



Developing a Set of Criteria for Prioritising GHG Emission Reduction Measures in Metallurgical Sector

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<http://doi.org/10.29227/IM-2020-02-30>

Submission date: 06-03-2020 | Review date: 22-09-2020

Abstract

Prioritizing climate change mitigation measures could help to identify most feasible or most nationally appropriated mitigation actions. This process can also provide important inputs for the development of national climate change strategies or policies. The paper applies Delphi method to prioritize criteria for potential climate change mitigation technology in the metallurgical sector in Vietnam. The consultation process has been done with ten experts in only two cycle to reach Kendall (W) value over 0.5. Then, 11 out of 21 criteria have been selected for Multi-Criteria Decision Analysis (MCDA) in prioritizing mitigation options in iron and steel, lead, zinc, tin and aluminium productions. Mitigation options with highest scores will be proposed for mitigation target of the metallurgical sector which could be inputs for NDC of industrial sector. The selected criteria include 01 indicator in emission reduction (GPT1), 01 indicator in environmental impacts (MT1), 01 indicators in social impacts (XH3), 02 indicators in economic impacts (KT1, KT2), 02 indicators in sustainable development impacts (PTBV1, PTBV2) and 04 indicators in MRV (MRV1, MRV2, MRV3, MRV4).

Keywords: prioritising mitigation measures, Delphi method, metallurgical sector

1. Introduction

Prioritising GHG emissions reduction measures is an important research activity to identify potential mitigation options that are appropriate for each country's context and resources. Basing on the assessment outputs, countries can develop feasible emission reduction scenarios and development orientation. In Vietnam, the evaluation of GHG emissions reduction measures has been implemented in national climate reports such as National Communication on Climate Change (NatCom), Technology Needs Assessment Report (TNA), Biennial update reports (BURs), and Nationally Determined Contributions (NDC). Besides, the development of Nationally Appropriated Mitigation Actions (NAMAs) also requires to assess and prioritise GHG emission reduction options.

The first TNA of Vietnam in 2005 presented 60 mitigation measures, including 16 mitigation solutions for the energy production sector, 05 mitigation options. For the civil sector, ten mitigation solutions for the cement sector, 08 mitigation solutions for the steel manufacturing sector, 02 mitigation solutions for the field of construction materials manufacturing, 04 mitigation solutions for the transport sector, 06 mitigation solutions for the forestry sector and 09 mitigation options for the agricultural sector (MONRE, 2005). The evaluation of 60 mitigation measures is mainly done based on assessments of barriers and difficulties of implementation. The criteria used to assess mainly GHG emission reduction potential, emission reduction costs and policy issues. The report has provided quite detailed information about each technology reduction measure of GHG emissions as well as the needs and

shortages of the implementation of these technologies. However, the report does not clarify the method as well as the scientific basis for evaluating priority options for technologies.

The Second NatCom of Viet Nam, submitted to the UNFCCC Secretariat in 2010, identifies solutions to reduce GHG emissions for energy, agriculture and LULUCF. There are 28 mitigation measures in The Second NatCom. The evaluation for 28 mitigation measures was carried out by the multi-criteria evaluation method (MCDA). Accordingly, a set of priority selection criteria are developed focusing on factors such as GHG emission reduction potential, GHG emission reduction costs and co-benefits. Experts in the related fields have consulted the evaluation of the criteria, but the development of these criteria is mainly synthesised from international guidelines with less appropriated to Vietnamese contexts.

The second TNA of Viet Nam in 2012 had been implemented for 03 areas: Energy, Agriculture and LULUCF with 42 mitigation measures. The criteria used to evaluate include: economic benefits, social benefits, environmental benefits and potential to reduce GHG emissions on a scale of 0–5 with increasing levels of benefits. The evaluation uses the Multi-criteria Decision Making Analysis (MCDA) method.

