Appendix 1

Record of ERIA Working Group Meeting:

Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternative Biofuel Introduction in East Asia Summit Countries

First Working Group Meeting (2018–2019), 30–31 January 2019, Bangkok, Thailand

1. Opening Address

The first meeting (2018–2019) of the ERIA Working Group (WG) was held in Thailand, hosted by the MTEC (National Metal and Materials Technology Center). WG Leader Dr Toba from the National Institute of Advanced Industrial Science and Technology, Japan (AIST) and representative of host institute Dr Sumittra Charojrochkul gave the welcome address and expressed great appreciation for all WG members. This was followed by self-introductions of all WG members and observers.

Dr Toba explained the outline of this new ERIA Energy Project and the WG title 'Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternative Biofuel Introduction in East Asia Summit Countries'. The present ERIA project focuses on the following subjects:

1. Evaluation of CO_2 emissions reduction by mobility electrification as a main research theme of this project, which will discuss best scenarios of electrified vehicles' introduction based on the simulation of the CO_2 emissions reduction, energy consumption in the transport sector, and biofuel utilisation. It is headed by Mr Ichikawa from Toyota, Japan.
2. Supply potential of next-generation biofuels from non-conventional resources, which will investigate the resource quantity of non-conventional biomass, the production process of bioethanol from non-conventional biomass, and its environmental compatibility. It is headed by Dr Toba from AIST, Japan.

2. Session I: Evaluation of CO_2 Emissions Reduction by Mobility Electrification

The session started with an outline of the subject presented by Mr Ichikawa. The scope covered three countries: Thailand, Indonesia, and India. First, information on policies such as biofuel introduction, power generation, and electrification vehicle introduction targets in each country were investigated. In the next step, scenarios will be set for each country and the effects of reducing CO_2 emissions and energy consumption were clarified by the simulation. Finally, based on these results, the best scenario for introducing electrified vehicles will be proposed.

Professor Atul Kumar from TERI Studies of Advanced Science (TERI-SAS), India gave the 'Evaluation of CO_2 Emissions Reduction by Mobility Electrification in India', in which he explained the current state of energy consumption in the transport sector, policies for realising low-carbon emissions, and plans for introducing electric vehicles in India.

Dr Nuwong Chollacoop from the National Metal and Materials Technology Center (MTEC), Thailand gave the 'Report from Thailand', in which he explained the energy situation, Thailand's Integrated Energy Blueprint (TIEB: 2015–2036) with emphasis on the Oil Plan, the Energy Efficiency Plan (EEP), and the Alternative Energy Development Plan (AEDP). Detailed information of bioethanol and biodiesel were shown with action plans and consideration of feedstock supply. Electrified vehicle (EV) policies and the current status of EV introduction were introduced.

Dr Adihika Widyaparaga from Universitas Gadjah Mada (UGM), Indonesia gave the 'Effect of Indonesia xEV Adoption Schedule on Carbon Emissions and Oil Consumption', in which he explained the energy situation and biofuel introduction roadmap in Indonesia. Government policies for low carbon emissions vehicle introduction were also explained. Leading estimates of energy consumption and CO_2 emissions were reported.

3. Session II: Research of Next-Generation Biofuels

In this session, Dr Arie Rahmadi from BPPT, Indonesia gave the 'Non-conventional Biomass as Feedstock for Transportation Fuel Potential for Indonesia' with biomass potential from forest residue and agricultural waste. Reports on recent research and the development of next-generation biofuels using lignocellulose, palm residues, and algae were presented.

Dr Toba presented the 'Fuel Production from Non-conventional Resources' on this subject. An overview of the types of next-generation biofuels produced from non-conventional resources and their production methods, factors that determine production efficiency, costs in bioethanol production, and examples of greenhouse gas emission calculations were presented.

All members were taken to visit the biodiesel upgrading test plant installed in Global Green Chemicals in Rayong.

Second Working Group Meeting 8–9 May 2019, Yogyakarta, Indonesia

1. Opening Address

The first meeting (2018–2019) of the ERIA WG was held in Indonesia, hosted by UGM. WG Leader Dr Toba from AIST, representatives of host institute Professor Dr Panut Mulyono (Rector) and Dr Deendarlianto (Director, Center for Energy Studies) gave the welcome address and expressed appreciation to all WG members.

Dr Toba explained the outline and progress of this ERIA Energy Project and the WG title 'Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternative Biofuel Introduction in East Asia Summit Countries'.

2. Session I: Evaluation of CO_2 Emissions Reduction by Mobility Electrification

A summary of the previous discussions, the issues at this meeting, and the reference values necessary for cost estimation were presented by Mr Ichikawa. Through discussions, the amount and timing of the introduction of electrified vehicles, what kinds of scenario will enable the achievement of the government's target of the introduction of electrified vehicles, and what effects biofuel introduction will bring were clarified.

Professor Atul Kumar from TERI-SAS, India set up five scenarios in addition to the business as usual (BAU) scenario and reported the results of simulating energy demand, fuel and biofuel consumption, and CO_2 emissions in India. According to a well-to-wheel's calculation, the introduction of biofuel had a good effect on reducing CO_2 emissions, but the introduction of electrified vehicles increased the emissions compared to the BAU case.

Dr Nuwong Chollacoop from MTEC, Thailand set up five scenarios in addition to the business as usual (BAU) scenario and reported the results of simulating energy demand, fossil fuel and biofuel consumption, CO_2 emissions, and economic

analysis. It was clarified that the combined use of biofuel and electrified vehicles is extremely effective in reducing fossil fuel consumption and greenhouse gas emissions. It was shown that vehicles using biofuels and HEVs are more cost effective than battery electric vehicles (BEV).

