The National Research and Innovation Agency (BRIN) has hosted the Research and Development 20 (RD20) Summer School 2024. Under the theme "Diversity of Knowledge on Decarbonization in Just Energy Transition Mechanism" young researchers from the G20 countries gathered from 7-13 July 2024 in Jakarta in a series of lectures, workshops and excursions related to the decarbonization of the energy system.

The RD20 Summer School offered researchers a comprehensive program, covering topics such as sustainable energy transition, circular economy, smart grid, artificial intelligence in the energy sector, and solar energy development. These sessions provided participants with valuable insight into the latest technological developments and their use, particularly in the realm of renewable energy and decarbonization efforts. By bridging theoretical knowledge and practical application, it supports participants to actively contribute to changes in the energy system landscape in the future.

As host of the RD20 Summer School 2024, BRIN emphasized their commitment to encouraging innovation and collaboration among young researchers around the world to pave the way towards a sustainable future. Through joint learning and understanding and by sharing knowledge and experience among scientists and engineers, this can foster new solutions and innovative thinking to overcome the complexity of energy transition strategies and decarbonization efforts.

The participants were also involved in interactive workshop sessions, panel discussions, and networking sessions, in order to increase participants' understanding of the complexities of achieving a sustainable energy transition. In 2022 Indonesia announced its plans to target a reduction of GHG emissions by almost 32% by 2030 in a business-as-usual scenario. Through presentations from high-level representatives from government ministries and leading corporations of the energy sector, researchers were able to get first hand insights into Indonesia’s energy transition and decarbonization plans on their path towards carbon neutrality by 2060.

This enabled them to better understand the specific needs and challenges Indonesia is facing and the technological and implementation solutions required for adaptation in the existing environment. Examples are the new local content requirement for renewable energy technologies, e.g. for solar modules a minimum of 40%, which presents a significant challenge on the supply side, or guidelines for the early retirement of fossil-fuel fired power plants and their replacement by renewable power projects.

Message from the Ministry of Energy and Mineral Resources Republic of Indonesia

Chrisnawan Anditya
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Head of Center for Data and Information Technology, Ministry of Energy and Mineral Resources, Indonesia

Within the Ministry of Energy and Mineral Resources we are responsible for the provision of all the relevant data in energy and related transportation and technology information for strategic policy making and reporting of the government. In order to fulfill Indonesia's obligations towards a carbon neutral society in 2060, total emissions of 915 million tons of CO_2 have to be reduced in 2030, of which the energy sector contributes 358 million tons CO_2. There are several areas which will contribute towards this goal. One is the development of nuclear energy, which can contribute to a reduction of 181 million tons CO_2, the next biggest factor is coming from energy efficiency and the third factor is coming from the introduction of clean power technologies which will replace coal and gas power plants and also through the co-firing of biomass and the replacement of gasoline through LPG in transportation.
Key priority for R&D in the energy sector is energy storage, as most new clean power additions will come from variable energy generation resources as wind and solar PV. For energy storage batteries and pumped-storage hydro will be the main technologies. As a large archipelago the second R&D focus will be on the development of a large interconnection system, the Indonesian "supergrid" and the development of smart grids. Through the existence of abundant natural gas resources, there is also particular interest in gas-based technologies like biogas, hydrogen and ammonia, which may be partly used in existing coal fired power stations. Their price is still very high, so we need to focus on research to reduce the cost of these technologies. In transportation there will be change from the ICE to batteries, which will also require research in the efficient use of these technologies.

The RD20 initiative offers us a good opportunity to learn from the experiences of other G20 countries who have implemented these technologies already before, and how they contributed to their decarbonization efforts. With this initiative we expect to get the lessons learned from others' experiences and how to put for example the use of solar PV and wind into reality. Indonesia has also abundant mineral resources, so it needs environmentally friendly technologies which will help to extract these resources and process them from upstream to downstream into end products, so we always look for existing environmental friendly technologies which can help our planning for the future. Through the RD20 initiative we are inviting other researchers to share their experience with us and to benefit from such events.

Message from the Organizer BRIN (National Research and Innovation Agency)

Agus Haryono
Indonesian
Deputy Chairman for Facilitation of Research and Innovation, BRIN, Indonesia

The Indonesian government has set a national target towards net zero carbon emissions by 2060 or sooner, with the main objective to make our environment cleaner and to provide a healthier life for our young generation in the future. With BRIN, we facilitate this process especially for research in renewable energy technologies and the funding of projects in universities or the private sector.