In 2015, Vietnam's NDC was submitted to the UNFCCC at COP 21 in which Vietnam identified a voluntary mitigation goal of 8% by 2030 and this effort could be achieved up to 25% with international assistance. In NDC of Vietnam, there were 45 solutions for 04 fields: Energy, Agriculture, LULUCF and Waste (MONRE, 2015). The evaluation of mitigation measures in NDC has also applied the MCDA method. Similar

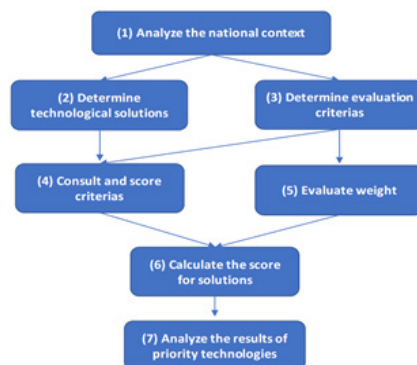


Fig. 1. A logical framework for sprioritising mitigation technologies in the metallurgical sector
 Rys. 1. Ramy logiczne ustalanie priorytetów technologii łagodzenia skutków w sektorze metalurgicznym

to previous studies and reports, the steps for implementing MCDA are clearly and specifically described, but the selection and identification of evaluation criteria are not detailed.

In 2018, Vietnam completed research and assessment of low carbon technology that contributes to NDC implementation (SPI-NAMA project funded by the Japan International Cooperation Agency). The project evaluated low carbon technology for 45 mitigation options in Vietnam's NDC and proposed additional technologies to reduce GHG emissions for energy, transportation, industry, agriculture, LULUCF and waste (JICA, 2018). The evaluation criteria used by JICA are not only limited by the potential of GHG emission reduction, co-benefits (economic, social and environmental) but also include some policy-related and development orientation criteria. However, the selection and method of formulating these criteria have not been detailed in the JICA report.

It can be seen that the prioritisation of GHG mitigation measures has been implemented in Vietnam since 2005. The main method used in these assessments is MCDA. However, the selection of evaluation criteria have not been carried out in any scientific method but mainly based on expert experience and international guidelines. Therefore, this paper will aim to use a scientific research method to develop and identify a set of indicators to evaluate and select priorities for GHG emission reduction measures in the metallurgical sector.

The paper applies the Delphi method with the analysis process divided into three stages before, during and after consultation. The consultation process is carried out in several rounds. In round 1, a series of open-ended questions which are appropriate to the problem is developed and sent to experts to find criteria that can be used to sprioritise mitigation activities. However, since this priority evaluation has been made quite popular all over the world, the study will inherit these studies and ssummarise them into common evaluation criteria. In addition, assessment criteria that are specific and appropriate to national conditions will be consulted by experts on climate change mitigation. After the evaluation criteria have been synthesised, the questionnaire on the importance and suitability of the criteria will be sent to experts for evaluation through the rounds until the consent index is reached. (Kendall index ≥ 0.5).

Climate change mitigation actions besides the main goal to reduce GHG emissions need to ensure co-benefits for sustainable environmental, economic and social development.

The set of evaluation criteria, therefore, needs to fully reflect these aspects. There are no official documents that specify globally accepted standard criteria for selecting NAMAs for international supports. Based on the theoretical basis and selectively using the inherited method of experience and practical scientific research results of the international (Massa et al., 2008; Posada, 2009; Asahi Glass, 2013; Malaysia Gas Association, 2014; EX Research Institute, 2012) simultaneously based on uniqueness, importance and independence in order to capture all aspects of the goal and ensure that the preferred outcome is justified and certain. The research team has collected, ssynthesised and drawn out the criteria that play a prominent and significant role in identifying and developing NAMAs. Different developing countries that are parties to the United Nations Framework Convention on Climate Change approve and consider it in their decision-making process.

2. Methodology

2.1 Assessment method of sprioritising GHG emission reduction options

Prioritisation of climate change mitigation measures will provide important input for developing a national climate change strategy in developing countries like Vietnam. This evaluation process can also contribute to capacity building and awareness raising in developing countries.

When sprioritising climate change mitigation measures with a focus on reducing greenhouse gas emissions, it is important that the technologies selected are appropriate to the conditions and development strategies of the countries. These priorities will also be shaped by the long-term social and economic development in Vietnam, such as increased sindustrialisation and urbanisation, as these will have an impact on final technology options.

An important principle when developing climate change mitigation plans, strategies and policies is to predict or forecast changes in future climate conditions. From this, it is possible to determine the impact of climate change on energy demand and greenhouse gas emissions. At the mitigation technology evaluation level, information on climate change scenarios should be collected and sanalysed before conducting a technology assessment. This is one of the foundational factors for sprioritising climate change mitigation technologies in accordance with national conditions.

