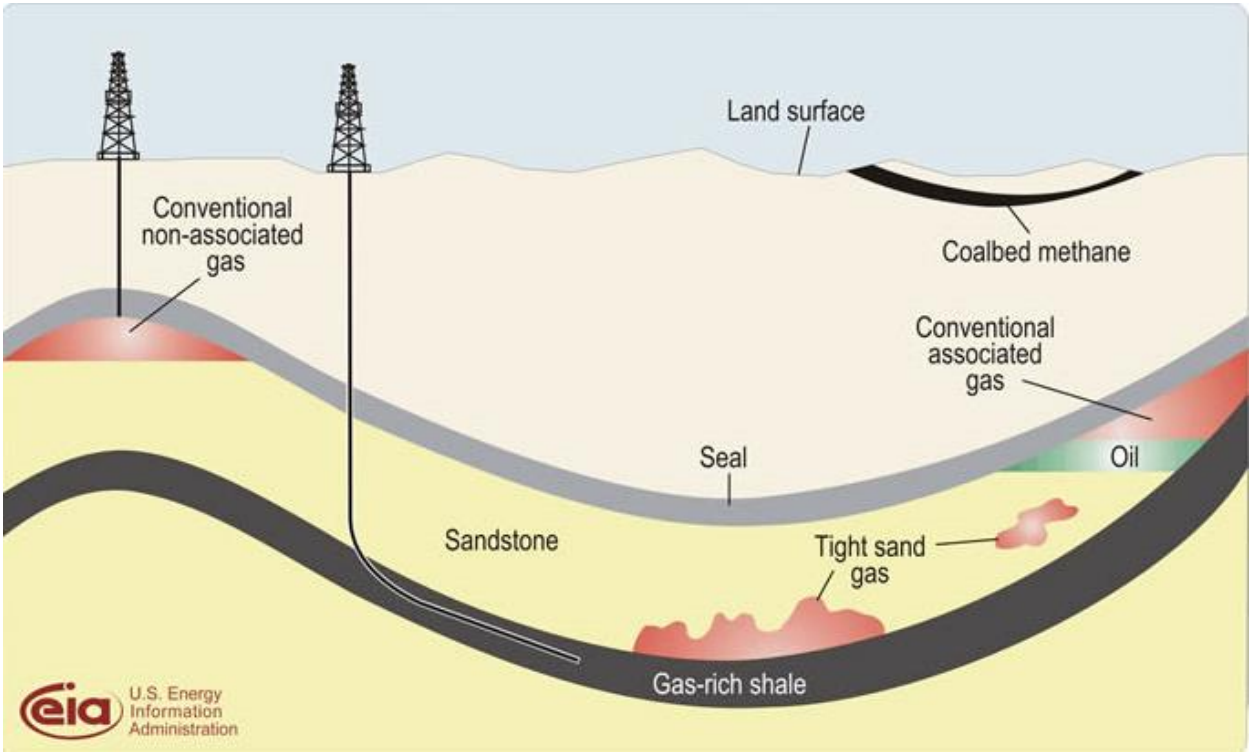
Delivery of Training on Basic Foundation Course for
Environmental Considerations of Associated Gas Processing and Treatment
23-25 March 2022, Online
13:30-17:30 CET

Training Summary and Documentation



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Abstract/Rationale

In oil production, historically, gas produced along with liquids (termed associated gas) was typically released into the atmosphere (venting) or burnt off (flaring), as it was not economical to recover. However, increased environmental awareness and growing demand for gas made associated gas recovery a priority for most established oil companies. Associated gas extracted from reservoirs often contains water, carbon dioxide, hydrogen sulfide, and liquid hydrocarbon condensates in addition to the gaseous hydrocarbon elements. For gas to be usable, it must be dehydrated, separated from liquid condensates, and cleaned of other impurities. This occurs in small gas processing facilities, often within the oil field itself, before the treated gas is shipped to an end-user. Associated gas processing byproducts, except condensates, must be disposed of as waste streams. Hence, several waste streams may be generated during gas processing and treatment. One major emissions problem from the natural gas dehydration process is that volatile organic compounds (including benzene, toluene, ethylbenzene, and xylene or BTEX) are released into the atmosphere via vent stream. To address this issue, the UN Environment Programme (UNEP), in collaboration with the Government of Norway's Oil for Development (OfD) Programme, supports countries in Africa, Asia, Latin America, and the Middle East with enhancing environmental governance and management in their country's oil and gas sector. Through this collaboration, UNEP offers this Online Global Training to previous UNEP-trained participants from all OfD-supported countries.

Background

The collaboration between UNEP and the Government of Norway's OfD Programme seeks to strengthen environmental management capacities in the oil and gas sector globally. In this regard, UNEP organized a training with the aim of building capacity to identify, prevent, and mitigate potential environmental and public health impacts of associated gas processing and treatment.

This training targeted all UNEP-trained participants under the UNEP-OfD collaboration who were interested in taking the course. Therefore, an open invitation was offered to all OfD-supported countries. The training was further tailored to the profile of registered participants, which entailed a diverse professional group:

- Government officials (local/national) in environment and other government ministries and agencies.
- Environmental advisors from national oil and gas companies and/or service providers.
- Technical consultants in the field of environmental assessments (environmental, social impact, and strategic environmental assessments, as well as auditing and compliance monitoring), water, and wastewater management.
- Civil society and national university members who cover oil and gas operations.

Due to ongoing global COVID-19 pandemic-related travel restrictions, and with participant safety and wellness of upmost importance, the training was delivered online to participants from 20 countries who met pre-training preparation requirements. Though online, the training maintained interactive components by combining theory with practice through case study examples and facilitated exercises. The training was delivered fully in English. Of the ~120 participants who joined the online training sessions each day, 107 successfully fulfilled all requirements and received completion certificates for the training course.

