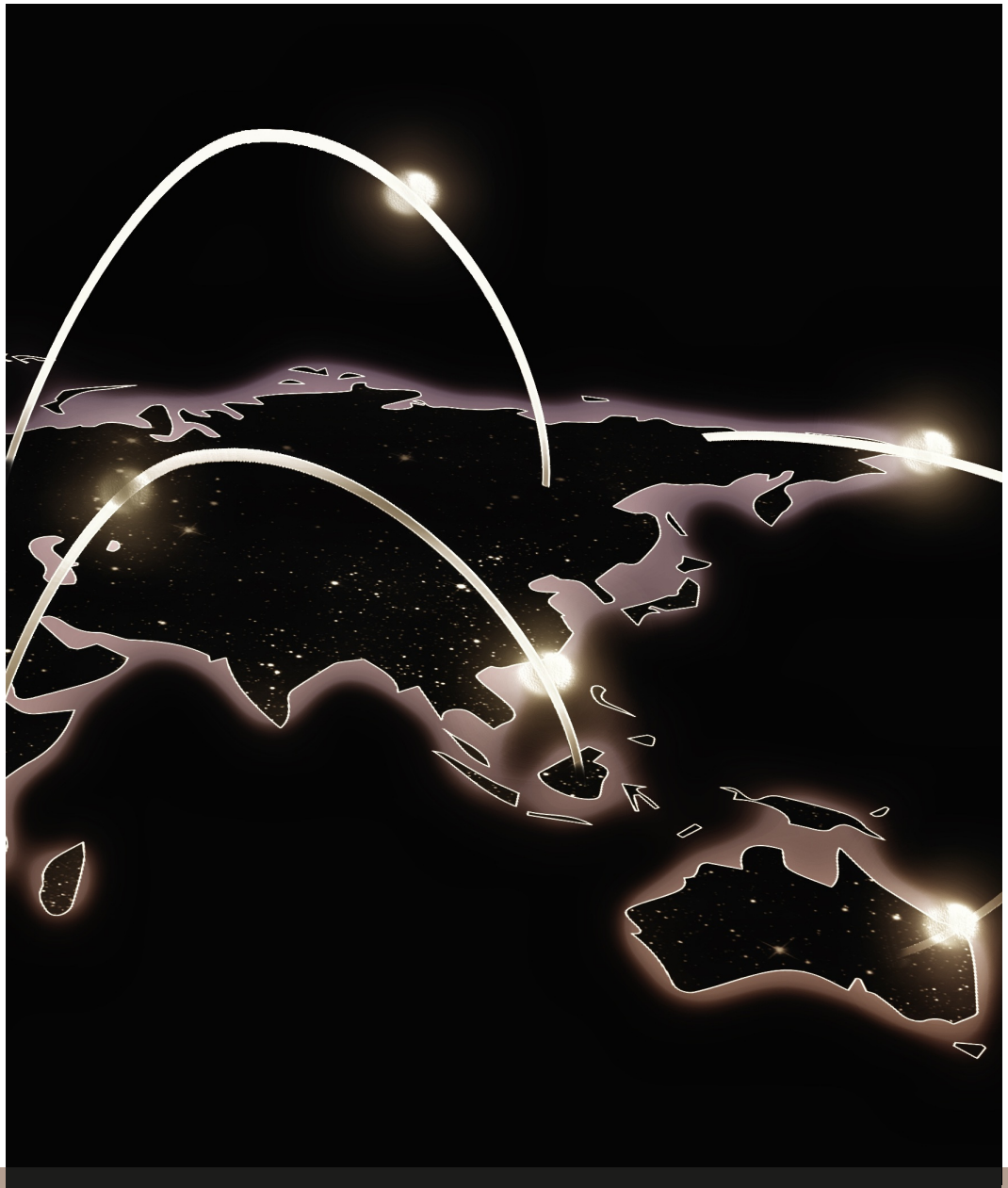
REPORT JAN 2022



CLIMATE MODELLING & GREENHOUSE GASES TRAINING FOR EARLY CAREER RESEARCHERS

Main Organiser

British High Commission Kuala Lumpur

Co-organisers

PENANG GREEN COUNCIL

PENANG 2030

In Association with

UK Science & Innovation Network

UN CLIMATE CHANGE CONFERENCE UK 2021

Contents

Executive Summary

Realizing the need to address the gaps in technical knowledge among young people in Malaysia, the British High Commission in Kuala Lumpur and Penang State Government through Penang Green Council have taken the initiative to conduct the Climate Modelling & Greenhouse Gases (GHGs) Inventory Training for Early Career Researchers for young people with an environmental background in Malaysia and ASEAN countries from 15th October 2021 to 25th October 2021. The training programme consists of the opening session, three days of training sessions with different participants and a focus group discussion involving six experts on data for climate action. The five sessions involved 265 participants from Malaysia and ASEAN countries.

The aim of the programme was to encourage and empower young people in Malaysia with both the scientific and technical skills to support climate action. The programme also provides a platform for young researchers to give their perspective on climate change and data availability in the country. Further, it aims to increase regional cooperation to drive climate action and build support for the COP26 through capacity building in climate-related scientific and technical skills. Through the programme, a talent pool that facilitates assessment and analysis in Malaysia and ASEAN countries has been inspired to contribute towards climate action.

The programme was successfully launched by His Excellency British High Commissioner to Malaysia and Yang Amat Berhormat Chief Minister of Penang giving their opening remarks to 188 participants during the opening session on 15th October 2021. The key findings of the IPCC AR6 report on climate change and its relevance to Malaysia was presented by Professor Fredolin Tangang from Universiti Kebangsaan Malaysia (UKM) who was followed by Professor Andrew Turner from University of Reading who presented on linking global to regional climate change. Participants were also briefed on Seberang Perai Low Carbon City by the Seberang Perai City Council, Penang. Before the Q&A session, the audience were able to get hands-on with a guide to the bite-size climate action modules by Dr Helena Varkkey from Universiti Malaya (UM) where participants were introduced to a website that provide climate change educational materials for teachers and students. Several modules provided focusing on electricity, transport, food, forests, trash and climate change.

The training took place on 18th, 20th and 21st October 2021 with different participants each day. In total, 65 participants were involved for the 3-day training, which comprised: expert Tuan Ismail Hj. Abdullah from the International Green Training Centre (IGTC) presenting on "Greenhouse Gases Inventory – Beginner Level", and expert Dr Chris Brierley from University College London (UCL) on "Climate models and how to use their projections". Between the two session the organizer also conducted a discussion session entitled "Youth for Climate Action" where participants were grouped into five different groups based on their knowledge and background depending on the discussion topic. Subjects covered the challenges and solutions in research and research and innovation related to climate change. Participants also explored the challenges and solution in improving data availability, accessibility and sharing. Discussions also touched on Malaysia's ambitions and proposed actions in view of the announcement in twelfth Malaysian Plan (RMK-12) on carbon neutrality by 2050. The roles of stakeholders in empowering the youth to contribute towards climate action were another of the five topics discussed during the session. The young people's contributions were analysed and included in the report for both future reference and to provide an insight into the current views of the youth of the nation.

The last session of the programme - a focus group discussion on "Data for Climate Action" - was conducted on 24th October 2021. The session was an in-depth discussion on data availability and accessibility, data sharing and on the role of institutions, organizations and industry in data for climate action. Experts also discussed approaches to communicating data and analysis with the community. The session involved two experts from the UK and four experts from Malaysia with a variety of backgrounds and expertise. The experts touched on the need for a centralized data centre that is equipped to take ownership and function as a repository for researchers to submit their data. Laws and regulations should be developed to protect such data and maintain its quality and integrity.

1. Introduction

The level of heat-trapping greenhouse gases in the atmosphere was projected to increase in 2019 and - for carbon alone - an increment of 0.6% was expected[1]. The breakdown of major GHGs gases in the atmosphere in the world are 90% Carbon dioxide (CO_2) followed by 7% Methane (CH_4) and 0.9% Nitrous oxide (N_2O)[2]. Globally, CO_2 emissions had grown by 1.4% in 2017 and 2.1% in 2018 reaching up to 37 Gt (Billion tonnes) with fossil fuel burning and cement production contributing to 90% of the CO2 emissions from human activities[3]. In terms of future projections globally, the International Monetary Fund (IMF) project an increase of 3.2% in Global Gross Domestic Product and if global economy decarbonized at the same rate as the last 10 years, an increase in global emissions will be seen in year 2019[4].

Increased heat in the atmosphere due to the greenhouse effect has also been experienced in Malaysia resulting in erratic climate behaviour. In recent decades there have been increasing occurrences of extreme events such as very high temperatures, high rainfall, dry spells[5], increasing thunderstorms and strong winds[6]. Furthermore, the trajectory for global warming based on current emissions to date is beyond 1.5°C and potentially 2°C[7]. Based on projections (Figure 2), average annual temperatures in Malaysia were expected to increase from 0.6°C to 1.0°C in 2030 and 1.2°C to 1.6°C in 2050[8].