The priority evaluation process of climate change mitigation technologies in the study follows the multi-criteria

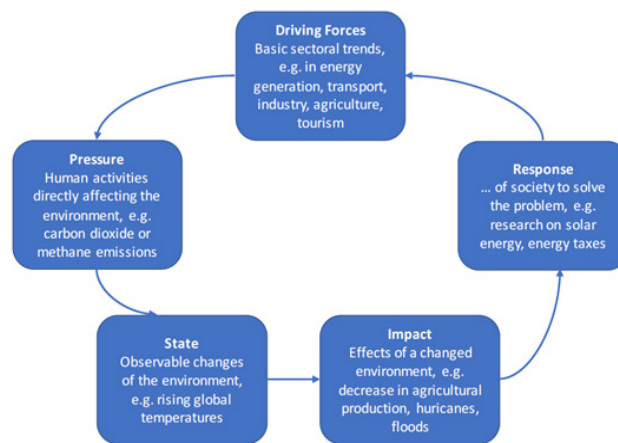


Fig. 2. Driving forces-Pressure-State-Impact-Response modified from original EU framework (EU, 1999)
 Rys. 2. Siły napędowe-ciśnienie-stan-wpływ-odpowiedź zmodyfikowana z oryginalnych ram UE (UE, 1999)

Tab. 1. Matrix of criteria evaluation according to Delphi method
 Tab. 1. Macierz oceny kryteriów według metody Delphi

	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6
Expert1	1	3	4	5	2	6	
Expert2	3	5	4	1	6	2	
Expert3	5	4	6	3	1	2	
.....							

Tab. 2. Assessing the importance of the evaluation criteria to sprioritise solutions to mitigation activities in metallurgy in Vietnam
 Tab. 2. Ocena znaczenia kryteriów oceny dla ustalenia priorytetów rozwiązań łągodzących działalności metalurgii w Wietnamie

Expert \ Criterion	MT1	MT2	MT3	MT4	XH1	KT1	KT2	KT3	KT4	KT5	GPT1	GPT2	PTBV1	CD1	CD2	MRV1	MRV2	MRV3	MRV4
1	14	4	5	1	15	16	17	8	9	10	18	11	19	12	20	21	13	2	3
2	7	1	3	2	8	19	20	10	11	12	21	13	14	5	6	15	16	17	18
3	6	1	2	7	8	15	9	5	10	3	16	11	17	18	19	20	12	21	13
4	1	2	3	6	4	13	14	8	15	5	16	17	9	11	12	18	19	20	21
5	5	1	2	6	7	9	19	4	11	12	13	14	15	10	16	20	17	21	18
6	8	2	3	9	1	10	11	6	12	7	16	17	18	13	14	19	20	21	15
7	3	1	4	2	8	14	15	7	9	10	16	17	11	12	13	18	19	20	21
8	5	6	15	1	7	9	17	2	18	10	19	3	11	4	20	21	12	13	14
9	13	3	4	9	6	14	10	1	15	11	16	2	12	8	17	18	19	20	21
10	18	12	13	1	2	6	19	3	7	8	4	9	15	20	16	21	17	10	11
Total	80	33	54	44	66	125	151	54	117	88	155	114	141	113	153	191	164	165	155
Variance	900	5929	3136	4356	1936	255	3136	3136	49	484	2025	16	961	9	1849	6561	2916	3025	2025

analysis approach described by Dodgson et al. (2009) and the Guidelines for Prioritising Mitigation Technology of UNEP DTU Partnership (MoNRE and UNEP, 2012). The relevant steps are shown in Figure 1. Typically in reports on assessment of climate change mitigation technology in Vietnam, the identification of evaluation criteria is made based on international guidance documents. However, the criteria in the guide are only common and general. In order to assess climate change mitigation technology solutions that are appropriate for Vietnam, specific criteria need to be developed for the Vietnamese context. Therefore, the study has applied the Delphi method to formulate evaluation criteria to sprioritise climate change mitigation technology for Vietnam.

