Hong Kong, the government regulates the electricity market as well by controlling the revenue cap through negotiation with the electricity producer duopoly, i.e. the Scheme of Control (SoC) agreement. Some see Hong Kong's Scheme of Control agreement with the two utility companies as lacking the ability to effectively control emissions, due to the fact that greenhouse gases are not included in the emissions cap (The Climate Group, 2010). The SoC is based on the utility companies being remunerated according to their capital investment, which is not the same as them being rewarded for encouraging energy efficiency or sourcing renewable energy. This is something that Hong Kong may learn from Iceland and other countries in the world.

How can we create incentives to encourage renewable energy on the production side when they will make the same profit anyhow? What are other appropriate measures in addition to financial incentives encourage a low carbon transition for the energy producers? How can we encourage distributed renewable generation? What can we do in terms of modifying policies and regulations (e.g. adapting building regulations for rooftops) to facilitate and incentivize renewable applications? This is something

Hong Kong has been implementing measures to fight against Climate Change.
(Environmental Bureau, 2017)

we all should think about.

Energy demand

Mitigation by reducing energy demand is also an important measure. Hong Kong is working on improving energy performance for government infrastructure. WSD and DSD, the main consumers of electricity in government infrastructure, are working on maximising energy efficiency in their plants and replacing or renovating aged facilities with highly energy efficient ones and also to optimise their performance. Highway Department can use low-to-medium wattage LED lights in appropriate parts of the public lighting system. In addition, the implementation of the District Cooling System (DCS) at Kat Tak Development will provide more energy efficient air-conditioning services for all non-domestic buildings, and is the first of its kind in Hong Kong. The Mandatory Energy Efficiency Labelling Scheme (MEELS) will provide further incentives for people to use more energy efficient products. These measures will be further discussed in the "Energy" section of this report.

Transportation contributes to 16% of the total carbon emissions in Hong Kong, and so Hong Kong is also looking at reducing carbon emissions from this sector, similar to what Iceland has been doing. As a much more dense city than Iceland in general or even Reykjavik, Hong Kong has a well-developed public transport system with the railway as its backbone, which is much more energy efficient than cities and countries with higher reliance on vehicles. Although 90% of Hong Kong's daily passenger trips are already by public transport (Environment Bureau, 2017), Hong Kong 2030+: Towards a Planning Vision and Strategy Transcending 2030 (Planning Department, 2017) proposes to reshape the travel pattern to reduce vehicle-based commuting needs through better spatial planning. The government

aims to further reduce carbon emissions by expanding rail with better integration of urban planning, housing and transport, improving accessibility and connectivity, enhancing public transport, leveraging smart technology for traffic management, fostering cycling-friendly environment, working with public transport operators to improve energy efficiencies, facilitating the introduction of new technology, and strengthening enforcement against traffic congestion offences (CliamteReady@HK, 2017).

In particular for Hong Kong, buildings account for more than 90% of the electricity consumption of the city (Environment Bureau, 2015). Thus, adoption of green building measures are especially important. This sets a favourable environment to have a financial incentive for reducing their energy use to save money. However, the capital cost for such measures may put off some private firms as the return period may be considered long and thus entail greater risk for their businesses. This is especially the case for existing buildings, whose owners have little incentive to retrofit or retro-commissioning. Engineers can help create more opportunities for easy, convenient and cost-effective implementation of energy saving measures.

Similar to Iceland, Hong Kong has put much effort into green building measures to decrease energy consumption -- in fact, it may be said that Hong Kong has done even more than Iceland to study, implement and promote green buildings. Hong Kong has our own local set of green building certification scheme, BEAM Plus, which is an effective means of creating "Transparency" as well as providing incentives to meet our targets. The government is promoting BEAM Plus for new buildings through granting gross floor area (GFA) concessions and leading by example for public sector buildings (Environment Bureau, 2017). The government is also reviewing possible ways of reducing energy use in existing buildings through energy audit, benchmarking, retro-commissioning, retrofitting, green building standards and promoting dialogue between public and private sectors. Measures to reduce carbon emissions from other sectors such as the "Green Construction Certification" and "Carbon Labelling Scheme for Construction Products" to encourage low carbon construction, for buildings as well as infrastructure, provide further incentives. The Government makes reference to the labelling scheme for public sector projects, while the schemes are gaining traction in Hong Kong with the private sector (Environment Bureau, 2015).