The online training included Q & A sessions with contributions from a couple dozen participants (see Annex 1). Presentations and other training materials (see Annex 3 and 4) were shared with participants a few days prior to and during the training. Participants undertook multiple group work and individual exercises/assignments, which helped them understand and identify key information in the environmental impact assessment process and preparing treatment methods for different waste types (see Annex 5). Participants also developed action plans, which highlighted priority challenges, current efforts and steps required to address these challenges, and the responsible or relevant institutions to implement them (see Annex 6). Lastly, participants collaboratively reflected on what they learned each day using virtual "post-it" notes on a virtual whiteboard (see Annex 7).

The following report summarizes primary training objectives, key discussion points, and participants' feedback from the training evaluations.

Objectives

The training raised awareness on environmental considerations related to gas processing and treatment. Specifically, it strove to build capacity for identifying, preventing, and mitigating potential environmental and public health impacts of associated gas processing and treatment. It also discussed how these considerations may be integrated as part of the sector's environmental due diligence, including through environmental impact assessment (EIA) processes, environmental compliance monitoring, contingency planning, and other regulations pertaining to the sector. Course objectives were achieved through six main criteria:

1. Developing basic knowledge of associated gas – its processing and treatment and why it is relevant for sound environmental management in the oil and gas sector.
2. Identifying possible waste streams that may be generated at each stage of the processing and treatment process (e.g., sulfur as a treatment byproduct).
3. Describing environmental issues/concerns at each stage of the processing and treatment process, including possible impacts on public health and safety.
4. Developing introductory knowledge on best-available technologies to prevent and/or mitigate potential environmental and public health impacts of associated gas processing and treatment, drawing from selected case studies.
5. Understanding basic principles of contingency planning for accidental gas leaks and other related pollution incidents.
6. Gaining an appreciation of global best practice in regulating associated gas processing and treatment and identifying complementarities and differences between national standards and practice.

Detailed recap of modules

Day 1/Module 1: An overview of associated gas – its processing and treatment

Scope and summary
THIS MODULE EXPLAINED WHERE ASSOCIATED GAS COMES FROM, HOW IT IS PROCESSED, WHAT ITS ENVIRONMENTAL AND HUMAN HEALTH CONCERNS ARE, AND HOW IT CAN BE UTILIZED IN ECONOMICALLY-OPPORTUNE WAYS. PRESENTER: ESAM WSHAH, *UNEP EXPERT*

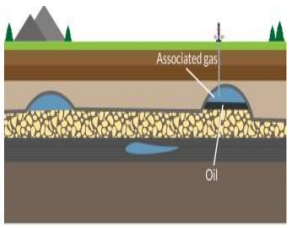
Main takeaways

- Associated gas, which is “associated” with crude oil production, was typically expelled as a byproduct. Associated gas processing is now being developed as a secondary, on-site energy source to power the extraction and processing of crude oil. However, its capacity declines a few years after initial exploitation.
- Energy-intensive industries, and especially power-generation processes, rely primarily on fossil fuels. The most pollutive and relied-upon source was coal, but this has been phased out in some parts of North America and Europe due to public pressure, newer technologies, and competitive fuel alternatives. This prompted the rising use of natural gas (and associated gas).
- Associated gas processing has a couple main concerns: gas is mixed with oil and/or water, contains (harmful) sulfur, and is extracted at inconsistent intervals.
- The concept of “waste” is changing in the fossil fuel industry. Most byproducts (associated gas, but also less intuitive gases like carbon dioxide and nitrogen) are demanded in the market somewhere. These byproducts can and should be directed to other uses and not be wasted.

Basic concepts

As identified in several publications, associated gas is defined as

Gas produced as a byproduct of crude oil production Associated gas reserves are typically developed to produce crude oil, which pays for field development costs. Reserves typically produce at peak levels for a few years before declining.[1]



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Why do we bother recovering sulfur?

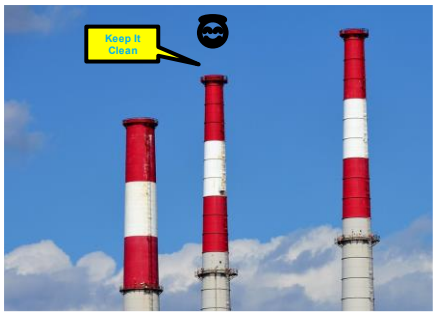

Figure 10 Stacked (Apergis , 2019)

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Group work exercise, day 1

Scope and summary

Participants were given an example environmental impact assessment (EIA) ahead of time to review. They were then asked to create a checklist (either individually or as a group) that could be used to assess the thoroughness of an EIA. The objective of this exercise was to help participants understand the principles that should be included in an EIA. See full group exercise prompt below:

Day 1, 23 March – Developing a checklist for Environmental Impact Assessment (EIA) review related to a gas processing project

You have been asked to assist and become part of the team who will review an EIA report that has been submitted for a proposed gas processing project: sample project: The Pembina Gas Processing Facility. Your job is to identify the major potential environmental impacts that may arise from the proposed project and ensure that the EIA report will assess these potential environmental impacts.

What type of information and commitments with regards to the management of gas processing would you need or request to see in the EIA submitted by the operator for this proposed project?

Instructions: You have 45 min to prepare this exercise

1. Elect a group rapporteur who can report back on the group output and discussions.

2. Develop a checklist that the EIA review team can use for their review on gas processing and treatment. During the preparation of the checklist, discuss the minimum level of details you need to be able to approve the EIA-report, taking into account your local/country context. Be as specific as possible.

Note: You may look at other sample EIA reports to gain a sense of what an EIA report should contain.