To better prepare the country to face the impacts of climate change, awareness-raising and empowerment of the public are very much needed to facilitate a climate resilient community. There are gaps in technical capacity in Malaysia to address climate related issues from quality data collection, analysis and the skills needed to produce accurate and holistic climate modelling. This programme therefore will provide an opportunity for early

[1] Johnson SK (2019) Here's how much global carbon emission increased this year https://arstechnica.com/science/2019/12/2019-carbon-emissions-look-to-tick-upwards-again/

[2] Ram & Chacko (2019) Creating Future-Proof Cities: How to Navigate the Climate Crisis

[3] Jackson RB, Le Quéré C, Andrew RM, Canadell JG, Korsbakken JI, Liu Z, Peters GP, Zheng B, Friedlingstein P (2019) Global Energy Growth Is Outpacing Decarbonization. A special report for the United Nations Climate Action Summit September 2019. Global Carbon Project, International Project Office, Canberra Australia.

[4] Jackson RB, Le Quéré C, Andrew RM, Canadell JG, Korsbakken JI, Liu Z, Peters GP , Zheng B, Friedlingstein P (2019) Global Energy Growth Is Outpacing Decarbonization. A special report for the United Nations Climate Action Summit September 2019. Global Carbon Project, International Project Office, Canberra Australia.

[5] Tang, K.H.D (2019) 'Climate change in Malaysia: Trends, contributors, impacts, mitigation and adaptations', Science of the Total Environment. Elsevier B.V., 650(September), pp. 1858–1871. doi: 10.1016/j.scitotenv. 2018.09.316

[6] Sammathuria, M.K., Ling, L.K., 2009. "Regional Climate Observation And Simulation Of Extreme Temperature and Precipitation Trends", Paper Presented at the 14th International Rainwater Catchment Systems Conference, 3–6 August. PWTC, Kuala Lumpur available at http://www.eng.warwick.ac.uk/ircsa/pdf/14th/papers/P1-3%20Sammathuria.pdf.

[7] Jackson RB, Le Quéré C, Andrew RM , Canadell JG, Korsbakken JI , Liu Z, Peters GP , Zheng B, Friedlingstein P (2019) Global Energy Growth Is Outpacing Decarbonization. A special report for the United Nations Climate Action Summit September 2019. Global Carbon Project, International Project Office, Canberra Australia.

[8] Ministry of Energy, Science, Technology, Environment & Climate Change (MESTECC) (2018), Malaysia: Third National Communication & Second Biennial Update Report to the UNFCCC.

career researchers (22–35 year olds) to upskill and learn the fundamentals of GHG inventory (accounting and reporting) principles and climate modelling from the experts. Young people across the country were mobilised to take part in this training. Apart from technical training, the programme includes sessions to introduce the latest narrative on GHG inventory and climate modelling in Malaysia delivered by Malaysian experts, an introduction to IPCC WG1 physical sciences findings, a session to highlight sectoral GHG contribution that aims to raise awareness of key GHG contributors. There will be group discussions to identify gaps in the current setting of GHG data (sectoral and state), the capacity (resource and skills) to analyse such data and looking to propose solutions that will mitigate against such sectoral contributions. IPCC scientists predominantly from the UK and Malaysia will be engaged throughout these activities. The training will also provide insights from the UK scientific community and provide opportunities for young researchers to broaden their perspective. Furthermore, it will provide networking opportunities between early career scientists and the UK scientific community.

The objectives of this training are as the following:

- Encourage youth to engage in climate change science and empower them with scientific and technical skills to support climate action.
- Provide a platform for young researcher to highlight their perspectives on climate change and data availability in Malaysia which will prompt a better data collection analysis on climate change in the future.
- Increase regional level cooperation to drive climate action and build support for COP26 through capacity building in climate related scientific and technical skills.

2. Programme

The Climate Modelling & Greenhouse Gases (GHGs) Inventory Training for Early Career Researchers consist of 3 major programmes which are: the opening session, the three days training programme and the last session - a focus group discussion on data for climate action. The detailed agenda for the programme can be found in **Appendix A.**

2.1 Opening Climate Modelling & Greenhouse Gases (GHGs) Inventory Training for Early Career Researchers

The opening session took place on 15th of October 2021 from 4.00 pm to 5.45 pm (MY time)/ 8.00 am – 9.45 am (UK time). The session was opened with remarks by the Chief Minister of Penang, Yang Amat Berhormat Tuan Chow Kon Yeow and by His Excellency Charles Hay MVO, the British High Commissioner to Malaysia. The session was attended by 188 participants from Malaysia and ASEAN countries with diverse backgrounds.

'Key Finding of the IPCC AR6 Report on Climate Change and Relevance to Malaysia' was delivered by Professor Fredolin Tangang, from the Department of Earth Sciences and Environment, Faculty of Science and Technology, Universiti Kebangsaan Malaysia. Professor Tangang gave a brief introduction to the Intergovernmental Panel on Climate Change (better known as IPCC) and the basic requirements in preparing the sixth assessment report. Several highlights of the presentation include the human influences on the climate using the models in the IPCC reports. The increment of global warming caused larger changes in regional mean temperature, precipitation, and soil moisture which consequently, caused larger frequency and intensity of extreme weather-related events. The carbon increment will also slow down the carbon sink process as higher cumulative carbon dioxide is release into the environment. It was also stressed that human activities have affected all the major climate system components with some responding over decades and others over the centuries. Professor Tangang also stressed the importance of building a climate resilient country that can mitigate and adapt to the impacts of climate change. Revised Nationally Determined Contribution (NDCs) of a 45% reduction in carbon emission by 2030 indicates the nation's determination. Urgent actions are needed as Southeast Asia is exposed and highly vulnerable to climate related hazards and disasters. Robust policy and actions that address climate variability and anthropogenic factors are needed in improving climate resilience and minimizing the impact of climate change.

Professor Andrew Turner shed light through "Linking Global to Regional Climate Change" on the factors that govern the cause-effect chain in constructing regional climate information. Climate change is a global phenomenon that manifests and causes consequences in

different regions. There is a profound need for local and regional information to assess the risks and plan for adaptation and mitigation actions. In gathering the information there is the need for a distillation process, where a broad range of knowledge is blended with diverse groups of users to distil information that will have both relevance and credibility. This will engage the values and knowledge of both stakeholders and scientists. Professor Turner also emphasised how users, producers and scientist groups are not homogenous and have diverse perspectives, values, and interests even on the same topic. Sharing relevant climate information between such groups is known as the distillation process. In climate modelling and studies, moving from global to regional scales requires relevant drivers and consideration of local perspectives. Values and context should also be kept in mind while considering the user's and producer's perspective. Professor Turner also mentioned the use of storylines as a tool for studying and communicating regional climate change which assist in conveying a situation or a series of events.

The third sharing session of the day was an introduction to the Seberang Perai City Council (MBSP), Penang, where green initiatives are an integral part of their governance. MBSP aims for: a 70% recycling rate from their current rate of 52.16%, a reduction of GHGs emission from 8 ton CO_2e (2016) to 6.31 ton CO_2e (2020), achieving renewable energy consumption up to 15% and replacing all their streetlights to LED. Smart governance was also part of their move forward especially in handling climate disasters such as floods which are forecast to increase in terms of both intensity and frequency in the coming years, due to climate change.

Community engagement is crucial in building a resilient and informed community. In addressing it, a session by Dr Helena Varkkey on "Let's make Climate Action Personal!: A hands-on guide to the Bite-Size Climate Action modules" was well received by the participants. The website (https://bitesizeclimateact.wixsite.com/malaysia) was developed to make materials on climate change and GHG available freely to be used by students and educators. Targeted modules that suit different ages and levels of education are available and are both interactive and informative. Modules include electricity, transport, food, forests, trash and climate change. Different formats and platforms such as podcast YouTube and TikTok are utilized on the website to increase engagement especially in young people.

2.2 Climate Modelling & Greenhouse Gases (GHGs) Inventory Training for Early Career Researchers

Applications for participants were open from 23rd August 2021 to 24th September 2021. A total of 129 applied to join the training. The organizer and trainers agreed that there should be a limit to 30 participants from Malaysia and ASEAN countries. Participants were selected based on their background and basic knowledge of environmental related matters. Those

with extensive knowledge especially in carbon were given priority to join the training as one of the main outputs is to create a talent pool that will ultimately be able to assess and evaluate the GHG emission and climate modelling conditions in Malaysia.

The training was conducted on 18th,20th and 21st October 2021 from 10.00 am to 5.30 pm (MY time) with each session attended by different groups of participants. Participants for each day were grouped in advance according to their background and the topic that they were to debate during the discussion session "Youth for Climate Action". All materials (including group allocation and discussion topic) were shared a week in advance in order that they might prepare for the training session. This decision was made to increase the efficiency of the training and encourage better interaction throughout the session.

The training session started with an ice breaker activity to introduce participants to the online platform 'Jamboard' (https://jamboard.google.com/) that was to be used again in the discussion session. The use of the resource during the ice breaker ensured that the subsequent sessions progressed more smoothly and gave participants the confidence in using it during the discussion session.

The first session, 'GHG Inventory – Beginner Level' was presented by Tuan Ismail Haji Abdullah, who is both director of the International Green Training Centre (IGTC) and Green Master Trainer acknowledged by the Department of Skills Development, Ministry of Human Resources Malaysia. The GHG training was intended to equip early career researchers, both undergraduates and postgraduates - to provide them with awareness about global warming and climate change issues, causes and impacts - to provide basic knowledge and competency on carbon footprint calculations and greenhouse gas inventory development. The training also set out to assess awareness and knowledge levels about global warming and climate change, and awareness about international, national and city climate programs.