Iceland is looking at measures to reduce the burial of organic waste at landfills and ways of utilizing methane generated from landfills. In a similar manner, Hong Kong is also investigating ways of reducing greenhouse gas emissions from disposal of waste and smart ways of utilizing methane from landfills. Hong Kong is building an Organic Waste Treatment Facility and starting to implement a comprehensive waste reduction strategy aimed at waste reduction broadly. While Iceland is burning methane for electricity production and to power its small-but-growing methane-powered fleet of vehicles, similarly Hong Kong is also using its landfill gas (which is predominantly methane) for powering on-site infrastructure and treatment processes. In addition, Hong Kong's T-park harnesses the energy in sludge from sewage treatment and converts it into usable energy. Iceland also has extensive mitigation measure for the industrial and fishing sectors as well as a lot of investment on carbon sequestration. Hong Kong has limited industry or fishing and agriculture and thus has not spared much effort on these aspects.

Adaptation

Adaptation to climate change is necessary in order to deal with unavoidable consequences of locked-in climate change, since much of the carbon emissions since the start of the industrial revolution has already happened and cannot be entirely removed. With the consequences of climate change such as floods, increased extreme weather events and heat waves endangering our daily lives and our property, measures must be taken to minimize the impact to society.

Building for climate adaptation

Hong Kong is already starting to implement such adaptative measures (Environment Bureau, 2017). Infrastructure is now being built to withstand higher climatic risks such as heavy rain, strong winds, landslides and flooding. Power utilities and the MTR Corporation are also doing their part to plan for climate vulnerabilities. To alleviate the heat island effect, to improve the urban climate and respond to climate change, we are incorporating urban climatic and ventilation considerations in planning and urban design. In light of the risk of more frequent extreme weather events such as floods and large storm surges, the government are looking at measures to make our drainage system climate resilient in an integrative approach using the Blue-Green concept, where we approach flood risk with an integrative approach (Drainage Services Department, 2016). These are good examples of where Hong Kong is starting to take measures to adapt to future climate change, but much more needs to be done.

Embracing New Technology

In Iceland, we learned how the Icelandic government as well as private firms in Iceland are investing in research and development (R&D) and adopting new technology to mitigate climate change and reduce carbon emissions. For

instance, Carbfix, where carbon dioxide from power plants are pumped into the ground with pressurized water to harness an innovative method of carbon fixation, and the use of methanol produced from carbon dioxide is being used as fuel for a small fleet of methanol vehicles on the road already, are examples of iceland's use of new technology. Hong Kong has much to learn from Iceland in this aspect. We can certainly take a more proactive approach in the adoption of innovative technology. We would also need to do more research on how to scale up new technology we have piloted already. The recent advances in smart technology and Internet of Things (IoT) is creating a golden opportunity for Hong Kong to become a smart, green and resilient city (Planning Department, 2016).

Planning ahead

It is essential to do the proper planning and build flexibility into our built systems and environment now to avoid difficulties in the future. Early anticipatory adaptation will be more effective and less costly than retrospective, emergency measures. As discussed by Ms Amy Cheung of the Planning Department, the Hong Kong government is incorporating climate change into our planning considerations. Incorporating ideas for low carbon living and adaptation measures for the impact of future climate change during urban planning will not only mitigate climate change and make Hong Kong more climate resilient, it will also make Hong Kong a more livable society in general. In addition, the Hong Kong government has invested much effort into planning for our necessary resources, such as addressing water resources in the face of climate change by diversifying our water sources and reducing demand. Similarly, measures to address food security in the face of climate change have been proposed (Environment Bureau, 2017). Planning ahead is important as this is how we can build a smart, green and resilient city.

Resilience

The role of education and raising public awareness on the risks of climate change and how to mitigate and adapt to it is of utmost importance. Climate change is not merely the responsibility of the government or big corporations -- it is the responsibility of all citizens of the world. When we involve the public more in our planning actions, and engage the entire community in actions on sustainability, the power of the masses can be utilized. We can also make sure that everyone is better prepared for climate change with a stronger sense of disaster-readiness.