(1) Analysing national context

Analysis of the national context is aimed at identifying national development goals and priorities, such as socio-economic, energy, and development goals and plans, or responding to climate change. In addition, this activity will also review and sanalyse development plans and plans of different

economic sectors. Scenarios on climate change, sea level rise and analysis and assessment of the impacts of climate change on sectors and fields have also been ssynthesised to provide the basis and foundation for the “nationally appropriate” of climate change mitigation technology solutions.

(2) Identifying technological solutions to mitigate climate change

The identification of climate change mitigation technology solutions can be referenced from reports of greenhouse gas reduction scenarios in the world or in the country where the assessment is conducted. If the country where the priority assessment does not have greenhouse gas emissions reduction scenarios is available, consult sources such as Climate Techwiki and the guidebook published by UNEP DTU covering the transport sector, construction and agriculture (to mitigate) and coastal areas, water and agriculture (to adapt); or IPCC evaluation reports (AR3, AR4, AR5). Countries that have developed mitigation scenarios can be referenced in national climate change reports such as the National Commu-

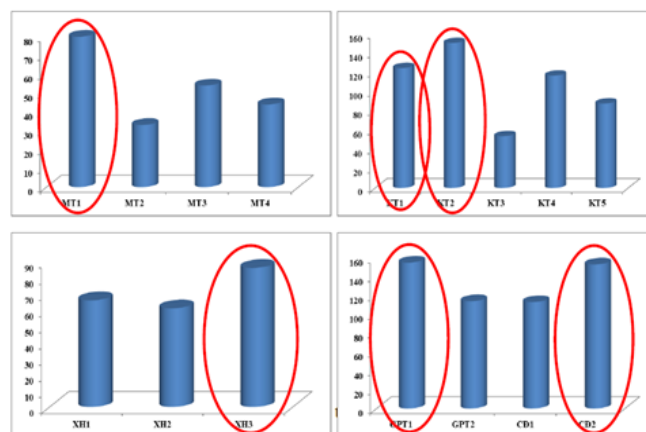


Fig. 3. The result on sprioritising criteria for mitigation measures
Rys. 3. Wynik ustalania priorytetów dla środków łagodzących

nication on Climate Change, and the Nationally-contributed contributions. Nationally Determined Contribution. Priority assessment of mitigation technology solutions in the above mentioned reports on climate change will help policymakers have a basis to build a roadmap to implement commitments on reducing greenhouse gas emissions. We also provide the private sector with information about potential, relevant and feasible solutions in that country.

(3) Defining evaluation criteria

To identify these criteria, the study has applied the Delphi method. Accordingly, experts in the field of GHG mitigation are consulted through different rounds until an acceptable consensus coefficient is reached on the criteria. The consultation process with experts has clarified the main issues/factors when selecting technology. In addition, experts have proposed criteria that reflect national development priorities. Criteria can be organised into sub-criteria and organised into different levels to help link development priorities.

(4) Consult and grade criteria

Technology options are evaluated based on selected criteria. Firstly, a performance matrix is constructed, in which the rating scale can vary for each criterion. For example, capital costs can be directly entered into monetary units, reducing greenhouse gas emissions in tons of CO₂, and qualitative criteria can be assessed on the Likert scale (or similar). The data of quantitative criteria will be standardised into the point of the criteria for each technology. Meanwhile, qualitative criteria will be assessed on a scale of 1-5 with increasing importance. The information for evaluation and scoring of criteria is compiled from national research reports on the reduction of greenhouse gas emissions and consultation from experts in this field.

(5) Weight evaluation

The criteria chosen to evaluate the priority of each technology option may not be equally important to the decision or to the achievement of a common goal. Therefore, the weights given to each criterion will reflect their relative importance in the choice of technology options. For example, is the cost factor more important than the reduction in greenhouse gas

emissions when choosing technology in the metallurgical sector? If yes, how much? This step aims to assign quantitative values to the relative importance of the criteria. There are many different ways to assign weights, such as consultations or statistics. However, within the scope of the study, the weights of the criteria were determined by standardising the results of expert consultations in the "Determining evaluation criteria" step.

(6) Overall assessing for technology solutions

All the information and views gathered in the above steps are merged, with several technologies selected for more detailed analysis. The total score for these technology solutions can be done using the Multi Criteria Analysis Model (MCDA) provided by UDP. The technology options are then sorted according to their total score, then two or three best scoring technologies will be selected for further analysis by SWOT method to clarify further the difficulties and advantages of implementation of mitigation solutions.