The training content covered global warming and climate change phenomena, greenhouse gas emissions and sources, carbon footprint calculations, greenhouse gas inventory and mitigation and adaptation actions. The session was conducted using a two-way communication approach, where the participants were invited to share their thoughts and opinions as well as to pose questions to the trainer via the chat feature or unmuting the microphone button and directly speaking with the trainer. Questions by participants were compiled and a simple analysis performed to gauge their level of understanding and interest which will inform future improvements. The questions and analysis are included in **Appendix B.**

The Youth Discussion session was scheduled from 2.30 pm until 4.00 pm to enable participants to share their views in identifying gaps in the current setting of GHG inventory in Malaysia, particularly in data availability in the sectoral and state level, and to propose solutions that might mitigate the challenges. The participants were assigned to one of five groups; each group having six members with Group 1 and 2 mainly consisting of

professional and postgraduate students, while Group 3, 4 and 5 were mostly undergraduate students. Each group was given one open-ended question to discuss, which was provided via email along with some reading material links prior to the training to increase their understanding of the topic and encourage a well-informed discussion session. The information collected was of qualitative data, which was recorded, classified, and analysed. The questions had been carefully selected and approved by BHC prior to the training. Coordinators were assigned to each group to ensure the discussion session ran smoothly. Five different topics were given to each group and some related materials were also provided in advance to help participants to prepare before the discussion session. The questions given to the participants are as listed below and included is the summary of the feedback from participants in Table 1 to Table 5. Detailed answers and in-depth analysis are included in **Appendix C.**

> **Group 1:** Assess the opportunities/scope available along with the challenges to venture in climate related research and innovation. Please include suggestions to address it.

Table 1 Responses from Group 1

Day/ Date	No.	Description
Day 1 / 18th Oct 2021	1	Further research on universe or nature factors (such as Sun activity, blackhole in universe, movement of Earth (tilt angle) on climate change on the Earth. Maybe human activity is 90% to blame and 10% of nature events)
	2	Public awareness, disclosure data, reader-friendly, media support
	3	Leadership decision and political changes affecting climate action
	4	Building public awareness on climate and environment issues
	5	Follow the science! According to the latest AR6 published by IPCC, the increase of extreme weather event from climate change has direct relationship to human activity
	6	Accessibility to data - on local level, consolidated climate related data - open, accurate, up-to-date, reader friendly data
	7	Carbon capture & storage (CCUS), open a 'business as usual' scenario, it can reduce carbon emission but neglect other environmental indicators, such as deforestation, acidification, depletion of fossil fuels
	8	Engagement with vulnerable groups, assist to help them adapt to future climate
	9	Funding and more technical research to help the palm oil industry to a sustainable future, forestry management. Reusing existing land to replant oil palm tree, any better sustainable technology to keep the soil quantity without using polluting chemical
	10	Mathematical modelling can help us predict end-user behaviour, socio-technical approach. Machine learning, open data, real-time data, real-time monitoring

Day/ Date	No.	Description
	11	More research on CCUS to reduce the cost and stress test it with carbon pricing to ensure the technology is economically feasible as compared to other carbon intensive technology
Day 2 / 20th Oct 2021	1	Gridded dataset is available to cater for the need of unavailability and inaccessibility of climate datasets. However, the resolution of the dataset is sufficient for large scale study (country, region), but not at all time able to cater for the need for river basin scale. The skill of extracting and handling the data is also needed where the person needs sufficient training for it.
	2	Challenges in publication - Research from developing countries have low opportunity to be published due to the "commonality" of such research compared to more advanced research in developed countries. Collaboration and integrated research between developed countries and developing countries can be used to tackle this issue.
	3	Awareness on Climate Change; lacking compared to covid-19 – hence, find a way to disseminate information on Climate Change. Improve ways of dissemination and increase the related program for awareness among people - especially school children - on climate change.
	4	Challenge: Lack of national datasets on emission factors. Studies on emission coefficients in a country are still very limited (in the number of studies as well as the diversity of sectors)
	5	Develop technology roadmaps for decarbonising sectors. Each roadmap can be analysed for technical feasibility, financial feasibility, socio-economic impact and carbon footprint.
	6	Solution: Invest in human and financial resources for sector-specific emission factor studies in each province of countries
	7	Opportunities: The IPCC methodology has been developed for the calculation of greenhouse gas emissions from activity sectors. Activity datasets for emissions calculations are available in statistical yearbooks and can be easily collected from departments of countries.
Day 3 / 21st Oct 2021	1	It's quite hard to search and get complete data
	2	Communication between agencies (federal and state agencies)
	3	Funding availability for climate study and climate innovation implementation
	4	Lack of experts in Climate-related field
	5	More comprehensive studies on disaster resilience against urban crawling, flash flood, rising sea levels, submerging mangrove forest
	6	Centralization and visibility of data repository in government website/ government research institute
	7	Integrating climate related studies/research into education in all levels (primary, secondary, university) - introducing the subject matter early to the community: statistics, environmental studies
	8	Legislation or incentives or policies to form strategic partnerships with private sectors to look into R&D in climate related research and innovation

Group 2: Discuss the existing challenges in research and innovation related to climate change and suggest solutions to address it.

Table 2 Responses from Group 2

Day/ Date	No.	Description
Day 1 / 18th Oct 2021	1	Challenges - Low Carbon City (Industrial Symbiosis Program) - not all states use this program. Lack exposure & expertise. Difficult to find a relevant partner.
	2	Challenges - research & policy making: lack of awareness, gap in knowledge and expertise in the local scene
	3	Challenges - collaboration between government, industry & academia. (Knowledge transfer, data availability & accessibility. Readiness - technology, funding)
	4	Solutions - authorities should promote/ enforce this kind of activity more. For example, more Eco-Industrial Park.
	5	Solutions - active collaborations, technical support, capacity building to retain homegrown talents
	6	Solutions - coordination (centralised) - mapping. Policy that is more inclusive, research grants & applications (empowering local experts and support of global experts).
	7	Solutions - strategic investment in technologies for Climate Modelling & GHG Inventory
Day 2 / 20th Oct 2021	1	Evaluation matrices to assess the impact of innovation/implementation policy
	2	Difficulty in implementing at lower/ground level (most of the policy discussed/implemented at higher level); no details of policy
	3	Formation of centralized National Data Center on Climate Change
	4	Encouraging/ initiating climate action public participation programs (bottom-up)
	5	Lack of regulation/ standards
	6	Technology/Industry extension program (education and training) to formulate/ disseminate technical standards and requirements.
	7	Profit consideration/ incentive to innovate
	8	R&D tax credit
	9	High priority on climate change related research funding
	10	Limited of funding and data
	11	Government, private and public organizations may provide financial incentives and support for the development and deployment of new technology.
	12	Insufficiently applied research
	13	Open for collaboration
	14	Lack of human resource/expertise
	15	Offer scholarship/ job opportunities
	16	Utilize social media to spread correct message to the public
	17	Lack of awareness

Day/ Date	No.	Description
	18	Vote for politicians with green agenda
Day 3 / 21st Oct 2021	1	Challenges - policy incentives issues, regulation barriers
	2	Challenges - commitment from policy makers, no domino effect
	3	Challenges - lack of supporting infrastructure
	4	Challenges - expensive technology support, unaffordable
	5	Challenges - skilled and professional human resources in R&D of climate change
	6	Solution - carbon tax regulation and Law enforcement (carbon tax)
	7	Solution - community supervision, towards legislator and executive to commitment with climate change
	8	Solution - fostering infrastructure development, more investment (collaboration private sector and government)
	9	Solution - money from carbon tax, should be allocated to climate change R&D technology development
	10	Solution - regular training to increase human resources capability to address climate change problems
	11	Solution - policy makers should redirect investment into net zero fund for R&D to battle climate change
	12	Solution - CCU (carbon capture technology) and related technology should be economical and feasible

Group 3: Discuss the challenges and solution to improve data (such as state and sectoral emission) availability and accessibility and sharing for consolidated climate action.

Table 3 Responses from Group 3

Day/ Date	No.	Description
Day 1 / 18th Oct 2021	1	Challenges - transparency to get ownership of the data
	2	Challenges - lack of funding
	3	Challenges - regulation is the main point to accessibility to obtain the data. In addition, should have stakeholders with all sections who are involved in climate data collection
	4	Challenges - not enough database
	5	Solution - reduce the complexity of the questions at data collection, so all people can understand and participate
	6	Solution - more collaboration needed such as between government, NGO's and research institutes.
	7	Solution - more collaboration needed between research universities, NGO's and big companies.
	8	Solution - not only do we need more financial investment but building support such as technological, skill and capacity development from

Day/ Date	No.	Description
		international sources is vital.
Day 2 / 20th Oct 2021	1	Challenges - lack of open access to databases for emissions
	2	Challenges - lack of data sharing mechanism
	3	Challenges - differing state and national methodologies for estimating emissions
	4	Challenges - financial constraints
	5	Challenges - lack of proper data integration and analysis which causes difficulties in translating the data obtained into information that is easy to comprehend and accessible by public
	6	Challenges - confusing use of jargon and complex figures and datasets of emissions data
	7	Challenges - incomplete or inaccurate reporting of emissions data
	8	Solution - more freedom of information not only on a state level but federal level
	9	Solution - a centralised database for emissions data
	10	Solution - standardised methodologies for state and national estimates for emissions to ensure accurate data
	11	Solution - budgetary factor to develop and maintain a data platform needs to be considered and a consensus reached among stakeholders.
	12	Solution - improve communications for public access and understanding of data
	13	Solution - conducting survey to communicate with public about the method and data accuracy
Day 3 / 21st Oct 2021	1	Challenges - publicly available data (currently not available)
	2	Challenges - data ownership
	3	Challenges - data availability non-granular
	4	Challenges - data that is available too complex for layman
	5	Solution - shift in policy (to making data transparent - open source)
	6	Solution - improve public private partnerships to have consolidated information
	7	Solution - simplify data (example: infographic/ Covid 19 data from KKM)

Group 4: Share your views regarding Malaysia climate ambition and action thus far, especially with the recent Twelfth Malaysia Plan (RMK-12) announcement of commitment to carbon neutrality by 2050.