Role of public vs private sector

One of the encouraging aspects we observed in Iceland was that the private sector played a major role in climate change mitigation. Power companies invest in geothermal and hydropower. Pilot schemes in alternative fuel vehicles are undertaken by the private sector. In Hong Kong, while we have taken some steps in lowering carbon emissions, much of it is in the public sector. The Hong Kong government is working on encouraging private firms such as property developers to take green building and energy saving measures by incentives such as Gross Floor Area (GFA) concessions. It would be great if Hong Kong can do the same and have a private sector-led movement towards green energy and low carbon measures. In addition, research and development on innovative energy production and energy saving measures is something that involves government, academia as well as private firms. Throughout our study, we heard examples of studies such as those on wind farm applications, solar farms and green building measures that involved institutions, government departments, utilities such as CLP, and private firms. The increase in R&D and collaboration and cooperation between.various involved parties and stakeholders is key to success.

Habits

As mentioned by Ir Dr. Otto Poon, Hong Kongers lag behind considerably as far as green habits is concerned when compared to other advanced Asian societies such as Taiwan and South Korea. In Taiwan for example, all citizens sort their waste and separate out recyclables and organic waste for collection, bringing them out when the garbage truck arrives. This kind of dedication may seem almost unimaginable to Hong Kongers accustomed to the convenience of throwing whatever garbage they have whenever they like, but this begs the question -- if the Taiwanese can do it for the sake of protecting the environment, why can't we? Can we make sustainability a part of our daily habits? Can we all think twice before we buy, consume, or generate waste? Transforming our culture and habits is certainly something each of us need to be involved in for sustainability.

Looking forward

With the proper planning and building for climate change, and more research and development, community building, and public engagement to increase the awareness of Hong Kong citizens on the risks of climate change and how to adapt to it, Hong Kong can surely become a more climate resilient city.

Hong Kong Engineers' Responsibility

The mitigation and adaptation measures have reflected the contributions and efforts that Hong Kong engineers have made to combat climate change. Our engineers have devoted themselves to design greener buildings with lower carbon footprint, build infrastructure / power plants that reduce the use of fossil fuels, and to execute adaptation works to protect the public from possible hazards such as flooding and landslides as a result of climate change. The amount of work that engineers have done shall be recognised and appreciated. On the path of fighting climate change, it is also time to evaluate what Hong Kong engineers can improve on existing works and to explore what have not been done and can be done further.

In the history of engineering, functionality always comes first when creating any design. While this should still hold true, some design factors such as environmental considerations, which were traditionally secondary factors, have now become primary factors. While engineers have been developing better hardware to protect the environment, the software has barely been touched on. The root of the energy consumption problem comes into two parts: the energy required for operation and the energy consumed from users. **Engineers should start to focus on users' behavioral pattern** [WONG. T C. (April 10, 2017). Personal Interview.] As an example, illumination provision in offices could be mapped to individual seats instead of floor zones. Such design optimises electricity saving from unnecessary illumination at other seats within a zone. The above demonstrates the consideration of needs without jeopardizing functionality (i.e. to provide illumination for an individual when needed). While the above design could be done in many ways, integrating users' behaviors would be most effective. By

turning the staff access card into the illumination switch for his/her corresponding seats, illumination is supplied only when the card is placed in the switch panel. When user leaves his/her seat, he/she will remove the access card from the panel to turn off the light [WONG. T C. (April 10, 2017). Personal Interview.]. Hopefully, if cultivated under the right environment, this change in habit shall create positive influence to users in other of their living habits. This example showcases the behavioral and psychological considerations taking place for a building design. It is time for engineers to step back and review whether the path towards hardware enhancement, which will eventually reach its plateau, is our way forward. Or shall we start creating designs that get down to the root of the problem (i.e. users' behavioral pattern)?