In Indonesia the total installed electrical generation capacity is 85 GW, with the majority of more than 40 GW is coal-fired, so in the near term the plan is to convert it from coal to biomass. In terms of implementation the biggest challenge is to transfer research results from the laboratory to the industry and the upscaling in industrial scale processes.

For us the challenges in the energy sphere cannot be overcome by a single country, so we have to cooperate with other countries which have more experience in achieving net zero emissions targets. Indonesia has still many problems in achieving its targets, so collaboration with other countries is a must. RD20 is one of the opportunities for us to establish many cooperations in developing our renewable energy sources, and I hope through RD20 we can initiate more cooperations.

RD20 provides the opportunity for meetings to get together with researchers and stakeholders in research and development in the energy sector, so I believe their engagement should be in more concrete terms in order to have a positive impact on RD20 objectives. That's why I suggest to support more engagement between organizations to give them for example the opportunity for bilateral meetings, e.g. BRIN and AIST, or CEA and NREL, so they can discuss more concrete projects. Multilateral projects are often more difficult to organize which makes it more complicated. In the last RD20 event I requested the organizers to have bilateral meetings between organizations, so after one year after the meeting I expected to have more concrete activities.

In Indonesia the engagement of the private sector in our research activities is still very low compared to other countries. Just looking at the budget for research and development, 84% is coming from the government and only 16% from the private sector.

In the RD20 summer school the participants are young researchers from different countries. Their collaboration and exchange will be important for future generations within the G20 countries. So we hope that the summer school provides the opportunity for contacts and networking for future collaboration between each other.

Cuk Supriyadi Ali Nandar
Indonesian
Chairman of Energy and Manufacture Research Organization, BRIN, Indonesia

In order to achieve the net zero emission target, we focus on renewable energy, first solar PV, wind and hydro, but we also want to utilize biomass, as the country has abundant natural resources. In the transportation sector we also have the priority to use palm oil for production of biofuel and the implementation of electric vehicles. For electricity generation, apart from those mentioned above, our priority lies in geothermal and also nuclear power. The Ministry of Energy and Mineral Resources have set up the energy transition roadmap, where the first priority is the installation of new solar PV, which may be realized within a shorter timeframe. The original target was a 23% share of renewable energies in 2025, but at the moment we have achieved only a share of 13%. Then, the National Energy Council (DEN) revised the target for the new renewable energy mix to 17 - 19 percent by 2025. One of our challenges is how to convert coal-fired power plants to biomass, so for example we started the co-development with the industry to convert boilers from coal to biomass.

Cooperation through RD20 with foreign countries is very important to us. As Indonesia has huge natural resources, we would like to develop necessary modern technologies and corresponding intellectual property rights for their environmental friendly exploitation together with our partners. Indonesia is a huge market not only for electrical energy generation but also for green transportation and carbon capture.

Real action is very important for us. Within RD20 we discussed about many topics and decided on priorities, but for Indonesia for example we need an action plan for the integration of a large amount of variable renewable sources (VRES) for power generation. This target includes some issues, especially stability, intermittency and excess power, so we need to decide on priorities and real actions after the RD20 summer school.

The industrial sector is very important for the implementation of our research activities, so further engagement in RD20 is very much welcomed.

Every country has their different challenges and opportunities, for example in Indonesia quality still does not play such an important role as quantity. The electrification ratio is still not 100%, for example the majority of the renewable resources are lying outside Java, but the majority of the demand is within the island of Java, this is one of our challenges. This is an issue we can discuss with other countries and learn from their experiences.

Voice from ERIA (Economic Research Institute for ASEAN and East Asia)

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Through an ongoing big joint project between AIST in Japan and ERIA two years ago when I stayed in Tsukuba Japan during a research project I was for the first time exposed to the RD20 initiative. I was first involved in the G20 process in 2010, and later I learned through my colleagues that the RD20 initiative was launched during the Japan G20 presidency in 2019. I learned about the RD20 summer school later when some AIST colleagues came to ERIA for an explanatory meeting and then BRIN contacted us and we had a couple of meetings about the RD20 summer school. Previously I had an exposure to a similar program which was the initiative of the German G20 presidency, they also had a summer school program which was held end of May and first week of June. I also know about the Science20 program (G20's science and technology engagement group), my analogy was that the RD20 was something similar to these initiatives.

When AIST asked ERIA for a partnership for the RD20 summer school they asked us what ERIA could contribute in the area of carbon market and carbon pricing where we are doing some research and they also asked for other speakers from India and Indonesia to introduce relevant experts that were needed. During that time my image and expectation was that it is an event for the promotion of these young researchers and to empower them for frontier knowledge that would benefit them. ERIA is an international organization and our mandate is also knowledge transfer, we have this knowledge and we bring this regional knowledge to our end customers.