Dr Adihika Widyaparaga from UGM, Indonesia presented the 'Effect of Indonesia xEV Schedule and Alternative Fuel Adoption on Carbon Emissions and Oil Consumption from Road Transportation'. Three scenarios were set up and compared with the BAU scenario based on the current biofuel condition. The EV plan alone has no significant effect on reducing crude oil consumption and CO_2 emissions, but using biofuels has been shown to have a greater reduction effect.

Ms Ruby de Guzman from the Philippines Department of Energy gave 'Updates on Electric Vehicles in the Philippines', in which she presented the government policy on electric vehicle introduction and activities in local communities to promote the introduction of electrified vehicles.

3. Session II: Research of Next-Generation Biofuels

Dr Toba presented the 'Fuel Production from Non-conventional Resources' details. The classification of non-conventional resources, the results of a survey on compatibility of biomass as a raw material for next-generation bioethanol production, technology for improving ethanol yield, and CO_2 reduction in the ethanol production process by using by-products were reported.

All members were taken to visit the Madukismo ethanol production facility, biogas digester facility at Gamping Fruit Market, and the UGM algae biofuel facility.

First Working Group Meeting 15–16 January 2020, Koriyama, Japan

1. Opening Address

The first meeting (2019–2020) of the ERIA WG was held in Japan, hosted by AIST. WG Leader Dr Toba from AIST and a representative of the host institute, Dr Masaru Nakaiwa (Director-General, Fukushima Renewable Energy Institute) gave the welcome address and expressed appreciation for all WG members.

Dr Toba explained the outline and progress of the ERIA Energy Project and the WG title 'Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternative Biofuel Introduction in East Asian Countries'. The items and issues for the compilation of policy recommendations were shown by the project leader based on the previous discussion.

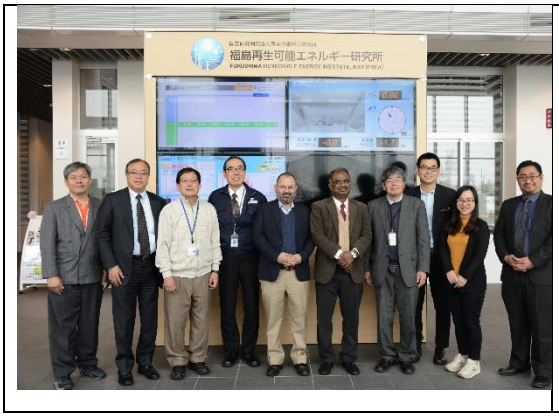
Professor Atul Kumar from TERI-SAS, explained the analysis results modified according to the provisional guidelines developed by the WG for policy recommendations.

Dr Nuwong Chollacoop from the MTEC, explained the analysis results modified according to the provisional guidelines developed by the WG for policy recommendations. The revised materials focused on reducing energy consumption and CO_2 emissions.

Dr Adihika Widyaparaga from UGM, explained the analysis results modified according to the provisional guidelines developed by the WG for policy recommendations. The revised materials show the analysis results that consider the CO_2 emissions associated with power generation, which were omitted in the previous discussion.

After the presentations, the WG leader suggested to the members what each policymaker, automobile user, and automobile manufacturer are expected to introduce electrified vehicles and requested that the proposals should be made with these items in mind. Based on the analysis results and discussion, the guidelines for policy recommendations were fixed, and each member made presentation materials for policy dialogue.

All members were taken to visit the Fukushima Renewable Energy Institute's renewable energy laboratory and mobile hydrogen stations supplying fuel cell vehicles.

 福島再生可能エネルギー研究所	

Appendix 2

Record of ERIA Working Group Policy Dialogue: Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternative Biofuel Introduction in East Asia Summit countries

Policy Dialogue, 25 February 2020, Bangkok, Thailand

1. Agenda

Organised by the National Metal and Materials Technology Center (MTEC) and the Department of Alternative Energy Development and Efficiency, Ministry of Energy (DEDE)

Venue: Mandarin A Room, Mandarin Hotel, Bangkok

Proceedings of the policy dialogue on 'Evaluation of CO2 Emissions Reduction by Mobility Electrification and Alternative Fuels Introduction in EAS Countries' organised by MTEC and DEDE in collaboration with ERIA on 25 February 2020, at the Mandarin Hotel, Bangkok.

Policy Dialogue on Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternative Fuels Introduction in East Asia Summit Countries

Mandarin A Room, Mandarin Hotel, Bangkok
Tuesday, 25 February 2020

09:00–09:30	**Registration**	
09:30–09:40	**Welcome address**	**Dr Venkatachalam Anbumozhi** Senior Economist Economic Research Institute for ASEAN and East Asia (ERIA), Indonesia
09:40–09:50	**Overview of ERIA project**	**Dr Makoto Toba** Leader, Non-conventional Carbon Resources Group, National Institute of Advanced Industrial Science and Technology (AIST), Japan
09:40–09:50	**Opening remarks**	**Mr Sarat Prakobchart** Department of Alternative Energy Development and Efficiency (DEDE)
09:50–10:00	**Group photo**	

10:00–10:15	**Coffee break**	
10:15–10:45	**Thailand presentation**	**Dr Nuwong Chollacoop** Leader, Renewable Energy Research Team National Metal and Materials Technology Center (MTEC)
10:45–11:15	**India & Indonesia presentation**	**Mr Shoichi Ichikawa** ERIA WG Sub-Leader
11:15–11:55	**Free discussion**	
11:55-12:00	**Concluding remarks**	**Mr Shoichi Ichikawa** ERIA WG Sub-Leader