While the answer to the above question may require some thinking time, there are some other works that Hong Kong engineers have barely been involved in and may wish to give it a go. **That includes collaborations with experts from other fields and lobbying with the government and the public.** As the world has changed by increasing complexity, the engineering problems that engineers solve have also become more complex. Fighting against the war of climate change, each individual group of experts with their expertise on the same field including biologists, climatologists, environmental scientists, and engineers, has been fighting solely on their own. Each and every group has been putting in great amount of effort towards one common goal. However, this war could not be conquered with one man's power. Us engineers in particular, have been creating designs and infrastructures to adapt to climate change without fully understanding the causes. This may have hindered the possibilities of creating a more optimised design or even a design that could help mitigate the climate change impacts. What is suggested here is to let experts in each field to utilise their professional knowledge on this topic and to bring all parties together to share and to collaborate, and to fight for a better solution [NG. C Y. (March 14, 2017). Personal Interview.]. For example, meteorologists and environmental scientists can provide information on the causes and impacts of climate change while engineers create the engineering design based on their inputs. The design can then be passed back to the scientists to evaluate its contribution in easing climate change. Meanwhile, other parties including planners and policy makers shall also be involved to ensure solutions have taken into considerations for all related stakeholders.

Another work suggested to be done is to **encourage engineers to pick up the role as lobbyists**. As environmental proposals and policies have increased in transparency in the recent years, there is a need of a professional and reliable group that can bear on the responsibility of effective communications between the government, the public and other stakeholders. As an example, the government has been encouraging and promoting green buildings. While the published government reports have listed out the benefits of energy savings for green buildings, there is still a gap between government's vision and developers' willingness to adopt. The missing details of how it could be implemented and the concerns that developers have may have pulled back the pace of green building development. In the practical perspective, the lack of standards put difficulties on developers to identify and to choose the type of construction materials that can fulfill a green building design [WONG. T C. (April 10, 2017). Personal Interview.]. In the financial perspective, information regarding return periods, initial cost and recurrent cost can facilitate developers for their decision making. Therefore, engineers shall be the middleman between government and developers to facilitate information exchange, and to help deliver stakeholders' concerns in order to foster green policies. Besides the decision making group, construction and operation and maintenance (O&M) also play an important part in making green infrastructure happen. Similarly, engineers shall help lobby with contractors

Engineers should start to focus on users' behavioral pattern when providing design solutions.

to encourage the selection, import, use, and maintenance of green construction materials and infrastructures. In return, engineers shall reflect to the government on the recognition of contractors' support. These works to be done by the engineers will allow better implementation and execution of green proposals and policies and shall yield more rewarding results.

While the above has covered actions that Hong Kong engineers could take as their responsibilities, there are several facts that will sink into engineer's mind. Unlike some other countries, Hong Kong does not have a lot of natural resources gifted from nature. Other social, economic and political factors have also imposed challenges for renewable energy implementation. Engineers shall appreciate her uniqueness and position, and to understand that there is no "one size fits all" solution. To tackle climate change in Hong Kong, **engineers have to develop unique solutions instead of adopting approaches from other countries**. Although Hong Kong herself has imposed some challenges for engineers to tackle, we should appreciate the blend of Chinese and Western cultures and the tremendous amount of information and technology exchange [LAM. C Y. (April 29, 2017). Personal Interview.]. Being exposed to a big pool of overseas practices and reference designs, Hong Kong engineers should have an open mind to digest, be inspired and to explore.

Gandhi said "Your beliefs become your thoughts; your thoughts become your words; Your words become your actions; Your actions become your habits; Your habits become your values; Your values become your destiny". The influence that each and every engineer can make towards combating climate change shall not be underestimated. With our fingers crossed, Hong Kong engineers will not only create positive changes to our local engineering industry but also to the rest of Hong Kong and the world.

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Conclusion

Iceland, the country of ice and fire, has always been utilising its abundant natural resources to maintain the livelihood of the citizens. Having that said, Icelanders never stop striving towards sustainability and taking an active part in the fight of climate change. Being one of the frontlines of climate change impacts in terms of melting glaciers, it is also certain that Icelanders start to become aware of the impact of climate change towards the world, and hence the theme of this delegation "Climate Change: the Happening".

The HKIE-YMC had been preparing for this delegation since August 2016, aiming to inspire our young engineers and let them experience "climate change" from an extraordinary perspective. Fifthteen delegates were chosen with an aim to review climate change from three areas; the team are to look into climate change from multiple perspective. With the inspiration gained from visiting Iceland, the team then look for advice from local environmental leaders on what the younger generation, in particular young engineers, should contribute to the fight against climate change.