2.2. Develop criteria for evaluating priority options

2.2.1. The Delphi method

The Delphi method is an interactive multi-stage forecasting method relying on experts to identify technical developments and trends. Its objective is to structure complex group opinions (Rauch, 1979) and to develop consensus on future developments among a set of experts participating on the panel (Linstone and Turoff, 2002). The method was developed by the RAND Corporation to generate scenarios for long-range strategic planning in the 1950–1960s (Gordon and Helmer-Hirschberg, 1964) and became a widely accepted approach (Kameoka et al., 2004).

There are two ways to use Delphi: traditional Delphi and Delphi used for four stages (Linstone and Turoff, 2002). The Delphi method is applied in many fields: economy, environment, sustainable development, land use, agriculture, transportation, nursing, tourism ... and climate change. Bunting (2008) used the Delphi method to facilitate interactive participation and reach a consensus in sustainable aquaculture development (Bunting, 2008). For the transport sector, a combination of the Delphi method and the Bayesian Network Model is used to predict highway accidents in developing

countries (Mbakwe et al., 2016). Delbari et al. (2016) uses the 2-stage Delphi method together with the Hierarchical Analysis Model (AHP) to identify and prioritise key competitive indicators for aviation services. The future of 3D printing is also consulted with experts using the Delphi method. Eighteen forecasts have been developed to provide future scenarios for the 3D printing industry (Jiang et al., 2017). According to Thomas Foth, the Delphi method has been used in 1085 articles on nursing research, and 799 articles have been published in nursing journals.

Nguyen An Think (2015) uses the Delphi method in combination with the DPSIR framework (Drivers- Pressures-States-Impacts-Responses) (EU, 1999; Martins et al., 2012; Elliott, 2014; Gari et al., 2015; Smith et al., 2016) (Figure 2) to assess climate change adaptation committees of local communities in coastal areas. Questions were asked to assess the level of consensus among members of the consultative group. The Kendall value calculated after the second round reached 0.681, showing the high level of consensus among the members. The study indicates that sustainable ecosystem development and new rural planning are considered as appropriate local adaptation measures in the study area. Nguyen et al. (2018) and the research team used Delphi method to develop a set of sustainable development indicators focusing on environment and health fields, applied for Quang Tri province.

a) Before consultation:

Step 1. Selection of expert groups involving into Delphi process:

The number of experts selected to participate in the consultation process using the Delphi method is 10 experts in the field of climate change mitigation from the Department of Climate Change - Ministry of Natural Resources and Environment, Institute of Science Meteorology, Hydrology and Climate Change, Energy Institute, Energy and Environment Consulting Joint Stock Company, Institute of Agricultural Environment, Ministry of Transport, Ministry of Construction, Ministry of Industry and Trade...

Step 2. Overviewing on prioritising criteria:

Summary of evaluation criteria for prioritising climate change mitigation technology in the world according to the technology needs assessment guidelines of UNEP DTU, IPCC, UNDP; guidelines on assessing and selecting NAMAs; and consult local experts on some criteria specific to Vietnam.

The set of indicators includes 04 groups:

(1) Group of climate indicators (GHG emissions reduction): The main objective to develop climate change mitigation actions is to reduce the amount of GHG emissions in each sector. The criteria to consider are:

+ GPT1: GHG emissions intensity (GHG emissions per product unit);

+ GPT2: Potential to reduce GHG emissions.

(2) Group of criteria of co-benefits (environmental, social, economic criteria):

+ MT1: Reduce air pollution;

+ MT2: Reduce soil pollution;

+ MT3: Reduce water pollution;

+ MT4: Strengthen sustainable natural resource management;

+ XH1: Create new jobs;

+ XH2: Improve the quality of life and health of workers;

+ XH3: Raising awareness about environmental protection;

+ KT1: Contribute to a green and sustainable economic transformation;

+ KT2: Scale of investment capital;

+ KT3: Effective investment;

+ KT4: Payback period;

+ KT5: Infrastructure development.

(3) Group criteria of relevance to the national/local context:

+ PTBV1: Has been implemented in the country/locality;

+ PTBV2: Consistent with national/local development policies;

+ PTBV3: There are policies and support mechanisms.