2. List of participants

No	Organisations	First name	Last name
1	Department of Alternative Energy Development and Efficiency (DEDE)	Sarat	Prakobchart
2		Watcharin	Boonrit
3		Minta	Poowatanavong
4		Thanakit	Joyjinda
5		Nattapon	Cheyphuak
6		Sutharee	Kiatman
7		Chanettee	Sikhom
8		Supatchalee	Sophonthammaphat
9		Dechathon	Ruangkraikollakit
10		Mongkol	Prongjuntunk
11		Siroj	Kuhavichit
12		Chumlong	Mungkung
13		Settapol	Wattanasit
14		Pariwat	Rachakrae
15		Natikorn	Prakobboon
16		Pakamas	Chanmaneechot

No	Organisations	First name	Last name
17		Nantawipa	Bandit
18		Rungthip	Chumnumsit
19		Natchariya	Chaipanya
20		Angkana	Wisetsingh
21	Energy Policy and Planning Office (EPPO)	Supitr	Kamglad
22		Vichien	Tantiwisarn
23		Korakot	Phupaiboon
24		Juthamas	Kijjanuluck
25		Supatchaya	Chonchanachai
26	Department of Energy Business (DOEB)	Krittika	Tawonkeaw
27		Poonsook	Tapanasopon
28		Nipon	Tapanasopon
29	Energy Regulatory Commission (ERC)	Krittiya	Channoy
30		Arisa	Anekwanna
31	Electricity Generating Authority of Thailand (EGAT)	Siva	Jaruwan
32		Weerapong	Mookjang
33		Tharinee	Peampongsan
34		Trithep	Pitasanurak
35	Metropolitan Electricity Authority (MEA)	Chutipon	Phongam
36		Lattanan	Kamolroongwarakul
37	Provincial Electricity Authority (PEA)	Parinya	Sonsaard
38	Office of Transport and Traffic Policy and Planning (OTP)	Nopporn	Jarungkiat
39		Suppanat	Chaleamsupanimit
40	Department of Land Transport (DLT)	Kiatnarong	Kruba
41		Chanitsa	Warachit

No	Organisations	First name	Last name
42	Office Of Natural Resources and Environmental Policy and Planning (ONEP)	Papada	Yensukho
43	Pollution Control Department (PCD)	Manwipa	Kuson
44	Office of Industrial Economics (OIE)	Yada	Ongwattanakul
45	Thailand Automotive Institute (TAI)	Thanawat	Koomsin
46		Thitipat	Dokmaithes
47		Chanudol	Churuangsakul
48	Thai Ethanol Manufacturing Association	Torsang	Chaipravat
49	Thai Biodiesel Producer Association	Sansanee	Wilaidaraka
50		Cattareeya	Suwannipa
51		Teerapat	Suthicharoen
52		Amolsiranat	Pulnual
53	Thai Automotive Industry Association (TAIA)	Soranan	Noppornprasith
54		Indra	Chandra Setiawan
55		Sasiwimon	Phattanaphattananon
56		Piyada	J
57		Preecha	Kriangseemuen
58		Chuthathip	Sinchow
59	National Metal and Materials Technology Center (MTEC)	Sumittra	Charojrochkul
60		Nuwong	Chollacoop
61		Peerawat	Saisirirat
62		Kampanart	Silva
63		Johannex	Fefeh
64		Kampanart	Thapmanee
65		Thawatchai	Ouchochasan

No	Organisations	First name	Last name
66		Phumanan	Niyomna
67		Papawee	Likitdecharoj
68	National Institute of Advanced Industrial Science and Technology (AIST), Japan	Makoto	Toba
69	Toyota Motor Corporation, Japan	Shoichi	Ichikawa
70	Economic Research Institute for ASEAN and East Asia (ERIA)	Venkatachalam	Anbumozhi

3. Presentation

The dialogue started with Dr Venkatachalam Anbumozhi giving the welcome address on behalf of ERIA, followed by an introduction of ERIA and the purpose of this energy project.

Dr Makoto Toba then gave an overview of this project on behalf of AIST as follows.

Purpose of the project:

- Proposal of best scenario of electrified vehicles (HV/PHV/BEV) introduction for reducing energy consumption (main theme)
  - ✓ Simulation of the greenhouse gas (GHG) emissions reduction effect will be carried out by the electric vehicle based on the electric power situation and the fuel efficiency improvement vehicles using biofuel.
  - ✓ The reduction effects of petroleum consumption and GHG emissions by the introduction of various electrified vehicles are specified.

- ✓ Best scenario of electrified vehicles (HV/PHV/BEV) introduction including biofuel utilisation for reducing energy consumption in transportation sector will be proposed.

- Estimation of the biofuel supply potential including the biofuel derived from non-conventional biomass resources (sub-theme)
  - ✓ Non-conventional biomass resources for next-generation biofuel production that enable the achievement of highly concentrated use of biofuel will be clarified.
  - ✓ For a typical case, a life cycle analysis will be done.

The policy dialogue focused on the main theme of the project, where best scenarios of electrified vehicles (HV/PHV/BEV) were presented to participants from the government, academic, and industrial sectors in order to crystalise policy recommendations for Thailand. Scenarios for India and Indonesia were also be presented for comparison.