Table 4 Responses from Group 4

Day/ Date	No.	Description
Day 1 / 18th Oct 2021	1	No clear focus on climate change in Twelfth Malaysia Plan (RMK-12)
	2	Focus more on public transport instead of green personal use vehicles
	3	Waste recycling - smart waste management for easily accessing information about public waste bins through Web/mobile applications.

Day/ Date	No.	Description
	4	More carbon sequestration actions - reforestation should be done to conserve biodiversity/ ecosystem
	5	DETS, carbon pricing
	6	Reduction of GHG in the workplace - cost saving actions
	7	More voluntary actions from the private sector
	8	Solar energy panels can be implemented on government facilities
	9	From the discussion, in my opinion and observation, the government can take up cost savings rather than spending more
	10	More stringent regulations in all industries/sectors
	11	The aim of carbon neutrality by 2050 is achievable with stringent enforcement and detail for the specific study plan.
Day 2 / 20th Oct 2021	1	Our neighbour countries would be inspired with our ambition in Twelfth Malaysia Plan (RMK-12) regarding carbon neutrality by 2050
	2	Carbon Taxing introduction pros: adding a platform for glcs/glics initiatives towards Net Zero Carbon. Cons: Net Zero Carbon is a language that not everyone in the public has the privilege to understand
	3	Continuation and improvement from the existing national policies on green technology (2009) and climate change (2019)
	4	Educate local people about reducing carbon footprint, creating an app which is user friendly so that everyone can calculate carbon emission
	5	The ambition is to be in sync with the Paris Agreement in 2015 to maintain temperature increase at no more than 1.5-degree Celcius.
	6	We do have a good plan; now we need to make sure all states are on the same track. For example, carbon neutrality in Kedah and Selangor and Kuala Lumpur are not the same. Government should really make sure every state is progressing to achieve CO2 neutrality by 2050.
	7	Implementation of green labels or carbon footprint on Malaysian products to promote lower carbon footprint lifestyle
	8	TNB develop and install floating and pv system on coal ash pond
	9	Technological contribution is also required in realising the Net Zero Carbon goal by 2050
	10	More power-saving energy vehicles to be produced
	11	All projects should have an environmental impact assessment. Because usually impact assessment reports are solely prepared for high budget projects.
	12	Include SDG course as one of the compulsory subjects in education
	13	Improve public transport, walking and cycling. More carpooling should be common practice
	14	No clear linkages of Twelfth Malaysia Plan (RMK-12) with UN2030 SDGs
Day 3 / 21st Oct 2021	1	Standard of living - huge gap between the capacity of each state to achieve carbon neutrality. Example, Penang vs Terengganu.
	2	Standard of living - take care of people first so people have the time to take care of the environment
	3	Policy & regulation - reduction of GHG emission by encouraging adoption of

Day/ Date	No.	Description
		renewable energy through green incentives. Example: Net Energy Metering and Feed-in Tariff
	4	Enforcement -limit of law enforcement authorities
	5	Education - more practical, technical, up to date knowledge and skills in tertiary education
	6	Education - readiness of individuals to cooperate with climate ambition is low. Such as circular economy, no knowledge of how circular economy bring benefits to them or helps company to save more money
	7	Education - increase public awareness on their responsibility towards the environment and also the benefits of practicing sustainable lifestyle
	8	Collaborative actions - Degazettement of Kuala Langat North Forest - contradicting decisions between State government and National direction of achieving 17% terrestrial and inland water areas gazetted as protected area in the 11th Malaysia Plan
	9	Collaborative actions - need more collaboration between the academic and industrial players. Example: commercialize research & development study

Group 5: Discuss on ways for youth to contribute towards climate action and ways the stakeholders should support them.

Table 5 Responses from Group 5

Day/ Date	No.	Description
Day 1 / 18th Oct 2021	1	Youth - raise awareness to the public via social media platforms
	2	Youth - educate youth and society at large on the knowledge of renewable products and waste management.
	3	Youth - join environmental organizations, groups, schools, community youth organizations
	4	Youth - localised community actions to address climate/ environmental issues local to the neighbourhood
	5	Youth - getting hands-on! Adopt sustainable lifestyle
	6	Youth - climate influencer (climate-friendly lifestyle, eco-minimalism)
	7	Stakeholders - companies to produce more high-quality environmentally friendly products (to make them more affordable) than producing more low-quality environmental-unfriendly products.
	8	Stakeholders - partnership with youth organization for joint environmental initiatives
	9	Stakeholders - provide financial support for climate action projects
Day 2 / 20th Oct 2021	1	Youth - volunteering in civil society organization
	2	Youth - be creative to deliver climate messages
	3	Youth - reach out to influencers to spread climate awareness
	4	Youth - promote eco-friendly tourism - Example: Airbnb
	5	Stakeholders - improve the education system, educate youths in climate

Day/ Date	No.	Description
		awareness at an early age.
	6	Stakeholders - provide funding to support research work
	7	Stakeholders - establish proper database for public accessibility
Day 3 / 21st Oct 2021	1	Youth - reduce emission from vehicles such as using public transport, carpooling, cycling
	2	Youth - staying at low carbon city
	3	Youth - starting a green business
	4	Youth - involvement in environmental organizations
	5	Youth - apply and create renewable energy in buildings or homes by investing in solar panels and NEM
	6	Youth - reduce, reuse, recycle
	7	Youth - participate in green technologies development
	8	Youth - adopting IOT (for example: Smart Home)
	9	Youth - invest in energy efficiency appliances such as MEPS which have 5-star label rating
	10	Youth - involved in both governmental and non-governmental organisation
	11	Youth - promotes climate change and environmental awareness on social media
	12	Stakeholders - government, industry player- provide education, training, mentorship
	13	Government- providing subsidies for energy efficient appliances
	14	Government, industry player - through education such as training, mentorship (high school and university level)
	15	Government - work opportunities in green matters
	16	Government should provide a grant or financial assistance to young people that want to initiate a green business
	17	Ensuring ownership and quality of decision-making for climate change adaptation
	18	Energy sectors or industry players - provide funds and invest in the project or development

Brief observations made from the discussions show the expected gaps between professional and postgraduate groups with the undergraduate groups in terms of their awareness and knowledge of the greenhouse gases inventory and emissions. They are also able to provide critical and comprehensive points during the discussion. The whole session provided insight and empowered those involved to voice their opinion openly in a technical setting. This opportunity also provided a basic understanding to organizers and acted as baseline information of the understanding of topics given during the discussion.

The training ended with the session “Climate models and how to use their projections” by Dr Chris M. Brierley from University College London. Dr Brierley was assisted by his PHD students Ms Zhiyi Jiang and Mr Tom Keel. Participants were introduced to two types of

Climate models which are the empirical model and dynamical model. The empirical model collects relevant observations while looking at the relationships between the observations. Meanwhile the dynamical model derives the fundamental physical equations from theory and lab work and introduces simplifications to make them solvable and manageable. The climate model system in response to timescales is different depending on the components. It takes approximately 1 year to run the climate model to see any changes in the atmosphere while in oceans, the time scales vary according to the conditions (tropics, deep or bottom). For tropic oceans, it takes approximately 50 years while in deep ocean it takes 500 years and, in the bottom, it takes 2000 years to observe the changes. Participants were briefly trained on the General Circulation Models (GCMs) that provide a numerical solution to fluid dynamics (Navier-stoke) equations. The advances in GCM complexity had been observed in these years as more processes of climate models were incorporated into a model called Global-Scaled Coupled Climate models. Participants then experienced the IPCC Interactive Atlas while divided into 3 groups with each group being monitored by the UCL team. A set of questions was given, and participants were required to use the interactive atlas to answer and give conclusions on the scenarios given. The training session was concluded by 5.30pm with a simple survey to gain feedback from participants (Refer to Section 3).

2.3 Focus Group Discussion on Data for Climate Action

A Focus Group Discussion (FGD) on Data for Climate Action was undertaken on 25th October 2021 from 4.00 pm to 6.00 pm (MY time)/ 8.00 am – 10.00 am (UK time) via zoom involving experts from Malaysia and the United Kingdom. The summary of the discussion is included in this sub-chapter.

2.3.1 Introduction

The aim of the FGD was to critically discuss data availability and accessibility especially for research purposes and to identify improvements needed around the techniques currently used. The FGD also provided an opportunity for an intellectual sharing and discussion on effective scientific communication with the public.