Climate change is here, is happening and is affecting our lives in all aspects.
When we were in Iceland, although temperature and feelings are not too much of a warning signal, what we have seen and heard are heart-breaking: shrinking glaciers which cause severe weather and made our ice cave trips more difficult, fishery industry are hugely affected by the warming sea, and so on. All these are signs to Icelanders that they should do something to combat climate change.

The changes, however, are very insignificant to be seen by the people of Iceland. It is also relatively easy for the people in iceland to shift their energy source away from fossil fuel, given the abundant geothermal energy underneath. Nevertheless, the government foresee the importance of sustainable development, and through changing the electricity pricing and various carbon reduction projects, it is hoped that the general public will be more aware of the changing climate and will work together to mitigate the impacts from climate change.

Climate change also affects Hong Kong, the small city in the far east. We organised several seminars and visits to review how climate change has changed Hong Kong in the last few decades. Rising temperature not only bring us more hot days, but more rainfall and rises on sea level, which brings us more catastrophic storm surge. To fight against the negative impact of climate change, both the public and private sectors had put their utmost efforts into the three keys to the solution: mitigation, adaptation and resilience.

It is well established that the greenhouse gas emission in Hong Kong mostly originated from the use of energy, in particular those from fossil fuel. Therefore it is also interesting to look at how Iceland achieve the so-called "fossil fuel free country". Given the abundant geothermal and vast amount of hydropower resources, we understand that it is difficult for Hong Kong to achieve 100% renewable energy as our natural resources are limited, and that we are forced to rely on fossil fuels. Nevertheless, the team gained inspiration from the Iceland on some carbon reduction projects so as to try to make Hong Kong a "Fossil fuel less city".

With the inspiration and experience obtained, we try to look for an answer on the ultimate question "what engineers should possess, and how engineers can contribute to this fight against climate change?" To do this, we conducted exchanges with officials in Iceland to gain inspiration from them, in turn we shared some Hong Kong experience on raising public awareness on the consequences of climate change, on which they find the "Hong Kong approach" very inspiring. Locally, we also conducted several interviews with environmental leaders to obtain their inspiration and advice to our young engineers on what to be equipped with in order to combat climate change, and that we came to a conclusion with the below four aspects:

- Engineers should provide engineering solutions based on user's behavioural pattern;
- Engineers should collaborate with experts in various field (e.g. environmentalist / scientist);
- Engineers should take a the role as a lobbyist and give out professional views on environmental issues; and
- Engineers should develop unique solution rather than copy other countries' practice / solutions.

Any activities with the theme of climate change remarks the adverse impact human has made onto our planet. This delegation has not only brought the impact and insight from climate change to HKIE-YMC and to HKIE, but to all engineers who wish to build a better, greener and more sustainable future.

Thank to the generous support from the advisors, sponsoring companies, Continuing Professional Development Committee of the HKIE and all local and overseas organisations, this delegation to Iceland was a success where all our delegates surely had gained much inspiration to become better equipped to fight against climate change, and to become influencial people as said by Leonardo DiCaprio, in the UN signing ceremony on the Paris agreement -

'You are the last, best hope of Earth. We ask you to protect it. Or we and all living things we cherish, are history.'

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Delegates' Messages

Mr. Michael CHAN

"The hottest year ever recorded" are the familiar phrases we have been hearing from the news for the past few years. We might have also experienced that nowadays in Hong Kong, the extent of summers is progressively lengthened with winters no longer wintry. Should climate change continue to happen in the future, perhaps one day, winter will vanish and become an historical event. We have thousands of reasons to ignore climate change and live our luxurious life, when all we need is one reason to save help save our planet earth.

Ms. Evelyn WAI

I am so thankful to be selected as one of delegates. The whole delegation series: the trip to Iceland and the fruitful local series, were out of my expectations. I obtained not only technical knowledge, but the attitude towards combating climate change. From the conversation with the locals in Iceland, to the interviews with local series speakers, it could be concluded that "climate change is happening", and these make my visions even clearer. In my lifetime, I will continue to contribute in working towards a sustainable future.