Mr Sarat Prakobchart then gave the opening remarks on behalf of DEDE, where the topics of electrified vehicles and biofuel were included in the Energy Efficiency Plan (EEP) and the Alternative Energy Development Plan (AEDP), respectively. On behalf of DEDE, Mr Prakobchart sincerely thanked ERIA, AIST, and MTEC for presenting study results, which will help DEDE shape its appropriate policy recommendations.

Then, Dr Nuwong Chollacoop gave the Thailand presentation starting with Thailand's commitment to global CO_2 reduction at COP21, a part of Thailand's Climate Change Policy, where the Nationally Determined Contribution (NDC) Roadmap targeted 10 and 31million tons of CO_2 equivalent for transport biofuel and energy efficiency, respectively. Assumptions of energy demand models, including biofuel and EV introduction and/or expansion, were presented to define various scenarios. Analysis results on energy demand, fossil fuel demand, greenhouse gas emissions, and biofuel (ethanol and biodiesel) demand were also presented. Then, assumptions on fiscal analysis, such as excise tax, relative vehicle price, collected taxes, fuel and/or electricity prices, and battery cost trends, were illustrated for fiscal (owner) and economic (government) analysis on net present value, total cost of ownership, and the government's collected excise tax reduction, to arrive at the output on cost of CO_2 reduction, cost of energy reduction, and cost of fossil oil reduction. Hence, overall policy recommendations were proposed for further discussion amongst stakeholders.

Next, Mr Shoichi Ichikawa made two presentations on behalf of India and Indonesia, which were detailed in other sections of this report.

4. Discussion

Director of Energy Efficiency Sector, DEDE, Mr Sarat

Q: From the Thai government target on xEV (1.2 Million in 2037) and biofuel (ethanol and biodiesel), do you think these targets and/or plans are appropriate? What are the issues and key success?

A: The answer is separated into two topics:

- ✓ For biofuel, the stock management in regional countries should be the solution for supply–demand imbalance in each fuel market.
- ✓ In the case of xEVs, the targets of all xEVs (HEV and plug-in xEVs: BEV and PHEV) are challenging. Therefore, if considering the implementation cost, HEV may be a solution for the near term and the plug-in xEVs may be a longer-term solution.
- ✓ Additional measures could be considered, such as the area base measure (i.e. traffic-congestion charge and/or city-centre charge for mitigating poisonous emissions) or the season base measure (i.e. a specific measure in the high particulate matter (PM) atmospheric season)

Q: Sharing comment from the public hearing of the Thailand Integrated Energy Blueprint that planning may not be limited to domestic consumption, but should consider export as Thailand is becoming ASEAN hub.

A: Noted.

Q: The electric motorcycle (e-MC) should be considered and/or included in the model. There are supported measures for the e-MC in Thailand.

A: We could add another scenario for e-MC.

Director of Materials for Energy Research Group (MFRG), MTEC, Dr Sumitra Charojrochkul

Q: In this work, the considered measures and scenarios focused only on light duty vehicles (LDV) or passenger cars. Shall we also consider heavy duty vehicles (HDV)?

A: As the Thai road transport emissions are dominated by LDVs that have higher vehicle numbers, this work focuses on the implemented measures for this sector only. However, HDVs could also be included in the calculation model.

Q: In the case of BEV, does this model take into account the change of energy mix as in the Thailand Power Development Plan?

A: The emissions factors for xEVs GHG calculation in this model refer to Thailand's Power Development Plan 2018, which is varied by the energy share for the planned electricity production.

Representative from Thai Ethanol Manufacturing Association

Q: From the calculation results, why is the impact on GHG reduction lower than the NDC target (5 MTonCO_2 compared to 41 MTonCO_2 in Transport NDC)?

A: Because this work focuses only on some measures of the NDC plan. Total GHG emissions analysis should include other measures, e.g. travel demand management, mass transit promotion, eco-driving, etc.

Leader of Transport Energy Efficiency Team, DEDE (Mr Watcharin)

Q: Because of the conflicting nature of EV and biofuel (EV promotion would reduce fuel consumption, and thus biofuel demand), does this study include this effect?

A: Yes, the model will take care of the net effect from these two factors.

Q: Should this study also include full life cycle analysis (LCA) on whole vehicle value chain?

A: Dr Anbu said this topic will also be included in the next phase of the ERIA project.

A: Dr Nuwong mentioned that the next phase of the ERIA project can be reported in the near future.

Vice President of Thailand Automotive Institute (Mr Thanawat Koomsin)

Q: Sharing personal viewpoints as automotive expert (not on behalf of Thailand Automotive Institute) as follows.

- ✓ This study focuses on the long-term policy of road transport vehicles, similar to the National Energy Development Plan, which has been changed often by political leaders, one after another. The direction of the national plan should be more solid and not change with political leaders, such as compressed natural gas (CNG) is no longer promoted as previously.
- ✓ Furthermore, mass transport measures should be prioritised to reduce CO_2 emissions, such as rail transport.
- ✓ Thailand wishes the best for all aspects like best safety, best emissions, best CO_2 reduction, etc. CNG promotion in the past needs to comply with the Euro IV standard.
- ✓ To address the PM2.5 crisis, additional measure policy packages, such as intensive vehicle maintenance or vehicle scrappage, may be necessary.
- ✓ If excise tax is removed from vehicles, it may help support the end-of-life policy to remove less energy-efficient vehicles with worse emissions.

A: Noted and will try to incorporate in the ERIA report for the Thailand case.

Representative from TAIA

Q: In the slide, there are the projection of ethanol/biodiesel fraction for the vehicle. Does the study take into account the recent oil fund law that cannot be used for fuel subsidies for 3 years (could be extended by cabinet approval for 2 years)?