3. Please prepare a file document which can be shared.

Reference documents:

- Pembina two lakes project final Terms of Reference
- Sample EIA reports:
    - Anadarko, Environmental Impact Assessment (EIA) Report for the Liquefied Natural Gas Project in Cabo Delgado, Mozambique
    - https://www.tullowoil.com/application/files/3615/8504/7326/ten-project-environmental-impact-statement-volume-1.pdf

Exercise checklist produced by one group (sample)

Participant name, group, or country	**EIA approval checklist**

	1. Does the EIA describe concerns of the public and indigenous communities? 2. Is the project well described giving background information? 3. Are the EIA objectives informative enough to guide assessment and impact (social, environment [physical and biological, public health) identification? 4. Is the scope well defined covering all aspects (socioeconomic, environmental)? 5. Are the local and national legislations, standards, and guidelines 9NEMA) followed. Are the international standards and best practices considered? (Compliance with all applicable standards). 6. Are the project activities well described (detailed) in relation to existing environment (physical/biological) and social conditions (socioeconomic, land use, indigenous knowledge etc? 7. Are the methods well stated to assess all environment (physical & biological) and social aspects? Are credible experts contracted? Are stakeholders consulted? Is the processing technology appropriate? Are safety measures in place etc? 8. Are the residual/cumulative impacts predicted & described? Are the mitigation measures and management actions in place following mitigation hierarchy (avoid, minimise, restore & offset)? Is net gain (no net loss) programme in place for biodiversity and the general environment? 9. Are the management plans (physical, biological, social, waste, gas leak contingency plan, national gas leak plan etc.) with set procedures in place to address the different project aspects. 10. Are the monitoring programmes/procedures well set? How about auditing programme? 11. Are the recommendations feasible? 12. Are cited materials referenced? 13. Are tables appended?

Day 2/Module 2: Preventing and mitigating environmental and public health impacts

Scope and summary
THIS MODULE EXPLAINED THE MITIGATION OF ENVIRONMENTAL AND HUMAN HEALTH CONCERNS OF ASSOCIATED GAS, CATEGORIZED TYPES OF WASTE RESULTING FROM ASSOCIATED GAS PROCESSING AND USE, AND DISCUSSED BASIC PRINCIPLES OF CONTINGENCY PLANS FOR ACCIDENTS AND OTHER POLLUTION-RELATED INCIDENTS. PRESENTER: ESAM WSHAH, *UNEP EXPERT*

Main takeaways

- Associated gas processing creates multiple waste streams, which may impact air, land, and water. Some of these “wastes” include CO2, SOx, and NOx.

- Monitoring is required to effectively reduce pollution. There are two main methods to monitor air pollution: Continuous emissions measurement systems (CEMS, which measure from stationary sources) and ambient monitoring (measure surrounding areas).
- Air pollution concentration levels decrease as they are emitted higher into the air. Yet, dilution is not a pollution solution. Ambient air monitoring ensures dilution and dispersion methods are effective for local emission sources.
- Emission-reduction objectives must be included in contingency plans, with minimum and maximum possible emissions identified. Standard operation procedures (SOPs) should be in place to achieve better monitoring and mitigation techniques and be updated as new variables are added to operations.
- Safety is everyone's responsibility. Contingency plans assure safety by including an instrumentation list (specific procedures for each component/equipment piece in the operation).
- Best available techniques (BATs) should be employed to realize both emissions/pollution reduction and human safety standards.

Stack gas plume

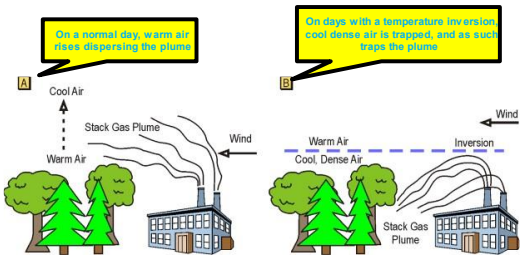

Figure 2. Industrial air quality management. Adapted from Instrument Technician ILM, Environmental Monitoring – Part A, 310404cA, (2019)

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Calgary during temperature inversion

Figure 3 Smoggy Calgary Temperature Inversion (Buracas , 2008)

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Group work exercise, day 2

Scope and summary

Participants were given several publications on oil and gas management ahead of time to review. They were then placed in groups and asked to create a pollution-management action plan that would protect different entities (land, water, air, wildlife, human health, etc). The objective of this exercise was to help participants understand the steps for managing pollution and identify key institutions in their countries responsible for carrying out these actions. See full group exercise prompt below:

Day 2, 24 March – Developing an encompassing pollution-management action plan for oil and gas processing

Instructions: You have 45 min to prepare this exercise

1. Elect a group rapporteur who can report back on the group output and discussions.

2. Discuss and identify the impurities that need to be removed so the associated gas can be used for energy generation activities in your country.

List them here:

Reference documents:

- Reader 1, Reader 3, Reader 5, Reader 6, Reader 7, Reader 8

3. Review the reference document shared with you on "Natural Gas Emergency Procedures and Accident Prevention". Discuss and determine the key elements which should be part of an effective emergency prevention and response plan for accidental gas leaks. Develop these key elements, also taking into account your own local/ country standards.