(4) Group of measurement, reporting and verification (MRV) criteria:

+ MRV1: A system of GHG emissions monitoring and sustainable development can be established;

+ MRV2: Basic calculations can be developed to quantify GHG emissions reductions and co-benefits;

+ MRV3: Can report on the progress of GHG emissions;

+ MRV4: Can ensure the accuracy and quality of the reported information.

Step 3. Develop criteria table and evaluation criteria matrix according to Delphi method.

b) During consultation:

Step 4. Application of the Delphi method round 1:

Meet and work with experts to consult and thereby assess the level of agreement with the construction index. The criteria will be ranked from low to high with increasing importance. Table 1 shows an example of a matrix that evaluates the importance and appropriateness of criteria.

Step 5. Data analysis round 1:

After collecting data using Delphi Method, Kendall coefficient was used to assess the suitability of the indicator. The level of consensus is scored according to the thresholds of 0.0-0.1; 0.1-0.3; 0.3-0.5; 0.5-0.7; 0.7-1.0 is equivalent to a very weak level of consensus; weak; medium; strong; very strong). The Kendall coefficient is calculated as follows:

When there are two signs x and y whose value corresponds to a set of values of the other sign in the form of statistical distribution, the Kendall coefficient can be used to assess correlation and consensus. Here, experts are independent variables, and criteria are variables classified according to increasing importance.

The Kendall coefficient (W) is calculated by the following formula:

$$W = \frac{S^2}{1/12K^2(n^2 - n)} \quad (1)$$

n is the number of elements x (the number of experts); k is the number of y elements (number of criteria). W has a value in the range (0, 1).

$$S^2 = \sum_{j=1}^k (R_j - R)^2 \quad (2)$$

$$R = \sum_{i=1}^n \frac{R_i}{n} \quad (3)$$

R is the sum of the terms for each element of y; R_j is the average of the sum of these terms.

Step 6. Application of the Delphi method round 2:

In case the Kendall coefficient (W) is greater than 0.5 in the first round, the evaluation process ends in step 5. This means that the experts agreed with the proposed index group. In case the Kendall coefficient (W) is less than 0.5 in round 1. The evaluation results will be sent to experts together with more specific questions about the reason and basis of the evaluation in the first round. To find out the disagreements between experts. The evaluation process will be repeated until the Kendall coefficient (W) is greater than 0.5.

c) After consultation:

After the data is collected in the final round, conduct an analysis of the results. The weighted value of the criteria will be determined based on the results of rankings evaluated by experts. The results are summarised, analysed, and a summary report with conclusions are sent to the expert group for saving and reference as needed.

After analysing and consulting domestic experts on 04 groups of indicators related to climate change mitigation mentioned above, the author synthesised 21 important indicators of these 04 groups and set up a questionnaire to conduct consultations with 10 experts.

Conducting round 1 expert consultations, the importance level of criteria set by experts from 1-21 is exactly equal to the number of aggregated indicators.

With the data collected from the table above, the Kendall coefficient is calculated as stated in chapter 2, and the result is 0.57. With a relatively strong coefficient of over 0.5, the experts agreed with a high set of proposed indicators, so there is no need to conduct Delphi round 2.

This result also helps to identify the indicators of the four selected groups that reach the highest consensus, thereby shortening the set of indicators to increase the accuracy in the priority selection of climate change mitigation solutions in the metallurgical sector. Vietnam's NDC in the next step of applying MCDA method. The expert group agreed very highly on the MRV index group, all the indicators in this group achieved the highest score compared to the indicators in the remaining groups, so all the indexes in this group were selected as the prioritising criteria. A mitigation solution is considered feasible and has the opportunity to implement successfully and effectively when it can measure, report and verify, having a solid MRV system.

3. Results and discussions

After analysing and consulting domestic experts on 4 groups of indicators related to climate change mitigation mentioned above, the author synthesised 21 important indicators of these 4 groups and set up a questionnaire to conduct consultations with 10 experts.

Conducting round 1 expert consultations, the importance level of criteria set by experts from 1-21 is exactly equal to the number of aggregated indicators.

With the data collected from the table above, the Kendall coefficient is calculated as stated in the methodology section, and the result is 0.57. With a relatively strong coefficient of

over 0.5, the experts agreed with a high set of proposed indicators, so there is no need to conduct Delphi round 2.