Lastly, a big "THANK YOU" to everyone who supported us to make our delegation happens!

I cannot imagined that we have already passed such a great journey in such a short period of time. Through the past 9-months, we have joined lots of informative activities, starting from various local seminars, site visits and sharings from experienced engineers and government officers, until the journey to Iceland, meeting with overseas experts and advisors. Through working will all delegates, who are energetic and wholeheartedly, I acquired not only the engineering knowledge, but also the friendship among the teammates.
I would like to thanks the advisors and delegates, as well as HKIE YMC for organizing the delegation and broaden the horizon of our young engineers.

Mr. Fred CHOW

Mr. Samson LEUNG

It is my great honor to take part in the HKIE-YMC overseas delegation to Iceland. Undoubtedly, this nine-day fruitful journey in Reykjavik has provided us with invaluable knowledge and experience in climate change issue, from natural wonders to engineering technologies, from environmental policies to concerted mitigation measures, and also friendship, collaboration, enthusiasm and others thing that we may not learn without joining this delegation. All the unforgettable memories and rewarding experience we shared would definitely broaden our horizons and enable us to become a successful engineer to engineer a better world.

Mr. Ivan WONG

Nine days was definitely not enough for this amazing journey! Iceland is so beautiful with its gift of nature. It is also unique in its energy-wise culture. Through cultural exchange, I was deeply impressed by the Icelanders' respect to nature and their intelligence in harassing it. Their response to climate change is positive which brings us aspiration in saving our planet earth. I am thankful for the opportunities to learn and explore in this Delegation. Special thanks must go to all delegates for making this trip happen. It was a memorable experience learning and travelling with you all.

Ms. Cally CHUNG

With the nice people and stunning landscapes, the YMC Overseas Delegation 2017 to Iceland was a memorable journey. In the technical visit, I learnt more on the application of natural resources with advanced technology. It is important to utilize the latest technology as it can help to maximize the efficiency of the natural energy.

I would like to thank YMC, advisors, delegates and others who supported this delegation. This cannot be a success without your full support and involvement. I have learnt a lot in both technical knowledge and personal development through site visits and collaboration with teammates.

Ms. Maggie CHAN

The place that impressed me the most was Jökulsárlón Glacier Lagoon. The powerful waves often pushed the icebergs to the shore of black sand beach, creating an incredible landscape of black sand with blue and white icebergs along the shoreline. Spectacular didn't even come close to describing it. However, due to rising global temperature, I found that the ice appeared to be more like ice floes instead of icebergs compared with the same scenery several years ago. A place like this could not disappear and I hope the awareness of fighting against climate change could be spread through this delegation report.

Ms. Kahl CHEUNG

The delegation to Iceland is indeed a reflective journey. When I feel Hong Kong is getting more humid and hotter, I start understanding that climate change is no longer a slogan. But what amazed me most was seeing the glacier melted into pieces and flew through the sea during the visit to Glacier Lagoon. Iceland is very lucky to have very rich primary resources, although they have a high ratio in renewable energy comparing to Hong Kong, it does not mean Hong Kong is not doing as well as Iceland as Hong Kong engineers are striving our very best to find out solutions in the limited boundaries.

Ms. Rachel NG

If you had told me what I would bring away from this delegation, I wouldn't have believed in you. It was my pleasure to work with our speakers and visiting organisations. The opportunities to interview and exchange thoughts with these great minds after each seminar were all mind-blowing. I couldn't ask for a better delegation team to work with in this nine-month period. They never hesitated to share their knowledge for the good of this delegation. It has been quite a ride and I will carry along with what I have learnt to continue on my chapter of growth.

Climate change has always been an issue close to my heart. As it becomes increasingly apparent that dire consequences will ensue if the business-as-usual scenario continues, it is essential that we start taking actions today. As engineers, we are called to the mission of building a better world. This means we not only build to the superficial requirement or primary purpose of a project , but that we build with sustainability embedded in the very essence of the planning and construction stages of the project in order to make climate mitigation and resilience in the very fabric of what we engineer.