Reference documents:

- Natural Gas Emergency Procedures and Accident Prevention, Fire and Life Safety Group
- Reader 2

Exercise results produced by one group (sample)

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**	**Focal points / lead institutions**
Land	Regulatory framework (e.g., waste management)	Involving different stakeholders-AIA studying (private, public, ONGs, institutions)	Environmental Management Authority/Council

Incidents and oil spills	Contingency and emergency response Plans	Proper coordination of stakeholders	Environment and Energy institutions and private sector
Air pollution	Evaluation of BAT Adoption of BAT for air quality control Assurance of meeting standards set by the government	Administrative Controls	Ministry of Environment, Environmental Management Agency and private sector
Water pollution	Meeting the standards through regulatory framework Evaluation of BAT Adoption of BAT for air quality control Assurance of meeting standards set by the government	Identifying different sources of water and evaluate the BAT for management	Environment Institution, Ministry of Energy/private sector
Public health	Pollution dilution	Research can be considered for	Environmental Management Authority/Council/private sector
Displacement of wildlife	Assessing the cause of wildlife displacement		Institute of wildlife/ONGs, private sector
Conservation areas	Identifying the protected and conservation areas		
Solid waste and hazardous waste	Providing regulation and procedures for waste management		
Groundwater contamination	Minimize the use of chemicals, proper testing of underground waters		

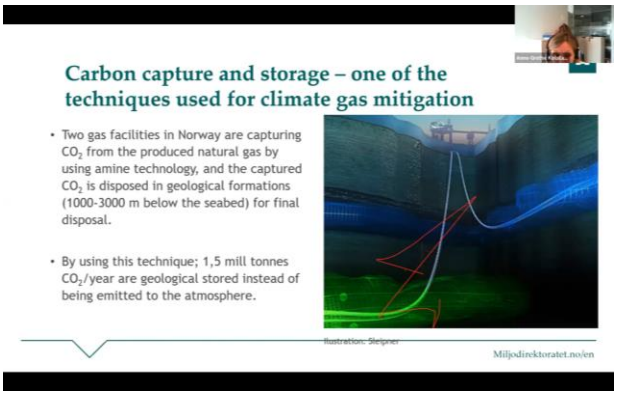
Day 3/Module 3: Global best practice in regulating associated gas processing and treatment

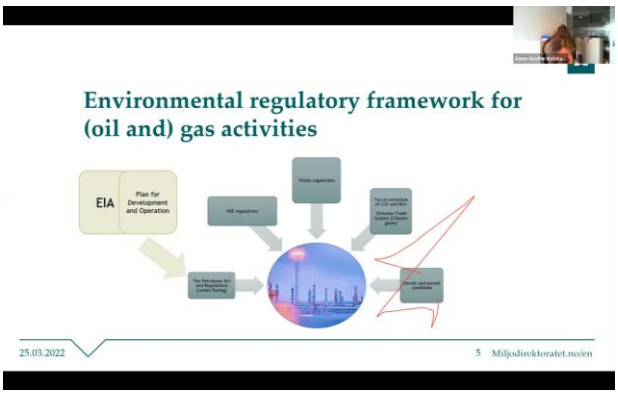
Scope and summary
THIS MODULE INTRODUCED NOVEL GAS TREAMENT AND STORAGE TECHNOLOGIES. GLOBAL GAS TREAMENT STANDARDS WITHIN BOTH ASSOCIATED GAS AND THE BROADER INDUSTRY WERE EXPLAINED. REGULATORY PRACTICES AT VARIOUS LEVELS (NATIONAL, LOCAL) AND AREAS FOR IMPROVEMENT WERE ALSO IDENTIFIED. PRESENTERS: ANNE-GRETHE KOLSTAD, *SENIOR ADVISER IN THE NORWEGIAN ENVIRONMENT INDUSTRY (SECTOR FOR PETROLEUM)* & ESAM WSHAH, *UNEP EXPERT*

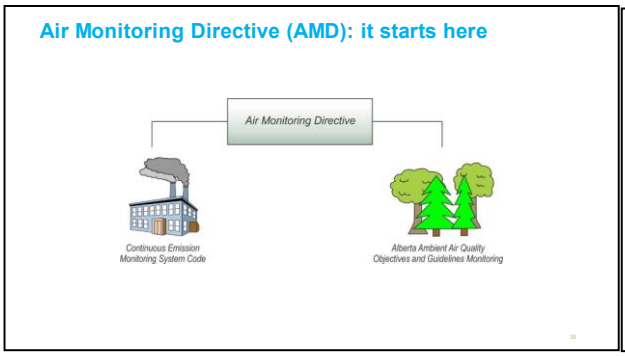
Main takeaways

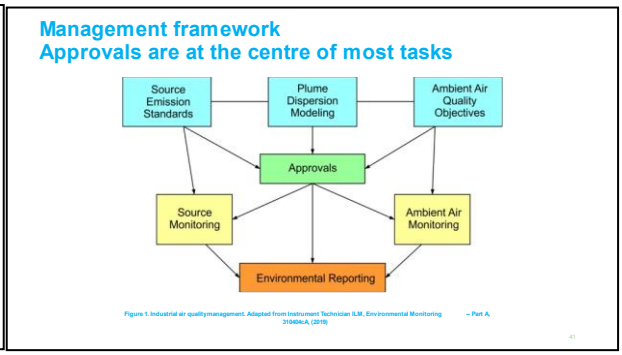
- Strong effort exists in Norway to implement and retrofit BATs in gas processing operations. All processes generating waste streams are considered. In Norway, the regulator's role is clear and professional, and they strive to maintain good relationships and dialogue between themselves and operators.
- Two Norwegian facilities currently capture CO2 they produce using amine technology, and then reinject it into underground geological formations for final disposal. These facilities dispose of 1.5 million tons of CO2 per year using this method.
- Best practice in Alberta, Canada employs CEMS to monitor emitted gases (SO2, NOx, CO, CO2, and total reduced sulfurs) and particulate matter (PM) concentrations. Norway's and Alberta's gas monitoring and regulatory frameworks can be used as benchmarks for other countries to follow.
- Monitoring can be done using two main sampling methods: in-situ (measured in natural or original position) or extractive (sample is removed from within the stack). In-situ measurements are based on the opacity of gas exiting the stack, while extractive measurements are based on the florescence or chemiluminescence of gas manually separated (extracted) from the stack.
- Quality assurance (QA) and quality control (QC) plans must be integrated into each country's CEMS "code", or guideline on designing, installing, operating, and maintaining the CEMS. These include daily validations, audits, and regular maintenance.
- Unwanted gas escapes, or "fugitive emissions", should be monitored (and minimized) at high-risk points in the operation. Mass spectrometers and open-path devices are the main techniques used for this.
- Air quality management is accomplished through regulation, environmental assessment, approvals (permitting), and enforcement. Governments hold the primary role of carrying out these tasks according to the laws that have been (or are yet to be) enacted in each country.
- The starting point for any country should be its air monitoring directive, or comparable law, which guides proper monitoring and reporting protocols for both CEMS (at source) and ambient