This result also helps to identify the indicators of the 4 selected groups that reach the highest consensus, thereby reducing the set of indicators to increase the accuracy in the priority selection of climate change mitigation solutions in the metallurgical sector. Vietnam's NDC in the next step of applying the MCDA method. The expert group agreed very highly on the MRV index group, all the indicators in this group achieved the highest score compared to the indicators in the remaining groups, so all the indexes in this group were selected as the prioritise criteria. A mitigation solution is considered feasible and has the opportunity to implement successfully and effectively when it can measure, report and verify, having a solid MRV system.

In addition, the emission reduction criteria only includes one indicator, so it is also preferred. The priority indicators of the remaining 5 groups are reflected in figure 3:

The simplified set of criteria includes 11 indicators: GPT1, MT1, XH3, KT1, KT2, PTBV1, PTBV2, MRV1, MRV2, MRV3, MRV4.

4. Conclusion

The results of the study show that scientific research methods can be used to assess the priority of climate change mitigation measures in the metallurgical sector of NDC in Vietnam. The study has applied the Delphi method to develop a set of priority evaluation criteria, the process of implementing Delphi method is described in detail in 6 steps with the purpose of increasing the accuracy in evaluating mitigation measures, and simplified criteria include 11 important criteria belonging to 4 groups: (1) climate; (2) co-benefits; (3) national context; (4) MRV. The set of criteria developed in the thesis framework should be further studied and updated in the coming time to suit the practical situation of Vietnam.

In terms of research methodology: due to the limited resources, the process of implementing the Delphi method has not consulted more experts in various fields related to climate change, and metallurgy, the more opinions it gathered, the more accurate the results of the consultations were confirmed; as well as in the process of setting up a set of priority criteria for GHG emission reduction solutions in the metallurgical sector. If it is possible to conduct a first round consultation with open questions, the result will be more appropriate than using selective inheritance methods from previous international studies.

Acknowledgement

The paper was completed with the permission of project manager and was used a part of research results from the project: "Studying and implementing the greenhouse gas inventory system and proposing a mitigation roadmap for the metallurgical industry" with project code BDKH.20/16-20. The project is under the Science and Technology Program to Cope with Climate Change, Natural Resources and Environment Management in the period of 2016-2020 with the Program code BDKH/16-20.

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Opracowanie zestawu kryteriów ustalania priorytetów środków redukcji emisji gazów cieplarnianych w sektorze metalurgicznym

Nadanie priorytetu środkom łagodzenia zmiany klimatu może pomóc w zidentyfikowaniu najbardziej wykonalnych lub najbardziej odpowiednich na szczeblu krajowym działań łagodzących. Proces ten może również stanowić ważny wkład w rozwój krajowych strategii lub polityk w zakresie zmian klimatu. W artykule, zastosowano metodę Delphi do priorytetyzacji kryteriów dotyczących potencjalnej technologii łagodzenia zmian klimatycznych w sektorze metalurgicznym w Wietnamie. Proces konsultacji został przeprowadzony z 10 ekspertami w zaledwie dwóch cyklach, aby osiągnąć wartość Kendalla (W) powyżej 0,5. Następnie 11 z 21 kryteriów zostało wybranych do analizy decyzji wielokryterialnej (MCDA) w ustalaniu priorytetów opcji łagodzenia w produkcji żelaza i stali, ołowiu, cynku, cyny i aluminium. Opcje łagodzenia z najwyższymi wynikami zostaną zaproponowane jako cel łagodzenia dla sektora metalurgicznego, który mógłby stanowić wkład dla NDC sektora przemysłowego. Wybrane kryteria obejmują 01 wskaźnik redukcji emisji (GPT1), 01 wskaźnik wpływu na środowisko (MT1), 01 wskaźniki wpływu społecznego (XH3), 02 wskaźniki skutków gospodarczych (KT1, KT2), 02 wskaźniki wpływu na zrównoważony rozwój (PTBV1, PTBV2) i 04 wskaźników w MRV (MRV1, MRV2, MRV3, MRV4).

Słowa kluczowe: *priorytetyzacja działań łagodzących, metoda Delphi, sektor metalurgiczny*