Ms. Sueann LEE

Big thanks shall be given to all delegates for this fruitful journey! Through this delegation, I wondered how pretty our nature would be. It was certainly fascinated to understand how the landscapes and sceneries could nicely collaborated with the green technologies and development in this place. Beyond enriching myself with technical and environmental measures, I was flared along the water stream in the hydropower plant and my heart was lingered in the waterfalls, enjoying the warm sunshine and wind breezes at the seashore. No matter what happens on the road, it is never a mistake for joining this delegation.

Ms. Hidy YAN

Ms. Winnie LAI

Iceland is ranked the highest in my list of countries to visit. I am very grateful to have this visit along with 15 delegates who are also in the field of engineering. In 9 days, we experienced the natural sceneries and various engineering related sites. It is not only amazing to see what mother nature can accomplished but it is also inspiring to see what engineers have achieved using natural resources. This journey has been unforgettable and inspiring. I am honour to have this experience with the 15 delegates as a part of my engineering development

Ms. Cola CHEUNG

I am so lucky that I am one of the members of the Overseas Delegation 2017. There was a series of local seminars related to climate change that allowed me to learn disparate ideas and perspectives from different opinion leaders. Furthermore, the delegation of Iceland was my once in a lifetime experience. It was my fortune to learn the advanced technologies and the unique Icelandic cultures with a group of talented young engineers. I would like to thank other delegates for teaching and helping me a lot in every aspect.

Mr. Dick YAN

Rome wasn't built in a day. We have made this delegation possible in half a year, little by little, from the very beginning until the complete overseas journey was out. Visited our overseas counterparts, we had exchanged our experiences and thoughts. I am sure that this delegation would be beneficial to both of the sides. I could see all the delegates' growth inherently and in terms of technical competence. We have achieved our purposes and the next missions would be to spread the message of climate change and work for it as our career, yet, hopefully this would not be lifelong.

Ms. Fanny YEUNG

"Travelling is better than reading millions of books." This idiom is always true. You cannot feel the power of nature just from the words or pictures. Iceland is close to nature, with mountains, glaciers, lava fields, etc. You will understand why hydropower and geothermal power can be used as renewable energy in their country when you are there. And through exchanges with Icelandic engineers, our horizon has been widened with inspirations.

It is my honour to work with all delegates. Through we are of different engineering background, we have grown and shared lots of happy moments together during the delegation.

Ir Ambrose CHEN

It is always fascinating to see how our young engineers grow in the 9-month oversea delegation, which you can see many things within. Not only the technical knowledge and practices that are "visible" to us; but the vibe and passion our young engineers possess in making tomorrow a better place, and this is far more valuable than the knowledge that we gained during the trip.

Thanks to the CPDC and all sponsors in supporting this sustainable event by HKIE-YMC, and I hope to see this delegation continue to nurture and brighten the career of many more young engineers to come.

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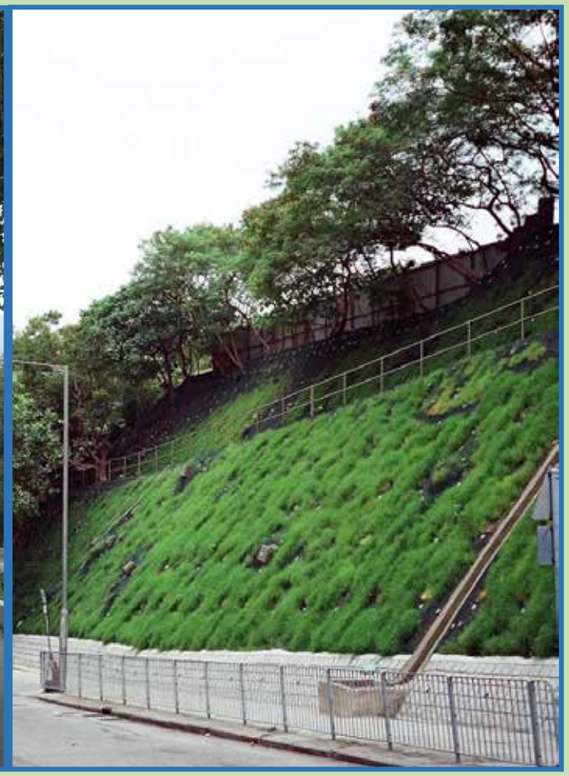

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