monitoring stations. CEMS Code and "ambient air quality objectives and guidelines" follow next, which should provide finer, site- and industry-specific technical details for air monitoring.









Group work exercise, day 3

Scope and summary

Based on content from the presentations, participants were asked to develop action plans (in groups) to address challenges/inadequacies in oil and gas management experienced in their countries. They identified current efforts in place, next steps to take, and institutions responsible for taking action in their countries. See group exercise prompt below:

Day 3, 25 March – Consolidate your team reflections. Please identify at least 2-3 priority challenges that require attention.

Exercise results produced by one group (sample)

Priority challenge for action	Current efforts	Additional steps to be taken	Focal points / lead institutions
1. Occupational health and safety	Legislation	Continuous training and modification of practices (update of SOPs)	Regulator responsible for OSH, MOH, Operator, contractor

2. How to deal with fugitive emissions	Air Pollution control legislation	Monitoring regime depending on type of emission and severity	Regulator, operator, contractor
3. Flaring/venting	Use of enclosed flare; repurposing gas emissions (e.g fire extinguisher filling; sulphur solids)	Legal Framework prohibits flaring except in exceptional circumstances; reuse of associated gasses via BAT for that country	Operator, regulator
4. Nonexistent codes/laws in emerging oil/gas economy	Developing necessary documents; using regulations from other countries with similar climate/issues; utilising international regulations	Consulting relevant authorities (stakeholders), international guidelines/standards	Regulator, operator
5. Conducting research on marine/terrestrial environment by oil and gas production	-Trainings and workshops without participants of relevant organizations, -Weak networking	-Networking -Public awareness about oil and gas	Universities, research institutions, environmental conservation departments.
6. Inadequate Research (environmental and health) about local conditions	Now it Is presented from the academy without a coordinated effort	Generate lines of study from the government	University or state scientific entities; linkages with external universities with studies in the relevant areas
7. Limited technology, knowledge/expertise in handling emissions/leaks	Training; Make training a requirement for the operator	Partnerships to build local capacity	Operators, regulators, contractors, universities
8. Inadequate reporting of incidents (technical and simple reports for both experts and community)	Simplifying the technical terms/reports for local community to understand	Engaging Education institutions	Regulators, operators, JV partners

Discussion overview

Throughout the training, participants raised questions related to various aspects of the modules, which were noted in a shared "Q & A" Google Doc (see Annex 1 for questions, comments, and answers). Some frequently-asked questions and responses are summarized below:

a) Uses and profitability of byproducts from gas processing and treatment
   - What are the different economically-useful waste types and which industries or countries are demanding them?
   - Sulfur is used in fertilizer, CO2 in methanol, and ethylene in plastic.
   - Policy makers should research the market to determine which gasses and chemicals are in demand by which industries.
   - Mindsets of policy makers and industries should be updated to the "nothing is waste" concept (boost awareness).

b) Feasibility/functionality of new waste-handling technologies added on (technical questions)
   - Should new processing facilities be built offshore, as many operations are opening there?
   - Research institutes are key for developing technology to solve specific waste-reduction needs (and to extract and store byproducts for economic use).
   - All technologies come in scalable capacities. Modular systems are ideal, as they require less space and can be transported/used offshore too.
   - The oxygen-free thermal process is the best option for cleaning up leaks at underground storage sites.

c) Acceptability of gas flared or vented (acceptable threshold levels)
   - Is it preferable to flare or vent gas?
   - Neither option is preferable unless they are implemented as emergency-only options.
   - Flaring thresholds, which should be emergency-only thresholds, are country- and weather-specific.
   - Environmental and health concerns should be identified first when setting emissions thresholds. Research institutes may also help with determining acceptable emissions limits and develop SOPs to achieve them.

Results of participant assessments

Prior to and after the training course, UNEP carried out a baseline and final knowledge assessment using a set of “exam” questions (28 questions in total), which was one way of evaluating improvements in knowledge attained through the online training. The questions, which were based on the training presentations, were multiple choice and true or false.

This type of written assessment only provides a partial valuation of individual participant knowledge. Participants also (presumably) gained knowledge through the group work discussions and direct interactions with peers and training experts throughout the training. Hence, it is important to view these knowledge assessment results in conjunction with the training evaluation results to see whether the training met their learning needs (discussed further below). Of the initially-registered participants (292), 107 completed both the baseline and final assessments. Participants who took both the baseline and final assessments registered a 12% average improvement in their knowledge of associated gas processing and treatment. Of the 147 individuals who completed the baseline assessment, the average score was 80%. Of the 107 who completed the final assessment, the average score was 92%.

Results of training evaluations

Participants were also given the opportunity to evaluate the training course based on their observations, expectations, and learning needs. One hundred and eight participants completed the evaluation.

Participants gave the training an overall 4.4/5. Forty-six percent of participants rated the training as 'excellent', while 52% rated the training as 'highly satisfactory' and 2% as 'satisfactory'.