A: The model assumption does not take into account the no-subsidy biofuel policy yet. The calculation refers to the base fuel for gasohol E20 and biodiesel B10.

Q: Why is battery price replacement cheaper over time and why are two BEV models listed?

A: The battery assumption is from already available information with some BEV models as representatives.

Q: Does this calculation include the impact of the vehicle age on fuel economy?

A: Yes, this model includes this issue. On the other hand, the relationship between vehicle age and annual mileage will be studied in the future.

Policy Dialogue in Indonesia, 3 March 2020, Yogyakarta, Indonesia

1. Agenda

Organised by the Directorate General of New, Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources

Venue: Meeting Hall, Centre for Geological Disaster Technology Development, Ministry of Energy and Mineral Resources, Yogyakarta

Proceedings of the policy dialogue on Energy Conservation for Road Transport organised by EBTKE, Ministry of Energy and Mineral Resources on 3 March 2020, at the Meeting Hall, Centre for Geological Disaster Technology Development, Yogyakarta. The meeting was held in the Indonesian language as the WG members from abroad were unable to attend due to the COVID-19 epidemic.

08:30–09:00	Registration	
09:00–09:15	Welcome and Opening	Director of Energy Conservation (EBTKE-ESDM)
09:15–10:15	Data Presentation and Energy Conservation Policy in the Transport Sector	Directorate of Energy Conservation
10:15–10:30	Coffee Break	
10:30–11:30	Expose the Benefits of the Transportation System Management to Energy Conservation	Center for Transportation and Logistics Studies, UGM
11:30–12:00	Discussion	
12:00–13:00	Lunch	
13:00–14:00	Exposure of Energy Sector Energy Conservation Policy Options	Center for Energy Studies, UGM
14:00–15:00	Exposure to the Description of Conditions of Energy Use in the Long-Term Transport Sector	Center for Energy Studies, UGM
15:00–15:30	Discussion	
15:30–16:00	Closing	

2. Affiliation of participants

1	Devi Laksmi	Ministry of Energy
2	Muhammad Hasan Imaddudin	PSE UGM
3	Adhika Widyaparaga	PSE UGM
4	Prof Tri Widodo	PSE UGM
5	Andi Luxbinatur	Ministry of Energy
6	Putri Cresti Ekacitta	Ministry of Energy
7	Indra Setiadi	Ministry of Energy - Centre of Data
8	Sunar	Ministry of Energy - Centre of Data
9	Rima Agustin	Ministry of Energy
10	Bambang Dwi	Ministry of Transportation
11	Arif B.P.	Ministry of Transportation
12	Sari Murdiyati	Ministry of Energy
13	Awaliah	Ministry of Energy
14	Anggraeni	Ministry of Energy
15	Joko Purwanto	ERIA
16	Andi Komara	Ministry of Industry
17	Rio Jan Piter	ASEAN Centre for Energy
18	Agus Taufik Mulyono	PUSTRAL UGM
19	Joewono S.	PUSTRAL UGM
20	Deni Prasetio	PUSTRAL UGM
21	Evi Wahyuningsih	IEA
22	Lestari	Ministry of Energy
23	Irwan Wahyu K	Ministry of Energy
24	Nanang	Ministry of Energy

3. Presentation

Dr Adhika introduced the energy situation and policies of Indonesia's transport sector, and reported the simulation results of energy consumption, CO_2 emissions, and costs of electrified vehicle introduction based on the scenario.

4. Discussion

Andi Luxbinatur, Ministry of Energy

- The results show that xEVs have very a small effect on oil consumption and emissions. Could you explain?

Answer: The xEVs comprise only a small part of the vehicle population. As there is no vehicle retirement policy, the existing internal combustion engine fleet, which also comprises older vehicles, continues to consume large amounts of fuel and produce emissions.

- Do the emissions include the lifecycle emissions from the xEV batteries? This is important as emissions reductions obtained from the use of xEVs might be offset by the life cycle emissions.

Answer: At the moment our model does not include any life cycle emissions. But that is an interesting prospect for the development of the model. We will note that.

Alloysius Joko Purwanto, ERIA

- I would like to highlight the importance of (Indonesia) having a comprehensive database for transportation information. For example, at the moment it is difficult to obtain the actual number of vehicles operating on the road. Having more data would contribute towards an effective predictive model.

Evi Wahyuningsih, IEA

- In the model how do you account for the energy content of biofuels? The energy content is known to be smaller than fossil fuels.

Answer: We have accounted for this using a multiplier for energy content of biofuels. The model thus presents the energy consumption in the form of standardised units (litter gasoline equivalent or MTOE) and also in volume of the fuel.

- Why was 0.5% per year used as an assumption for the fuel economy improvement? It might be too low.

Answer: We have made 2%/year scenarios that show an improvement in oil reduction. For this presentation we wanted to highlight the effect of xEVs and alternative fuels without the effect of increased fuel economy improvement. As such we did not include it in the presentation. We chose 0.5% as a worst case fuel economy annual improvement.

Andi Komara, Ministry of Industry

- The reason why the bioethanol mandate is not working is not because of a lack of supply or feedstock. The main issue in regards to ethanol supply for transport is the price the Ministry of Energy sets at a fixed value periodically (every month). The value is currently set at around IDR10,000 per litre. Bioethanol producers are reluctant to sell as there is an economic gap and they prefer to export or sell for other purposes.