RD20 is about research and development and it was born out of the G20 process, so it needs to be aligned with the G20 mission and goals, which might be summarized as policy coordination. Within the G20 we have advanced and big economies, and emerging and small economies. Basically the value addition comes from bringing these gaps to narrow down. So the developing countries could learn from the advanced economies, first the curiosity to develop and second to find a solution for a certain problem. There are joint global problems that the G20 are trying to address commonly, but where solutions could be differentiated in a certain way. So how RD20 can bring solutions for the global problems, that is what we need to bring into consideration. There are developmental gaps that exist, that is what RD20 could mean, that is where development exchange could happen. That could come from the RD20 summer school. In reality there a country silos and research silos that exist, but normally there is a wide participation of developing countries, that is where exchange could happen. There is also a huge variety of research disciplines, where exchange would be beneficial. Then there is also the issue of financing support, where maybe two participants are cooperating on a common project, and through the invitation of a third researcher where RD20 could contribute

through a financial mechanism as maybe a small grant to allow joint research and development. In another sense RD20 could also foster innovation through such events as the summer school to develop new ideas, and to facilitate and nurture the common ground to work together.
Every researcher who is an expert in his field could contribute to the RD20 initiative by bringing frontier knowledge to either a group of young researchers or engineers, which can bring a multi-disciplinary thinking to this group. On the other side there is the question of how to incentivise top researchers to contribute, because it is their valuable time to prepare presentations which is not being compensated. As an organisation, we are already cooperating with 16 different nations, we are involved in the G20 process, so we can bring some G20 presidential thinking to the RD20 program, the way what we are discussing, how we are discussing, how to make research more useful and usable for us.

Voices from the young researchers participants

Ghulam Mohy Ud Din
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I became to know about the RD20 summer school through a colleague which participated in the summer school in 2023, so I took the initiative to talk to my manager and suggested to participate in this years' event. On top of everything the most important motivation for participating in this summer school was the diversity of the knowledge on decarbonisation and especially the sustainable energy transition. My whole work objective in my research is to achieve a sustainable energy transition. I expected that the event will be truly diverse and touch on those subjects which I will normally not do, because my research is really advanced, this will give me the opportunity to touch on some diverse topics, for example today we heard about the circular economy and life cycle assessment, and an entirely new capital to be developed in Indonesia with the objective of low emissions, so it is very interesting of how all these individual features fit into the overall system planning and how they can impact positively to the outcome of the decarbonisation plan for the future.
I am very pleased to become to understand these new topics today I heard about and learned from, it definitely broadens your spectrum of thinking of what you are going to integrate and features which are going to affect the outcome and which we are not thinking at the moment.
I believe the objectives for RD20 are very general, whereby we are placed in a very narrow research spectrum where we are trying to contribute to the energy transition for our future. We have to fit in those objectives into a research perspective. So on following up on those core (RD20) objectives, so I thought, this is the right thing, because this type of alliance of the research organisations where we can really have in-depth discussions on different topics, and where we can really explore more on our own research spectrum and where we can become to know where we can contribute more significantly and easily through the RD20 platform. I really expect that these discussions should facilitate on the way to the next level of collaboration. I myself being favourable towards open data tools,

models and data sets for research purposes, and these are one of the contributions I am trying to do myself to this area. I am a strong advocate for this throughout that platform so the research community can benefit from that. This will help us collectively to understanding and doing research and sharing and collaborating on our research activities in different fields.

The conferences which we normally attend are very specific in their content, for example the Power Systems conference which I just attended last June in Paris, these conferences have normally very specific themes and are confined to a very specific research area. What is also missing is to present research issues in the specific local context, so for example when you place a certain solution in a different local context, the solution might be different. You have to understand all those kind of diverse aspects and to have to identify those problems in a different context, so only this will help to come up with a really global sustainable energy transition. This is an area where RD20 could contribute a lot.

I am also working on the Australian electricity market model, so I am interested to look into those real system characteristics and I am thinking of the real problems that can be faced and to solve them, rather then to do only theoretical research. I am not criticising it, I am a great fan of all the research which is being done across countries around the globe, but I am really interested to look into the real problems. One of the ways to find the real problems and to get on the real solutions is to exploring them practically. I actually had the chance to explore Vietnam's power system. In February this year I was delivering a presentation in a workshop which was organised by CSIRO and the Department of Trade of Australia. In that workshop we were able to talk to the Vietnamese representatives to understand about their power system, which was very interesting, because the characteristics of their power systems were entirely different from the Australian power systems, their problems were unique, they needed unique recommendations and solutions for that. That actually helps to widening up our own knowledge and understanding of how the systems work in different specific regions, that is the diversity which can be learned through RD20.