Participants also rated the extent they believed the course's six primary learning objectives were met (score range of 1 = not met to 5 = fully met). When merging result percentages across all six learning objectives, the majority grouping (59% of respondents) felt objectives were fully met; the second-highest grouping (38% of respondents) felt objectives were mostly met; and the lowest grouping (3% of respondents) felt objectives were somewhat met.

When asked how knowledge received from this training may be applied, 75% indicated they would 'share training materials with other colleagues'; 44% indicated they would 'organize a follow up meeting to share knowledge and training materials with other colleagues who could not attend'; 86% indicated they would 'apply knowledge in EIA reviews and approvals'; and 71% indicated they would 'apply knowledge for conducting site inspections'.

Participants gave significant positive feedback. Many enjoyed the interactive elements (group work, quizzes, whiteboard exercises). They also appreciated the vast expertise of the two expert presenters. Participants finished the course feeling that they had enhanced their knowledge of technologies, risks, planning, and regulatory frameworks to make a positive difference with gas management in their countries.

Participants also provided constructive feedback on how to improve future trainings (summarized):

- Group session time should be longer to engage persons from other countries
- More videos related sustainable associated gas production (and ensure videos will work)
- Simplify technical aspects of the presentations for better understanding
- More explanation on how to treat each type of impurity
- Allow more participants during the Kahoot test sessions for all members to participate
- Too many participants in one training, which reduces the level of participation
- Too many participants in each breakout group
- Need experts from other regions (Africa, South America)
- Additional breaks needed
- Implement more ways to increase trainee participation
- Better facilitating of the breakout sessions
- Replace text with visual aids on the presentation slides
- Reduce daily training session length, but increase number instruction days

Consult Annex 2 for further evaluation results details.

Annex 1: Q & A table

Participant name/institution	Questions/ comments	Expert response
UNEP, Marisol Estrella	How do companies deal with sulfur in a profitable way (e.g., in Iraq)?	Technology can deal with this. Sulphur can be shipped to another country that buys/uses it. Laws should be implemented in a way that enforces the treatment or utilization of sulphur, but these laws aren't always enforced. Countries can start their own industry for sulphur (for fertilizer). Mindsets of policy makers and industries need to be changed (boost awareness).
KENYA- WISE. Dr Tom Nyangau Nyachieo	At what stage is benzene gas introduced in the oil supply chain? How is it monitored owing to its carcinogenic properties?	Continuous emission monitoring system: how fast it can be sensed, reported, and solutions developed. Starts with enacting law to address the contaminant (setting limits). SCADA systems also can address it. Finally, you can go to each industry and explain both the problem and solution, so they can implement it. Propose problems at the nearest university/government research institution to find solutions to deal with certain chemicals. Regarding emissions to air, it starts with the environmental impact assessment and permitting process. Solutions also come through production-sharing agreements.

Urias Taylor	How can CO2 be used in other industries? You mentioned it can be used as fertilizers? Is it directly used as CO2? Is it possible to treat all impurities in a natural gas in a single system?	CO2 can be converted to methanol, or ethylene for plastic. It also can be used for Enhanced Oil Recovery.
Filomena Pedro. ANPG-Angola	After separating the contaminants, is the carbon dioxide used? If yes, for what purposes?	Yes, it can be separated. CO2 can be converted to methanol, or ethylene for plastic. It also can be used for Enhanced Oil Recovery.
Mahmud Mohamed, Somalia	What if the production is going offshore? Should they build the processing facility on the ship?	All technologies come in scalable capacities. Modular systems are needed for this because they're more efficient and don't take up as much space. Each step (module) will handle each impurity separately.
Gollis University, Mubarak Abdulkadir Warsame	What are the other gasses, and how do we deal with them?	Gasses are typically the same across the world and everywhere experiences the same problems/solutions. Current gasses exceed environmental limits. Heavy metals (associated with gas production) can have a value.
Akoth Sisiria	1. Is it possible to manage/process associated gasses alongside oil and gas production to avoid accumulation? 2. Venting vs flaring, which one is preferable?	Yes, it is possible, and this is the current practice. None of them are options unless they are implemented as emergency options. But, if flaring or venting cannot be avoided, flaring is preferable, absolutely, regarding both climate and safety aspects.

Faisal Abdi Mumin/Garowe Municipality, Puntland, Somalia	On CO2 and the new techniques in Canada, you (Esam) said you don't have enough CO2. What does that mean? If the O&G industry is managing CO2 with new techniques - BAT, what about the other industries? What is your advice for a country planning to discover O&G resources?	It means that the CO2 we can collect from different resources is NOT enough for the industries we re-use the CO2 for. Oil and Gas leading the new technologies. Whatever ever O&G is utilizing, the rest of the industries will follow. My advice is to use your own experts to advise on the resources development and NOT to depend on the expert that the operator will bring. The experience from Norway is that although captured CO2 from natural gas could be used for enhanced oil recovery (that is, to be injected into the reservoir instead of injection of water or natural gas to increase oil recovery), it would take continuous and large volumes of CO2, and this is not available (you'll need to capture CO2 from several sources). We know that CO2 is a commodity (for EOR) in the US and Canada but has not been considered as a solution in Norway (offshore).
Kevin from Kenya, Department of Environment, Turkana County Government	What is the best technology/internationally-accepted method of handling a confirmed case of toluene underground seepage from a SOBM waste holding site?	First you must isolate the leak and make sure it doesn't get larger. Then, the best way is reclaiming the contaminated soil and clean it using an oxygen free thermal process.