Reply from Arif B.P, Ministry of Transportation. But even if the price is right, our production capability is insufficient to provide for the entire vehicle population.

Reply from Andi Komara, Ministry of Industry. If there is sufficient demand and an acceptable price, producers can upscale production.

Andi Komara, Ministry of Industry

- The model shows that a large portion of the costs are due to the cost of xEVs. xEVs are expensive mainly due to the battery cost. But this cost will reduce with time.

  After 2022, the cost of batteries is projected to reduce to below US$100 per kilowatt hour. This will bring the cost of xEVs down. As such, the cost of xEV purchase should also be modified to change annually.

Answer: Noted. We will update the model for variable vehicle costs.

- In Perpres 55/2019, there is a provision to set tariffs to 0% for BEVs and PHEVs as both can operate fully on electric power. For class B vehicles which cost around IDR200 million, if there are xEVs of that class, the cost still seems affordable. But vehicle

manufacturers seem to prefer making xEVs for class C vehicles which are more expensive.

Question: Has there been any initiative from the Ministry of Industry to approach vehicle manufacturers to produce xEVs domestically? Certainly that can reduce cost further?

We have approached multiple vehicle manufacturers, but it seems that they are reluctant to produce locally. We think that this is likely due to the investment risk as the demand is still uncertain.

Alloysius Joko Purwanto, ERIA

I agree with a system of carbon taxing to help promote greener initiatives. But applying a carbon tax scheme must consider revenue and growth.

Tri Widodo, PSE UGM

We have conducted a study on carbon tax for vehicles previously. The carbon abatement tax we found was US$42.7 per ton CO_2 equivalent and was still applicable with positive economic growth. This can be a solution for cross subsidising.

Policy Dialogue in India, 13 March 2020, New Delhi, India

1. Agenda

Organised by TERI School of Advanced Studies (TERI SAS) and The Energy and Resources Institute (TERI)

Venue: Conference Hall, The Energy and Resources Institute (TERI), India Habitat Centre, New Delhi

Proceedings of the roundtable policy dialogue organised by TERI SAS and The Energy TERI on 13 March 2020, at the Conference Hall, The Energy and Resources Institute (TERI), India Habitat Centre, New Delhi.

Time (Hours)		Details
11:00–11:05	Welcome and Setting the Context	Mr Shri Prakash, TERI School of Advanced Studies
11:05–11:10	About the study by ERIA	Dr V. Anbumozhi, Economic Research Institute for ASEAN and East Asia (ERIA)
11:10–11:05	About the study	Dr M. Toba National Institute of Advanced Industrial Science and Technology, Japan (through video conference)
11:15–11:50	Findings from Thailand and Indonesia Country Study	Mr Shoichi Ichikawa, Toyota Motor Corporation, Japan (through video conference)
11:50–12:20	Findings from India Country Study	Prof. Atul Kumar, TERI School of Advanced Studies
12:20–12:50	Moderated Round Table Discussion	
12:50–13:00	Conclusion	Dr V. Anbumozhi, ERIA

2. List of participants

S.No.	Name	Organisation
1	Venkatachalam Anbumozhi	ERIA
2	Shri Prakash	TERI SAS/TERI
3	Atul Kumar	TERI School of Advanced Studies
4	I.V. Rao	TERI

5	S. Ichikawa*	Toyota Motor Corporation, Japan
6	Makoto Toba*	AIST, Japan
7	Soranan Noppornprasith*	Toyota Daihatsu Engineering & Manufacturing, Thailand
8	Sasiwimon Phattanaphattananon*	Toyota Daihatsu Engineering & Manufacturing, Thailand
9	Sourabh Rohilla	SIAM
10	Dipanjan Banerjee	Tata Motors
11	Abhishek Sharma	Praj Industries
12	Paresh Kumar Goel	MoRTH
13	Yash Saigal	Tata Motors
14	Piyali Das	TERI
15	Sanjukta Subudhi	TERI
16	Arindam Datta	TERI
17	Saswata Chaudhary	TERI
18	Shariff Qamar	TERI
19	Palak Thakur	TERI
20	Aravind Harikimar	TERI
21	Promit Mookherjee	TERI
22	Michael Dioha	TERI School of Advanced Studies
23	N Balaji	TERI School of Advanced Studies
24	Suchit Hoti	TERI School of Advanced Studies
25	Shinu Kari	TERI School of Advanced Studies
26	Swapnil Nikam	TERI School of Advanced Studies
27	Chetan Gusain	TERI School of Advanced Studies
28	Shadman Haque	TERI School of Advanced Studies
29	Suraiya Rahman	TERI School of Advanced Studies
30	Madhumitha C L	TERI School of Advanced Studies
31	Zubin Anand	TERI School of Advanced Studies
32	Md. Anas Imam	TERI School of Advanced Studies
33	Saurabh Nepal	TERI School of Advanced Studies

*: Through video conference.

3. Presentation

Dr Venkatachalam Anbumozhi, ERIA, Indonesia

The objective of this study is to find out the policy directions for the growth of electric vehicles and biofuels. Electric mobility has been a debated topic across the globe. In India, electric mobility has been advocated to address concern on raising level of air pollution. Electric mobility can bring a sizeable reduction in air pollution from the transport sector. However, as electricity generation in India is dominated by coal, consequently electric mobility will increase CO_2 emissions from the power sector.

In this study, we have conducted well-to-wheel and tank-to-wheel type of analysis. The electric vehicle introduction is coming at the same time with biofuel. Hence in this study, we are creating awareness and providing a scenario analysis based on the assumptions. This will give some idea on how East Asian economies can achieve energy security with the Paris agreement goals.