Panels selected for the FGD were based on their background and involvement in data acquisition and utilization throughout their careers. Details on panels involved are shown in table 1.

Table 6. Experts for Focus Group Discussion

No.	Experts	Designation/ Organisation
1	Professor Peter Thorne	Centre Director – ICARUS; Professor of Physical Geography
2	Professor Fredolin Tangang	Chairperson & Professor, Faculty of Science and Technology, Universiti Kebangsaan Malaysia
3	Professor Iain Donnison	Head of Institute of Biological, Environmental & Rural Sciences (IBERS), Aberystwyth University.
4	Professor Dato Dr Tan Shau Hwai	Director, Centre for Marine and Coastal Studies (CEMACS), USM
5	Ir. Azman Mat Jusoh	Director, Water Resources and Climate Change Research Centre, National Hydraulic Research Institute of Malaysia (NAHRIM)
6	Dr. Sharina Abdul Halim	Senior Lecturer, Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM)

A set of questions was given to experts separated into four major sections: 1) Data availability and Accessibility, 2) Data Sharing, 3) Institutions, organization, and industry and 4) Communication of data and analysis to the community. Each of the sections includes a few questions that address the topic given. Experts were given a week before the FGD session to prepare based on the question set they were allocated. The FGD session gave experts the opportunity to raise issues, discuss, and exchange views on the topics. All inputs by experts were recorded and extracted for the report preparation.

2.3.2 Data Availability and Accessibility

The availability and accessibility of data can be defined as the existence of data made freely available (e.g. internet) across time and space even if disruptions occur. Such existence depends greatly on the uses and ability to acquire it with the aim of achieving a certain objective and it is the most essential factor before research or a study can begin. Data in this time should not only be made available, but also accessible on a relevant time and spatial scale. In making data available and accessible especially for research in the UK, 'FAIR' data principles were introduced as the ideal standard standing for Findable, Accessible, Interoperable and Reproducible. Data is made findable principally via submission to recognised national, regional and/or international repositories. Data presented must follow certain formats especially in terms of quality assurance and screening with transparency in method of data collection or treatment to make it usable for other research purposes. With a consistent standard, data can be made exploitable when shared via internationally recognised repositories which will enable the greatest possible users to access, analyse, and

utilize the data. It also ensures that the data are harmonised to enable interoperability of the data and assures long-term access and reproducibility.

In the Malaysia context, while data availability is high especially in many universities or local agencies, access and accuracy of data are challenging and remain areas of concern among data users. Malaysia can be considered to have a data-rich environment, however, the high-quality data released in practice are still lacking. Creating a platform where data owners can deposit their data safely a year or two after their research completion would be an effective solution for data storing and sharing. A platform that allowed real time research-based data could be managed by a related agency under the federal government's jurisdiction. This will address one of the obstacles in data sharing, which is the fragmented legal framework that halts the 'open data' concept and at the same time creates hurdles in sustaining publication.

In terms of data storing, quantitative data are mainly well captured while qualitative data are rarely stored. In producing a holistic analysis, qualitative data should also be adapted in projection and observation related to climate change. Details related to local or indigenous knowledge which are important and add more value when addressing the adaptation to and impact of climate change. Stressing the importance of qualitative data will increase its value and encourage it to be stored and made accessible for research purposes.

In the UK, researchers are required by funders to keep their data for 10 years to receive the research grant. This requirement drove universities and research institutes to establish a storage and retrieval mechanism to ensure data are available for 10 years. Researchers in the UK are also currently looking into methods to ease the incorporation of the requirement into their work including preparing backup tools for data storage, providing DOI (Digital Object Identifier) numbers for data and the capacity to sustain the whole process.

In the context of historical meteorological data there are several stages depending upon how the original data was collected. If it was originally collected via handwritten paper records, then the first necessity is to perform data rescue which typically involves:

- Inventorying
- Imaging
- Transcription
- Provision

These steps can be highly labour intensive and do not need to be carried out simultaneously. Particularly if the hard copy forms are on unstable media the immediate priority should be their inventorying and imaging. There are new and imaginative ways using citizen's science and classroom based participatory learning by which the rescue transcription to a digital format can be undertaken. Once digitised, it needs to be made discoverable and be shared with relevant repositories. Some of the challenges include

reticence of data rights holders to share the data, not knowing where to send the data, and issues of a technical nature.

In ensuring data is traceable and usable, the information should be made available along with features such as metadata and it must be allocated an ID number for future references. Qualitative information of data should also be included in detail. Historically, data was not shared in open spaces and were mostly stored using physical filing methods. Digitizing all data is the first step in making it accessible, manageable, and shareable. There is also an urgent need for the standardisation of methodologies to derive data across organisations and agencies which will provide a better time frame for establishing what data is useful for climate studies. Improvements are also needed in institutional structures, responsibility and capability within government and related agencies. The current environment where researchers are heavily reliant on funds or grants to complete a project, (Notable ICT sectors and application exist) however, data journalism is not at the forefront.

Developed and developing countries face different sets of challenges due to their internal capacities and aims. Progressive initiatives are needed to bridge them to allow easier data acquisition processes. Initiatives such as the ACRE data rescue and the Copernicus Climate Change Service data management in conjunction with NOAA's National Centres for Environmental Information can ease the data acquisition process in all stages. More international support and buy-in from all parties would improve the utility of these efforts, many of which are led by the international community. In understanding climate change and its risks, large scale and transboundary studies are important. Prioritisation should be given to setting up data collection stations that are built around location and specific needs, more than existing political boundaries. These require the use of technologies (eg. remote sensing and continuous automated loggers) which are less accessible to developing countries and at the same time, they require the aid and financial support from developed nations to ease the transition.

2.3.3 Data Sharing

Data sharing in both the UK and Malaysia are still far from the ideal situation whereby all data are shared openly without restriction and deposited in internationally recognised repositories. There remains a perception around ownership and intrinsic value. Numerous studies show that once data is openly shared, the economic benefit to the national economy far outweighs the costs of provision. Given the challenges of ongoing climate change data provision is key to ensure that decisions are made in the best possible context ensuring climate smart, climate ready and climate resilient development choices. Climate Change (CC) Knowledge Portal is the only well-known climate change centred portal with data specifically addressing climate change in Malaysia. Other than the portal, data acquisition usually must go through departments or agencies that own the data. It will only be shared

upon request and approval instead of made public on digital platforms which at the same time limits automated inter-agency data exchange.

Data must follow standard formats that are well explained so that they can be used for other purposes. Emphasis should also be given to sharing the method or technical aspect of data especially for treated data as the method of processing the data will define the data differently. In CORDEX for example, data uploaded in the portal must go through a data screening and quality assurance process in order to ensure the data is reusable in future research. The CORDEX Southeast Asia is the result of funder's requirement for the research to keep the data and set up a data centre. However, setting up a data centre is a complex process where several aspects need to be taken into consideration such as continuous funding, manpower and additional assistance by government is needed along with effective mechanisms to enable researchers to upload their data in the database.

At a local level, Malaysia is far behind in climate modelling and monitoring. There are very few long-term datasets that are accessible and made known publicly. There need to be monitoring stations specific to climate change studies on the land, sea and in the atmosphere. In marine studies, early warnings could come from remote stations that differentiate anthropogenic impacts from climate impacts and could be valuable for understanding potential risks. As for climate modelling, improvements are crucial to increasing the resolution used either in Malaysia or in the UK. Most of the management and policy interventions are done on a much smaller scale and would benefit from these increased resolutions, where prediction of climate impacts will be more specific and localized.

Challenges in data sharing in Malaysia are faced by government agencies as well. Data exchange between government agencies also faces the issue of bureaucracy. The process of obtaining data can delay research progress up to months at time. Planning for research timeframes therefore takes in consideration of the data acquisition process thus resulting in an extended timeframe which will affect the cost and ultimately limits the potential of real time analysis. In addressing this issue, setting up a data centre under the government will ease the data sharing and storing efforts.

A one-stop data centre with credibility and assurance of quality and integrity will encourage researchers to deposit their data and inspire confidence in utilizing the data as well. The Malaysia Open Data Portal is a portal with 12,832 data sets that cover general matters in Malaysia by Malaysian government agencies. However, the platform does not include research related data by the scientific community. A data centre would also eliminate the issue of transparency as it would be the only referral body. This would also address concerns around how the data would be used and facilitate the local culture of acknowledgement when data is used. There is also the need to develop proper guidelines, laws or agreements between data sharer and user which would provide the opportunity for the data owner to publish their work first and to get proper credit for their contribution. In the case that data

was obtained to a grant or fund, multiple usage of the data with proper credit would provide the funder with added value since the outcome of their funded project is used for subsequent research.

Establishing a Data Act will ensure that data usage is controlled and ensures the continuity of data over time. Quality control and robustness of data will encourage replication of study. It is also important to have a network of sources considering geographic limitations and working to standards and protocol of data usage would nourish and enhance the study and its finding. Broader sharing of data spatially and temporally would also encourage collaboration among researchers across the globe.