Sinime Paulker - NMDPRA, Nigeria	Considering that gas flaring is part of gas processing operations as against its effect on the environment, is there a globally-accepted minimum / maximum volume of flare that can be accommodated by a government regulatory agency?	Gas flaring should be an emergency-only option. It's part of the process, but not the solution. Some countries have acceptable limits (Norway, Canada) that their industries are able to keep. The yearly amount of gas volume to be flared from a specific facility is probably dependent on whether there is a planned maintenance shutdown that particular year. I've seen some figures indicating that about 1% of the produced gas volume may be flared due to maintenance and safety operations.
Sinime Paulker - NMDPRA, Nigeria	If there is an acceptable threshold by these countries (Norway, Canada) in the flaring of gas? What could be the likely index in setting such a threshold?	The threshold depends on several things, like weather conditions for example. Here in Canada, you can flare up to 1 ton of sulfur a day. An efficient way of reducing flaring is to put a tax on the CO2 emissions. Norway has these taxes, and in addition, the operators must apply for a yearly amount of natural gas to be flared (application based on experience and from planned maintenance operations). This is from a climate and efficient use of gas resources point of view. As Esam says, you may need to regulate the flaring by the amount of sulphur to be flared to keep within your national or local ambient air quality standards.

	How does one define different EIA processes? Who defines it?	Government defines the classes. Initially, EIA starts at class 5, which is very general. Each EIA class approaching "1" (going downward) becomes more detailed. There may be different approaches in different countries. In Europe, there is an EU-directive to be followed by all European countries. Industrial sectors are listed in this directive as Annex 1 industries (EIA mandatory), others as Annex 2 industries (EIA may be required based on the size of the industry). The requirement for the content of the EIA is in principle the same if an EIA is required, but the EIA will be less comprehensive for a smaller project than a large one.
NEMA Kenya - Ngitahaja Lokuto Sylvester	Have the relevant regulations and institutional frameworks been adequately reviewed by the preparer (Individual expert/ Consultancy firm) of the EIA report?	The EIA-report should explain and list the legal framework (on relevant environmental issues) that has been identified as applicable to the project and it should also contain a list of the permits the proponent will need to apply for (and to whom to apply) and preferably with a timeline.
Guilherme de Ventura, Mozambique	What is the rationale of limiting the flare to 1 ton of SO2 per day in Alberta, Canada?	The rationale depends on several things, like weather conditions for example. Along with other reasons, the environmental policy for the country needs to match the rationale.

Samuel Agbetsiafa	Esam, could you pls explain the Amine Unit which is the source of the CO2?	I sent a handout explaining it.
Guilherme de Ventura, Mozambique	As a regulator, can one set a limit for emissions? If yes, what is the basis for that?	Identify the environmental concerns first. Look at how others are handling them. Then research the best limits that go well with the country's environmental policy. The research institutes will help a lot setting the limits and giving SOPs to achieve them. In addition to the above: Emission limit values can also be set based on what the Best Available Techniques (BAT) is for such plants / facilities / processes. This is the European approach, and one reason for this approach is to ensure a so-called level playing field, meaning the producers of e.g. ammonium meet similar, minimum environmental requirements in all countries. If necessary, due to local conditions or concerns, the national regulator can impose stricter limits. However, in many cases, the regulator may need, before new emission limit values are decided on, how and to which costs the particular facility will be able to comply with these rules. You want to know if the facility will be able to comply, and also how long is needed to make the necessary investments in new technology. Thus, there is need for dialogue and to require that the facility investigates and present the options for the regulator before final decision is taken.

NEMA Kenya - Selelah Okoth	What would you investigate to see how to recycle and reuse gasses (sulfur, nitrogen oxides)? Has modeling been done to predict economic feasibility?	Look at the market and see what it needs. Try to use your waste to fit the market needs, then you will have a win-win solution. It is best to increase cooperation with the research institutes so they can give the BAT that works with this situation. The research institutes will develop the feasibility of each solution and help choosing the best one.
Felix Paipe, Mozambique	Why abandon coal while BAT exists?	Most countries still use coal. Coal has several issues, mainly environmental. Coal was eliminated in Canada because the best available technologies aren't mature enough to make coal energy clean. It is possible to eliminate the CO2 emissions from coal power plants by deploying CCS, but too expensive to be implemented if not possible to sell the CO2 for EOR purposes (not likely in Europe).
UNALM - Miguel Angel Quevedo Beltrán	Is there methodology or guidelines to better identify the chances we have to minimize the environmental issues?	Yes, there are guidelines from Alberta, Canada (will be shared as a handout with link to website). In Europe there are Best Available Techniques Guidance documents.
Faisal Mumin	Thoughts on how a country should start dealing with associated gas (like Somalia)	Look at what other countries (Canada, Norway) are doing with their standards. Contact local universities to conduct research to create standards for your country. Government can cultivate these relationships.

	What is the place of condensates when detecting impurities?	Look at points where pressure drop is maximum, you'll find the condensates.
NARE Department_Kenya_BOAZ LOKATUKOI	This is a shared environment: Sometimes environmental inspectors seem to be regulated by oil and Gas Companies through limited access. Could there be policy decisions to enhance collaborative approaches and complementary roles?	The policy must come from the regulator and the operator to follow. Sometimes, the oil and gas operators have requests that the regulator needs to listen to and try to adopt but without the scarification of environmental limits. The policy - if not there already - can be designed and implemented. Look at the countries around you and try to see what they do. Try to modify the available policies to your own country and projects.
Samuel Kofi Agbetsiafa (EPA, Ghana)	Difference between natural and associated gas?	Associated gas is at the very top of oil (blanket on top). They're more similar than different. They're treated similarly.
	What is the mechanism for capturing CO2?	Gas goes through amine unit, CO2 gets captured, compressed, and sent under the ocean.
Gaspar Marques	Any implications in the future of storing this amount of CO2 underground? Any environmental concerns?	It's been studied extensively in advance how this CO2 will behave. There's no way for it to escape, but the storage formations must be carefully selected. There is also a need for monitoring systems (seismic surveys are used) to document the behavior of CO2 in the storage formation.