The study has two broad divisions:

1. Evaluation of emissions reduction in the transport sector by mobility electrification and biofuels.
2. Best scenarios for emissions reduction.

Three countries of India, Thailand, and Indonesia were analysed in this study. These countries have their basic policy frameworks for electrification of the transport sector. We analysed the policies and identified what could be future opportunities in the transport sector. Therefore, we conducted this round table to get feedback on policy direction from the industry stakeholders and the policymakers.

Dr Makoto Toba, AIST, Japan

The purpose of the study was to find the best-case scenario of electrified vehicles (HV/PHV/BEV) introduction for reducing energy consumption in the transport sector. The motivation of this project is to obtain the optimal answers to the questions raised on electrification of vehicles through simulation.

The following scenarios were assumed for the simulation study:

India scenarios:

1. Business as Usual (BAU) scenario (Base/Reference)
2. Alternative Fuels Scenario (AFS)
3. Moderate Electrification Scenario (MES)
4. Aggressive Electrification Scenario (AES)
5. Moderate Electrification cum Hybrid Promotion Scenario (HPS)
6. Only Electrification Scenario (OES)

Indonesia scenarios:

1. Business as Usual (BAU) Scenario (Base/Reference)
2. Increased Biodiesel Use Scenario
3. Increased Bioethanol Use Scenario
4. CNG Implementation Scenario
5. Vehicle Electrification (xEV) Scenarios

Thailand scenarios:

1. Business as Usual (BAU) Scenario (Base/Reference)
2. Alternative Fuels Scenario
3. Plug-in xEVs Expansion (1.2 million xEVs) Scenario
4. Hybrid Expansion Scenario (Minimum HEV)
5. Hybrid Expansion Scenario (Maximum HEV)
6. Combination Scenario (Alternative fuel + Minimum HEV)

Analysis of the simulation results showed that the combination of xEVs and the use of alternative fuels such as biofuels is the most effective way for carbon emission reduction. The use of CNGs for heavy duty vehicles and electrification of light duty vehicles are reasonable solutions to reduce oil consumption, in turn, reducing the carbon emissions. Scenarios are compared for cost of BEV introduction due to the construction of infrastructure and the cost-effectiveness of reducing oil consumption and/or CO_2 emissions due to BEV introduction, the combined cost of xEV mix and alternative fuel use.

Mr Shoichi Ichikawa, Toyota Motor Corporation, Japan

The results of 'Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternate Fuels Introduction', for Thailand and Indonesia case were presented as reference information.

Scenario analysis for Thailand

The following scenarios were taken for the study.

Alternative Energy Scenarios: Ethanol E20 will be successfully implemented in the market until 2037 causing total demand of 7.5 million L/day. Biodiesel B10 will be successfully implemented in the market till 2037 causing total demand of 8 million L/day.

1.2 million xEVs Scenario: Electrification of vehicles, that is 1.2 million units, sold up to 2036.

HEV BOI and HEV Extreme Scenarios: Total HEV sale achieves 320,000 units within 2023 (full production capacity of BOI investment plan committed in 2018) and HEV dominates 50% sales of passenger cars (gasoline originated) by 2036.

The study results when analysed in terms of total energy reduction, fossil fuel reduction, and CO_2 emissions reduction showed that the use of biofuels combined with an HEV/BOI scheme is an effective solution. Thailand' s power generation mix is dominated by natural gas and coal, and thus electricity from environmentally-friendly sources for BEV should be ensured in the Power Development plan in terms of well-to-tank CO_2 emissions. A combination of xEVs (HEV/PHEV/BEV) introduction together with biofuel utilisation is the most effective in reducing oil consumption/CO_2 emissions. xEV mix (especially HEV expansion) consideration has a positive effect on promoting the use of biofuel thereby supporting the agricultural sector. While xEV promotion will contribute mainly to the reduction of gasoline consumption, imbalance between gasoline and diesel fuel consumption is still an issue since diesel fuel consumption is much larger than gasoline consumption. Hence, reducing diesel fuel consumption should be prioritised by the appropriate blend of biodiesel.

Scenario analysis for Indonesia

The following scenarios were taken for the study.

Reference scenarios: Created as BAU based on the current biofuel condition in 2018 with B20 for biodiesel and no implementation status for ethanol. Governments' biofuel mandate, CNG roadmap, and LCEV roadmap are considered.

Biofuel scenarios: Developed and compared to reference (BAU) to examine the effect of the following scenarios on oil use and carbon emissions. In this scenario, three cases were assumed. Bio1 is according to biofuel plan (Biodiesel B30 and Bioethanol E20). Bio2 where biodiesel taken as B30 and Bioethanol as E0. Bio3 where biodiesel taken as B0 and Bioethanol as E20. Bio4 where biodiesel taken as B50.

xEVs Scenarios: Developed and compared to reference (BAU) to examine the effect of the following scenarios on oil use and carbon emissions. In this scenario, three cases were assumed. xEVs-1, is according to the Ministry of Industry, LCEV roadmap. xEVs-2 is according to roadmap for BEV trucks, buses, and motorcycles but all passenger cars as BEVs. xEVs-3 is according to the roadmap for BEV trucks, buses, and motorcycles but all passenger cars as HEVs. xEVs-4 is according to the roadmap for BEV trucks, buses, and motorcycles but all passenger cars as PHEVs.