I can personally contribute to the RD20 process through presentations on my own work on network security, I have also made available my models, data sets and tools on open source to share it with the community for the purpose of transparency. I would be very happy to continue to contribute in that sense.

Asad Hasan Sahir
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My first job after graduation with a master's degree was with an Indian petroleum company, where I worked in the area of crude oil distillation and refining efficiency improvement. Then I moved on to pursue a PhD in clean coal technologies, where I was introduced to the subject of biofuel co-firing during my stay in Colorado, USA. My research always centered around leveraging already existing energy infrastructure. The same problem we are facing with the introduction of hydrogen, where we are having a lot of existing natural gas pipelines which potentially could be used for transportation of hydrogen. It is a question of how we can use modern calculation tools, such as fluid dynamics to investigate systems, which have already a history, which may benefit from advanced analysis.

My main personal motivation to work in the field of decarbonisation technologies lies in the fact that India has a very large population, so we have concerns about energy equity. So how we can help our population to get access to energy which is affordable. Renewable energies have a very important future, especially in a country which is moving from an emerging to a developed economy. And these are the aspirations which are shared also by our current government. For a developing country one of the important issues is to provide access to energy and equity. Hydrogen is also an important vector to be explored, but recently my focus has changed on how to use bioenergy. We are also working on the decarbonisation of the iron and steel industry as well as the resource requirements for the petrochemical industry. So these are the four areas I am interested to look at. Coming to the summer school I am also finding similar aspirations for Indonesia which is also diversifying its energy structure. So an event like this is a very important opportunity to see how a country is thinking in re-planning its resources, as well as to participate in an event where major research organisations like NREL, AIST from Japan as well as the university from Birmingham and CEA from France provide an excellent opportunity to engage in these type of conversations.

I was part of the organising team which was welcoming delegations for the G20 summit last year, where I participated in the secondary education working meetings, where part of it was also research and development. Through Google search I learned that there is also an RD20 initiative and that there was a summer school. I was very much excited about the idea on the common objective of research in the field of decarbonisation. I am convinced that a single country can not address a large problem, because although the energy technologies may be similar, but the context of applying those technologies is very different. So what is happening in Indonesia is not applicable to India because of the geographical size. The United States may have another different context on manufacturing and what are their needs in the future. And for example India is planning to undertake massive investments in its petrochemical infrastructure, but there is a lot which we can learn from the United States and Europe when it comes to life cycle assessment of technologies. So why don't we have a collaborative mechanism where we can learn and synergise between different nations and their scientists. So RD20 can be a great way of doing this. 20 years back a lot of

research collaborations were happening bilaterally, but multilaterally only on a few occasions.

An area which can benefit besides the typical PhD candidates is exposing our undergraduate students to these initiatives. For example the German Academic Exchange Service welcomes students from all over the world, but there could be a particular theme on energy where the participating countries may identify certain topics on decarbonisation, I think of a three to five year program where they could have internships towards these topics. For example we have participants from Bangladesh and the United States which participate on online internships, and everyone of these emerging leaders wants to do something for the world, so it is just to create those mechanisms, so I think an initiative like RD20 can join in and centralise such mechanisms. So it is not about a summer school, a task force or a workshop, but it is an opportunity for the participating nations to truly benefit from an immediate need to collaborate.

Another opportunity which I really appreciate is the US Department of Energy solar decathlon design competition, which they opened to countries like India and Africa, and the idea is that teams come together and they design and manufacture solutions based on solar energy, this initiative had a resounding success. So maybe RD20 can bring these initiatives together which then can have a wider footprint.

I am involved in many bilateral and multilateral research programs with individual countries, for me the main learning I am looking forward in RD20 is how different countries are approaching the same problem but through a different lens, and it is my opinion that every country has its own analysis under a given context, even if there is a lot of learning which can be done through sharing of data, sharing of insights. For example if there is some wonderful research which is being conducted in Germany, and if I am a researcher sitting in India, I will need to consider whether there are solutions where both countries can work together in developing joint technologies which can be applied in India, but there might be also other countries which might be working on the same item. So this is an area where RD20 can support to provide better visibility. I will definitely encourage other senior researchers to participate as a lecturer in the next RD20 summer school as well as to learn from the emerging generation of researchers by seeing their enthusiasm, by seeing the diversity of topics in the poster sessions, which has been a wonderful experience.