Improvements can be made by ensuring that data are shared openly under a clear open data licence. Wherever a repository can be identified this ensures that they are also propagated to that repository which oftentimes requires a push for data from the data provider. To encourage better inclusivity and usefulness in climate change knowledge, there should be an improvement in medium and long-term collaboration between UK and Malaysian climate scientists with adequate financial and institutional support. Feedback from Malaysian scientists on the expected changes to their local tropical ecosystems where impacts can be translated to the local scenario will provide a better understanding of the multiple impacts to the natural ecosystems and the human populations at varying temporal (short/medium/long term) and spatial (local/national and regional) scales.

The newly approved World Meteorological Organization (WMO) Unified Data Policy Resolution mandates meteorological services to integrate earth system data policy and call for unrestricted data exchange. There are still post sharing challenges that need to be addressed such as format, which may be proprietary (excel) or not assured long-term support. In addition, to enable users to exploit the data, data should be presented in a homogenous set along with required details. Part of this harmonisation includes reconciling data from disparate sources as much data has been shared repeatedly such that redundant copies exist in multiple archives. It is necessary to ensure these records are reconciled which isn't simple as the geolocation information may differ as may the data if it has been quality controlled and/ or homogenised in different sources. There are many resources around how to perform these tasks,guidance can be found on the Copernicus Climate Service including on data rescue and data submission as well as from the World Meteorological Organization's website.

2.3.4 Institutions, Organizations & Industry

Malaysia is still lacking an approach to segregating responsibilities according to departmental boundaries. Cross-cutting issues are not addressed effectively when addressing climate action using available data. Unless climate change issues are framed in a

more immediate context, they will not be prioritized in the national agenda and will remain on the back seat. Empowering grass root level is one of the main concerns in developing a climate resilient community. Climate-sensitive communities such as fishermen and farmers should be able to access and understand the data to assist their economic activities. With proper training and incentives, communities can be made ready for technological advancements.

In terms of law and governance, some data are considered private and confidential especially when it involves a concessionaire. There is a risk of the data being exposed and affecting financing and business-continuity. This halts data sharing from industry and limits their ability to be involved. A regulatory body that can ensure data security along with proper agreements on data sharing would address this issue and enable industry to distinguish themselves from their competitors.

In the UK, there are several funding mechanisms that encourage the link between academia and industrial sectors. Mechanisms vary between governments; however, the main aim is to create a healthy environment where research is fuelled by industry. Industries are expected to be protective of Intellectual Property that stems from funding especially in public-private investment. The requirements of involvement by industries are mainly depending on the size of the funds given. There are schemes where industries will co-fund with a funder (where industry deposits funds into the overall pot and once it is released, it is considered public funding which allows more research to take place in the interest of gathering more information in the public domain.

In Malaysia, there have been efforts from government and private sectors to encourage the same initiative, however, the approach is not well applied yet and most funding is from the government and international bodies. In creating a healthy system, a grading and labelling approach is a method that can quantify the industry's efforts toward combating climate change and this effort requires support from public private partnership and research expertise. One of the examples is the Malaysia Good Agriculture Practice (MyGAP) where advantages are given to those who comply with the scheme. Not only does this build healthy competition in the industry, it also provides performance indicators. Ecolabels are another effort that should be utilized by the government as they can help identify local products on the international market.

There are several issues that disrupt the engagement of climate change issues in Malaysia such as the very subjective and non-specific presentation of climate change impacts on the local scenario. This could stem from inadequate scientific information of the various manifestations of climate change impacts on the local scale. There is also the traditional approach of segregating responsibilities according to departmental boundaries which is inadequate in handling specific and cross cutting issues, and it also limits the ability to solve the issue holistically.

Industry and governments need to be convinced of the inherent policy, societal and economic arguments behind openly sharing environmental data. This requires sustained discussions recognising inherent values and positions to come to satisfactory solutions. Responsible bodies should initiate a campaign on climate data collection by agencies, research institutions and industry that are presented in meaningful and understandable ways. This will encourage participation and inclusiveness. Relevant sectors should be identified and the gaps in capabilities should be addressed.

Further efforts are needed in convincing data providers of the inherent value of sharing environmental data. Observations of the world should be openly shared so that it can be fully understood allowing the best possible decisions on how to respond to changes. From a moral and a scientific perspective, it is hard to make a defensible argument for holding on to data for more than a very finite duration. There is a need to be able to access and exploit every piece of data available to ensure optimal decision making, particularly bearing in mind that observations of all phenomena are inherently sparse in space and discontinuous in time.

In tackling the issues, clear data governance structures are required which for environmental data require cross-jurisdictional consistency. The newly adopted World Meteorological Organization (WMO) data resolution represents a step-change in governance of ongoing and historical hydro-meteorological data holdings. However, the challenge is the implementation which will require buy-in from national meteorological services, regional associations, and numerous other actors. International data repositories need to be made considerably more robust. They need to be supported by multiple parties to protect against a single point of failure. There needs to be adequate funding to undertake the work along with strong advertising and international buy-in via WMO, Global Climate Observing System (GCOS), World Climate Research Programme (WCRP), and International Plant Protection Convention (IPPC), International Council for Science (ICSU) and other relevant data governance bodies.

Unshared data will prevent real-time forecasts which could otherwise save lives and livelihoods or reanalysis of past changes that could impact future decisions and planning and help us understand the trajectory of climate change. Data that are not shared are akin to deliberately putting on an unnecessary blindfold when we are already being guided along the path only by the faintest of moons.

2.3.5 Communication of Data and Analysis to Community

Improvements in education, training that builds public awareness, and persuading the community to participate whether formally or informally will increase involvement in climate action. Experts should also understand and study behavioural changes for future

reference and as a tool to measure the efficiency of programmes. Communities should also be given the opportunity to understand the cause and impact of climate change while relating it to their daily practice. It is important to breach the language barrier and translate technical and scientific terms into layman's language.

Technical experts rarely interact directly with the community due to the nature of their work; however, their insights are crucial in building policy papers. Selection of stakeholders in any engagement must put an emphasis on translating the technical aspect of policy with its use - to be delivered to the community - in mind. The cascade of information should focus on standardization and translation of the information so that it will be understood by the community. Utilization of technologies - especially those enjoyed by the young generations - will help to spread information faster. It is important to identify the demographic and the right method of communication while bearing in mind current trends.

There are substantial improvements ongoing in this regard driven by the urge to provide climate services. Data access is improving, although there is very considerable scope for future improvements. Climate service practitioners offer the opportunity to translate data into actionable information by governments, industry, and society. Scientific endeavours such as global and regional reanalysis products can convert data into spatial and temporal realisations of the changing climate system that can potentially be more widely exploited.

Community advice identified that future engagement activities need to allow people to ask questions and share ideas on an ongoing basis. Therefore, the use of interactive social media by the government will be increased over time. The extensive networks, diverse communication tools, and methods used will extend the reach of current information on climate change into the community. There are two levels of data dissemination to the community:

1. In the form of primary data that could be useful to industries/communities where with it, they are able to determine the changes and impacts to their respective sectors themselves.

2. Highlighting the modelled impact of climate change to specific industries/communities according to the data and information collected.

Educational institutions, concerned with career opportunities should introduce syllabuses that include climate resilience and readiness. Improving education, training, and public awareness on climate change is an important measure for persuading the whole of society to jointly participate in activities for the mitigation of and adaptation to climate change. Both formal and non-formal education is indispensable in changing people's attitudes in building their capacity to assess and address their sustainable development concerns. It is also critical for achieving environmental and ethical awareness, values and attitudes, skills, and behaviour consistent with sustainable development, and for effective public

participation in decision-making. Climate change risks should be framed to highlight their impacts and importance on the current generation. Understanding how this will happen at a local or even individual scale will draw attention.

Climate change issues, impacts, and ultimately resilience are so important that they should be taught in the primary school curriculum. As with many scientific and technical insights there needs to be a translation of those findings in a common language made accessible to the public. There are numerous novel ways in which technical aspects can be communicated. In the context of data management there have been several highly successful citizens science-based data digitisation projects that have collectively led to the transcription/ analysis of hundreds of millions of observations from land, ship, balloon, and satellite platforms.

Pioneering work by researchers around the world highlighted how climate data rescue can be integrated into a classroom-based setting enabling students to actively participate in the rescue and provision of data. This could be augmented by collection of oral histories and other similar activities to build rich historical contexts. Such participatory learning has benefits in terms of the students learning about past climate changes but also has benefits for national and international research if the rescued data is shared openly.

Communities that can understand, disseminate, and act will direct the policy makers in the right direction. A well-informed community will demand the right changes in the right areas, progressing to a climate resilient community.

3. Feedback and Recommendation

Participants were required to complete the post event survey to receive their e-certificate. Based on the survey, 39.1% participants chose the “GHG-Inventory for Beginner Level” session as the session that they liked most followed by 35.9% choosing the “Climate Models and How to Use Their Projections” and 25% choosing the “Youth for Climate Action Discussion” session. A balanced selection was chosen by participants for the 3 main sessions.