The results showed oil consumption and CO_2 emissions of road transportation will decrease by 20% and 12% respectively, making it the largest reduction. This is due to the combined effect of the EV plan and biofuel, and also the use of CNG. The effect of xEVs for reducing oil consumption and CO_2 emissions is limited as contribution is only to new vehicle population, no difference of CO2 emissions between the xEVs without electricity from renewable energy.

The most cost-effective single action for reducing oil consumption and CO_2 emissions is biofuel implementation due to the widespread effect for all existing vehicles using gasoline and diesel fuel blends, with a larger reduction of oil consumption by ethanol blend. Therefore, the combined use of biofuels and CNG with xEV mix (including HEV) is the most effective and needs to be encouraged.

Toba and Ichikawa participated in a video conference from Japan due to immigration restrictions associated with the epidemic of COVID-19.

Prof Atul Kumar, TERI SAS

The results of 'Evaluation of CO_2 Emissions Reduction by Mobility Electrification and Alternate Fuels Introduction', Findings from India Country Study was presented as the main message of the policy dialogue.

Scenario analysis for India

The following scenarios were taken for the study.

Business-as-Usual Scenario: Characterised by continuation of existing trends.

Alternative Fuels Scenario (AFS): Accelerated pace of deployment of CNG-fuelled vehicles and biofuels such as ethanol/biodiesel.

Moderate Electrification Scenario (MES): Moderately higher road-transport electrification across all vehicle categories compared to BAU.

Aggressive Electrification Scenario (AES): Aggressively higher road-transport electrification across all vehicle categories compared to BAU.

Moderate Electrification cum Hybrid Promotion Scenario (HPS): Variant of MES with higher share of HEVs compared to MES scenario.

Only Electrification scenario (OES): Hybrid of BAU cum AES scenario.

Policy Recommendations: BEVs could be a better alternative to fuel-based automobiles to mitigate air pollution, but to switch to electric mobility in the short term is hard to achieve, and the effect of BEV introduction in reducing oil consumption/CO_2 emissions is limited as contribution is only to the new vehicle population. Key factors such as consumer acceptability and desirability need to be addressed before making BEVs a reality in India. The major challenges in the transition to electric mobility today remains the relatively high cost of BEVs (due to battery cost) and lack of a ubiquitous charging infrastructure network. Due to coal dominance of electricity generation in India, electrification alone do not have much effect in reducing CO_2 emissions. Use of alternate fuels such as biofuels and CNG will play a crucial role. Use of CNG should be promoted for HCVs and long-haul buses, while efforts on electrification of LCVs maintained, as these vehicle categories are dominated by diesel fuel, which is the majority of petroleum fuel consumption in India.

4. Discussion

Mr Banerjee, TATA Motors

- Growth of powertrain and biofuel both are recommended.
- Mix of powertrain and biofuel will depend on use case scenario. While there might be pure electrification in two-wheelers and three-wheelers, there might be mix in four-wheelers and heavy-duty vehicles going forward.
- In India, two-wheelers growth is significant and the pollution count is higher. Hence, targets should be specified for electrification of two-wheelers.
- Fuel cell applications should also be considered in near future.

Mr Saurabh Rohilla, Society of Indian Automobile Manufacturers (SIAM)

- It is evident from the study results that the emissions reduction in the transport sector can be carried out using a mix of technologies.
- We should have multi-faceted objectives in the policies.
- Pollution should be the major factor in the policy objective. Technology improvement should thus be based on that objective.
- From industry point of view, the technology improvement should be followed with respect to consumer requirements.

Mr Abhishek Sharma, PRAJ Industries

- It is evident that in the near future there will be a good demand for biodiesel and bioethanol. Studies on the availability of agricultural produce available for biofuel generation should be done.

Dr Piyali Das, Sustainable Biofuel Division, TERI

- Countries with high diesel and coal demand should be targeted.
- According to 2017–18 data, crude oil import to India was 220 million metric tons having a carbon value of 190 million metric tons; import of coal was 200 million metric tons having a carbon value of 150 million metric tons, and natural gas is 15 million metric tons having a carbon value of 11.6 million metric tons.
- If we transfer the import to resources like agri-residues, forest residues, landfill biogas, municipal solid waste, and used cooking oil. These resources are not readily available.

- Technology development to elevate the use of these resources is needed.
- Refinery integration of existing refineries for vegetable oil and pyrolysis oil will be one of the best solutions.

Dr Sanjukta Subudhi, Sustainable Biofuel Division, TERI

- Use of second-generation biofuels should be recommended.
- Hydrogen and fuel cells should also be connected with the source. Technology advancements also should be done for such alternative fuels.

Mr Shoichi Ichikawa, Toyota Motor Corporation

- In India, the use of CNG and LNG for heavy duty vehicles should be recommended.
- Bio-ethanol targets should be improved in future.

Prof Atul Kumar, TERI SAS

Q: What is the industry view on CNG and LNG use for heavy duty vehicles?
A: The technology is commercially mature. As soon as the infrastructure for LNG distribution is built, there will be rollout of LNG-based vehicles.

Mr Michael Dioha, TERI SAS

- Electrification of vehicles should be built on consumer acceptance.
- Cost to the consumer is the current limitation for the electrification of vehicles.
- Robust policies to incentivise xEVs is needed.

Concluding remarks by Dr V. Anbumozhi, ERIA

- Market readiness is a major difficulty for transformation.
- In India, PHEV should be encouraged in the short and medium term.
- Consumer markets should be built for transformation from internal combustion engine vehicles to biofuel to electric and then to hydrogen vehicles.
- Superimpose the mode of transport, that is using public modes of transport for regular commuting.