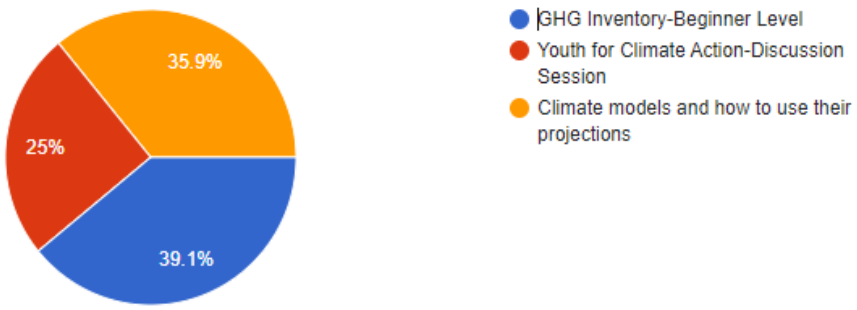


Figure 1 Session preferred by participants

Opinion was sought whether the objective of the training was clearly defined before the course began and throughout the length of the course and almost 95% of participants agrees that it achieved their expectation from the training. The program was well structured and sufficient time was allocated for each session, however 12.5% of the participants have neutral opinions on this statement. Most of the participants said they learnt something new after going through the training. 95% of participants found that the information shared throughout the training was very useful and this training also met the expectations of the participants.

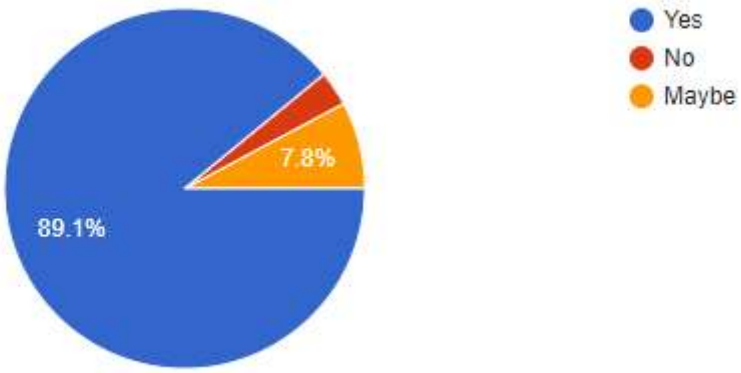


Figure 2 Expectation of participants towards the training

The instructors' knowledge and delivery, the content and the structure of the training programme were the top elements liked most by the participants. The medium that was most likely to have promoted the training was through friends or colleagues and from Facebook. For upcoming projects organized by Penang Green Council (PGC) and British High Commission (BHC), most of the participants said they would love to join and would recommend this type of training to their peers.

There were several suggestions given by participants on improving the training such as extending time allocated for the discussion part and to extend the training to more than 1 day to include in-depth training and broaden the topics. To extend the participation and also the interaction between the speakers and participants, more engaging activities could be conducted. There was also a suggestion to conduct a short and simple quiz or test to ensure the participation from the audience was accessible and measurable. There were also suggestions around sharing the material ahead to participants. As for the content of the training, positive feedback was mostly received from the participants suggesting that the speakers were resourceful in terms of knowledge. However, they also suggested providing various examples of the wider background of the participants and making the training session more technical by providing simple hands-on Greenhouse Gases inventory calculation examples. In the context of lecture design, participants suggested making specific greenhouse gas inventory methods available for a certain field. As for the climate

modelling, a longer time allocation was suggested to enable discussion. Further the questions could have been given prior to the presentation by the speaker so the participants could put together rough ideas.

As for recommendations from the organizers, a longer training period could be considered for future training as well as providing hands-on material that participants could directly utilize during the training around GHG inventory. Due to the absence of some participants during the training day, future training could consider a commitment on fees to ensure that participants didn't take the opportunity for granted.

Appendix A – Program Tentative

The opening session took place on the 15th of October 2021 from 4.00 pm to 5.45 pm (MY time)/ 8.00 am – 9.45 am (UK time).

Table 1 Agenda of the Opening Session

Time	Program	Speaker
4.00pm – 4.10pm	Opening by Penang Chief Minister YAB Tuan Chow Kon Yeow	
4.10pm – 4.20pm	Opening by His Excellency Charles Hay MVO, British High Commissioner to Malaysia	
4.20pm –4.45 pm	'Key findings of the IPCC AR6 Report on Climate Change and Relevance to Malaysia'	Prof Fredolin Tangang, Department of Earth Sciences and Environment, Faculty of Science and Technology, Universiti Kebangsaan Malaysia
4.45pm – 5.10pm	Linking Global to Regional Climate Change	Prof Andrew Turner, National Centre for Atmospheric Science & Department of Meteorology, University of Reading
5.10pm – 5.20pm	Seberang Perai Low Carbon Cities	Mr Ahmad Zabri bin Mohamed Sarajudin, Acting Director of Urban Services Department Seberang Perai City Council
5.20pm – 5.30pm	"Let's make Climate Action Personal!: A hands-on guide to the Bite-Size Climate Action modules"	Dr Helena Varkkey, Department of International & Strategic Studies Faculty of Arts & Social Sciences, Universiti Malaya
5.30pm- 5.45pm	Q&A and Closing	

The training was conducted on 18th,20th and 21st October 2021 from 10.00 am to 5.30 pm (MY time) with each session attended by different groups of participants.

Table 2 Agenda of Training Session

Time	Program	Trainer/PIC
10.00 am -10.10 am	Opening	Welcoming speech and brief introduction on the programme by PGC
10.10 am –10.30 am	Ice Breaking	PGC
10.30 am – 1.00 pm	GHG Inventory – Beginner level	Tuan Ismail Hj. Abdullah, Director, International Green Training Centre (IGTC)
1.00 pm – 2.30 pm	Break/Zohor	
2.30 pm – 3.45 pm	Youth for Climate Action – Discussion Session	Facilitated by PGC Assisted by IGTC
3.45 pm – 4.00 pm	Break	
4.00 pm – 5. 15 pm	"Climate Models and How to Use Their Projections"	Dr Chris M. Brierley, Associate Professor in Climate Science, UCL Dept. of Geography, University College London.
5.15 pm – 5.30 pm	Closing	Feedback survey

A Focused Group Discussion (FGD) on Data for Climate Action was done on 25th October 2021 from 4.00 pm to 6.00 pm (MY time)/ 8.00 am – 10.00 am (UK time) via zoom involving experts from Malaysia and United Kingdom.

Table 3 Agenda of Focus Group Discussion Session

Time	Program	Remarks
4.00pm - 4.10pm	Introduction	Outlining content/expectation
4.10pm - 5.00pm	Sharing by each experts (5 mins/ experts)	
5.00pm - 5.50pm	Focus Group Discussion	
5.50pm - 6.00pm	Closing	Encouraged to email for additional info to include in report

Appendix B – Participants Question & Answers by IGTC

Table 4 List of Questions Asked by Participants throughout the three-day training

No.	Questions
1	Is there a reason, why the climate observatory is based in Hawaii?
2	How is the climate change calculation being made?
3	Why are we using carbon intensity, and not concentration?
4	What is the country standard for emission and inventory calculation for Malaysia?
5	Is there a template for inventory available?
6	Do we have to develop one inventory template, on our own?
7	Does the base year have to be the first year of reporting? Let's say year 2020 is the first year of reporting but the number might be low and inaccurate due to low production. Can company choose other year as base year?
8	Is there a database of emissions factor specifically for Malaysia context?
9	A question of a slightly different topic, although hydroenergy is considered as less carbon emission, however it also causes land use change (forest flooded to build dam), is the emission due to land use change be included in such carbon emission calculation?
10	How to improve the GHG emissions, especially in the Palm Oil industry?
11	What is the difference between the carbon footprint and water footprint?
12	Does the GHG content for each fuel change at each stage of conversion, i.e., from primary supply to final consumption or from gas to liquid? And how do we take this change into account?
13	Is Malaysia practising this carbon footprint remark on their product?
14	Does the removal of GHG refer to removal through carbon sinks?
15	What is the current progress to have a carbon accounting framework in Malaysia?
16	Does Malaysia national policy refer to Intergovernmental Panel on Climate Change (IPCC) Tier 3 measurement?
17	Do we have centralised GHG inventory data in Malaysia that is accessible by public? As far as I recalled Europe and US have it.
18	As you already mentioned that three main causes of climate change, which is the most serious causes among only three causes in our world? I think we are describing and emphasizing the last causes related to climate change. I would like to know the first and second causes of climate change in more detail especially in implementing role in our countries.
19	Does Tier 3 corporate include up to emissions from consumers?
20	Is the data source only in kWh? Can it be material consumption?
21	How do calculate the emissions? Do they use online calculator or something?
22	Does each company, organisation use the same template to measure the emission inventory?
23	What happen if we calculate for the inventory in a wrong scope?
24	How do we choose a base year?
25	Where do I usually get the emission factors for say, agricultural industry in Malaysia?
26	A lot of resources give different emission factor units e.g., joules/kg/l etc how do I choose which emission factor to use?
27	Is there a limit for GHG emissions be produced and is it different among the industries?
28	Are there any successful carbon capture examples in Malaysia or globally?
29	I am curious whether whose responsibility in Scope 3. Is it the company or consumers?

No.	Questions
30	What if the company has non-controlling stakes?
31	What is the time frame for GHG inventory? Is this depending on the purpose we want to use it or always do it in annually?
32	Does urban farming (eg. rooftop/community garden) count as both adaptation and mitigation action or either one?
33	How many years more can we rely on coal to power our electricity if we do not switch to the alternative?
34	CO2 capture is kinda controversial right? As it provides a reason for human not to change their current unsustainable behavior. After the CO2 is captured, where is it kept and if any leakage happens, what responsive/correction action need to be made?

Frequently Used Keywords

Amongst the three days, there were a number of questions that were repeated and were categorized according to respective keywords that were repeated in the original context of the question. Key responses are illustrated in Figure 3 and the summary of the repeated keywords used by participants are as tabulated in Table 11. Other questions that were not repeated are grouped into others as seen represented in Figure 4.

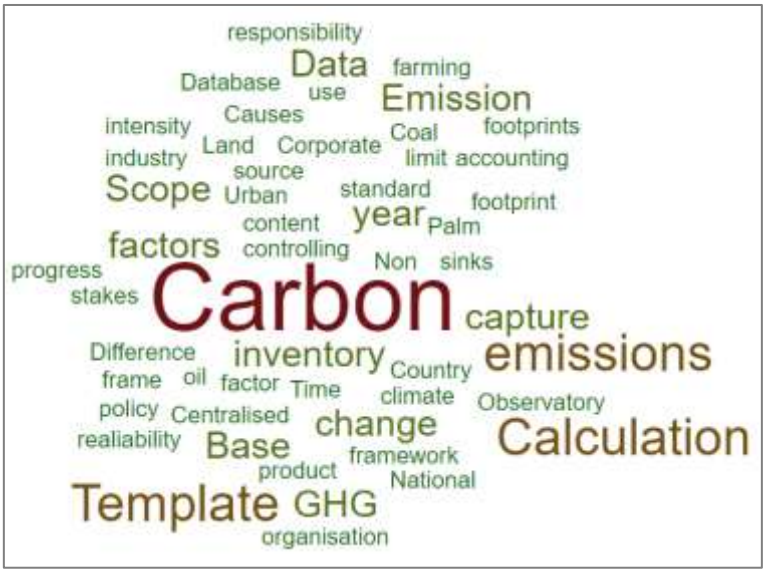


Figure 1 Tag Cloud of Keywords from Questions Asked

The recurring keywords were of carbon capture, emission factors, base year, calculation and template with 2 questions for each keyword posed throughout the session. The questions posed mirrors the interest of the participants towards GHG inventory specifically in the developing the emissions inventory, emissions calculation and carbon capture. Largest percentage of non-repeated keywords were utilised by participants with a 70.6% which however, some of the keywords are not using the correct or the most accurate term.

Themes of Questions Asked

From the 34 questions recorded, each question posed was grouped into themes in which the context of the question was related to; such as climate change, term usage, policy/ regulation/ standard, emission calculation, GHG inventory, database, stakeholder emissions and Carbon Capture, Utilisation and Storage (CCUS) as seen in Figure 4, Table 12 and Figure 6.

Figure 2 Tag Cloud of Themes of Questions Asked

The largest theme asked was regarding stakeholder emissions with 7 questions or 20.59%, which refers to the emissions from the industry sector. Stakeholder emissions refers to bottoms-up sources of emissions, segregated by sectors including industries, commercial and corporate sector. This reflects the interest of the participants were more towards stakeholder emissions and emissions calculation. The participants understand that the majority of the emissions are from stakeholders, and questions were towards how the stakeholders could calculate their emissions and develop their own inventory. Least theme asked is the term usage, with 5.88% or 2 questions were given by the participants which refers to the term carbon intensity and carbon footprint.

Appendix C – Youth Discussion Analysis

The questions given to each group are as of the following. These questions had been carefully selected and approved by BHC prior to the training. Coordinators were assigned to each group to ensure the group stays on topic, each participant provides their thoughts and opinions, and for timekeeping purposes.

Question 1: Assess the opportunities/ scope available along with the challenges to venture in climate related research and innovation. Please include suggestions to address it.

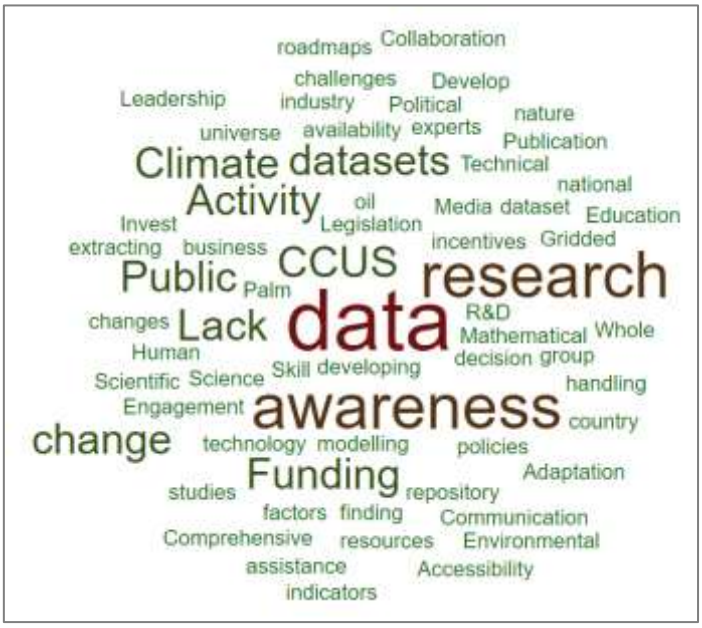


Figure 3 Tag Cloud of Key Responses for Question 1

For all the three days, participants highlighted the importance of research and R&D by using the keyword eight (8) times throughout the sessions or 26.67% of overall of the sessions' responses. The responses include opportunity in research on natural factors, technical research, modelling, CCUS, research and collaboration with developed and developing countries, disaster resilience and research partnerships with private sectors. 20% of the responses were related to data inclusive of datasets, data availability, and data repository. Group 1 also highlighted public awareness and investment and funding as the opportunities and challenges to venture in climate related research and innovation.

Question 2: Discuss the existing challenges in research and innovation related to climate change, and suggest solutions to address it.

Figure 4 Tag Cloud of Key Responses for Question 2

For all the three days, participants highlighted the main challenge and solution to existing research and innovation related to climate change is financial issues; including investment, funding, allocation and reallocation of carbon tax. This is represented by 25.49% or 13 of 51 of total keywords from responses discussed by the participants. Another main keyword mainly used is regarding policy, regulations and authority. The challenges presented were the lack of authority and enforcement, and the solutions were to law enforcement and introduction of policies. Other points brought upon the discussion were lack of skills and expertise, research, capacity building and training. Other than that, data availability, collaboration between entities, lack of and development of technology and infrastructure, as well as other non-repeated keywords such as carbon tax, community supervision and public participation programme, political change, social media, scholarship and job opportunities, mapping and lack of exposure.

Question 3: Discuss the challenges and solution to improve data (such as state and sectoral emission) availability and accessibility, and sharing for consolidated climate action.

Figure 5 Tag Cloud of Key Responses for Question 3

For all the three days, participants voiced their main challenge and solution to improve data availability and accessibility is data related issues; namely, data availability to the public, data integration and accessibility, data complexity, ownership, data sharing and data incompleteness and inaccuracy. This represents 15 of 30 keywords that were identified or 50% of the responses from the participants. Other than that, they emphasized the importance is financial constraint; specifically regarding to lack of funding, financial constraints, investment and budget factor. Collaboration and partnership between entities are also important as well as communications and emission methodologies. Policy change, regulation, stakeholder engagement and building support were also presented during the discussion.

Question 4: Share your views regarding Malaysia climate ambition and action thus far, especially with the recent Twelfth Malaysia Plan (RMK-12) announcement of commitment to carbon neutrality by 2050.

Figure 6 Tag Cloud of Key Responses for Question 4

For Group 4, the recorded responses were more of a variety compared to other groups. In general, the participants felt the aim of carbon neutrality by 2050 is achievable, in sync with Paris Agreement and may be an inspiration to other countries; however, with more policies, enforcement and regulations. The government role, policies, enforcement and regulation were presented six (6) times and represented 16.67% of overall feedback. Education was brought up five times throughout all sessions, such as the need and importance of integrating climate change into tertiary education and to the public. Twelfth Malaysia Plan (RMK-12) was mentioned twice during the discussion, once regarding no clear highlight on climate change and UN's SDGs. Other repeated keywords highlighted were transportation; such as prioritizing public transportation improvement, implementing cost saving actions, collaboration between entities, development of technology and renewable energy. Other non-repeated keywords include public awareness, standard of living of the people, capacity of each state, implementation of EIA in projects, green label products, carbon tax, waste recycling, carbon sequestration, carbon pricing and voluntary actions.

Question 5: Discuss on ways for youth to contribute towards climate action and ways the stakeholders should support them.

Figure 7 Tag Cloud of Key Responses for Question 5

Similarly, to Group 4, Group 5 provided a myriad of feedback. 14.63% of them agreed on financial related ways for youth and stakeholders to contribute and support towards climate change; such as funding for research, projects, products, business, and for companies to produce high-quality affordable products. The same percentage also emphasized on green businesses, products and appliances to be invented and used in daily life. 9.76% of the total feedback also highlighted the importance of adopting and adapting an eco-friendly lifestyle. Social media and influencers, education and participation in environmental-related organisations were also presented four (4) times each. Other non-repeated keywords are capacity building, job opportunities, decision making, renewable energy, transportation emissions, database accessibility, eco-friendly tourism, partnership with organization, community actions, and awareness.