NMDPRA - NIGERIA, SINIME MATTHIAS EMMANUEL - PAULKER	Should there be areas of conflict between the operator and regulator in regarding the local laws, how best could it be handled, especially if such laws are critical to the regulator?	The operator needs to know the importance of the regulations. It is the regulator's job to explain why the law is there and why it is important to follow. Conflicts are healthy if wisely handled and well explained.
Urias Taylor	Is there any technology that could be favourable for temperate, humid, and cold climates?	Each technology has advantages and maybe side effects. I need more information so I can answer this question, like technology to handle what, and why humidity and temperature are important to consider.
Kenya, Ngithaja Lokuto Sylvester	How is wind speed and direction important regarding pollution?	Wind speeds determine how fast pollutants can travel. Also indicates where pollution will likely drift to (which regions, ecosystems, human settlements may be downstream).
Kenya, Ngithaja Lokuto Sylvester	What must a comprehensive project/site inspection incorporate? That is, key areas to investigate.	Regulator needs to identify the variables associated with the project. Also, needs to define the environmental concerns associated with this project or that. A list of those items can solve the puzzle easily and then follow in a systematic manner.
John Barreh	What does Mr. Esam mean when he says that the regulator is not 'policing' the operator's work activities! Ordinarily, the regulator's work as an enabler is regulating and policing activities of the operator! Please clarify that role?	If the operator explains the importance of the environmental concerns and how they affect the country's wealth, then the operator will gladly follow. The regulator is not catching mistakes, rather giving solutions for the wrong practice, and trying to solve problems rather than putting obstacles.

		Show the problem and give solutions, it is much better than penalizing only. Norway (from a regulator's point of view): dialogue is good, but regulators need to make sure the operator corrects the non-conformity issues within a time-limit (hence: police role). When the regulations and permit conditions are performance based (functional requirements) rather than technical prescriptive, the regulator will not recommend specific solutions. But the regulator may share experiences that can be useful for the operator.
	Difference between quality control and quality assurance?	Quality controls are the tools you use to determine if the standards are there/followed or not. Quality assurance is a plan that states if standards can be carried out.

Annex 2: Summary responses of participant evaluations

Figure 1: Participants' rating of learning objectives being met

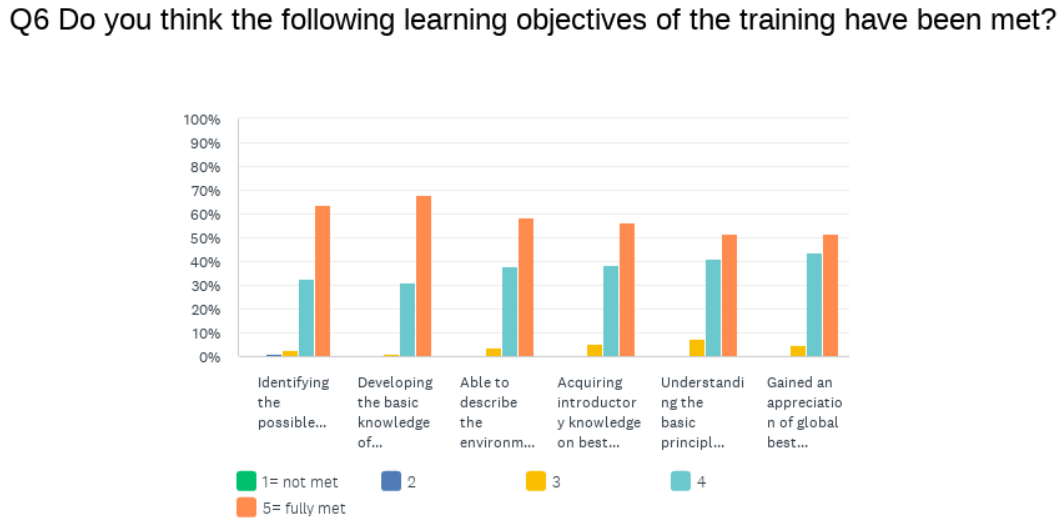


Figure 2: Participants' overall rating of training

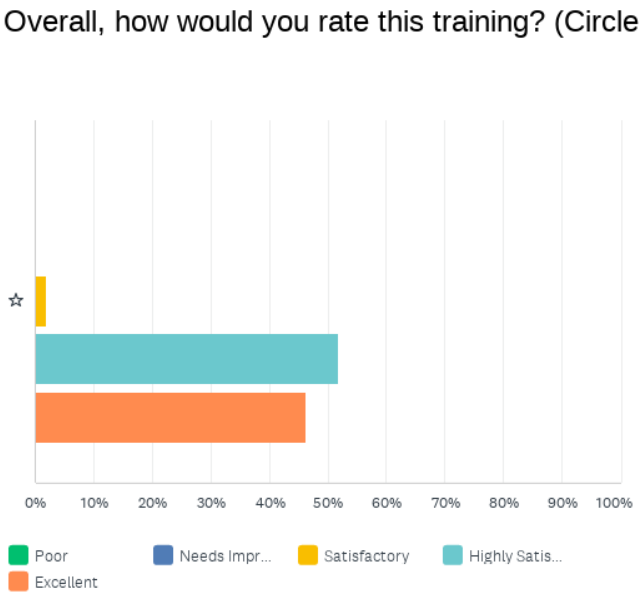


Figure 3: Participants' intended application of knowledge gained from training

Q11 In what ways can you apply the knowledge you received from this workshop?

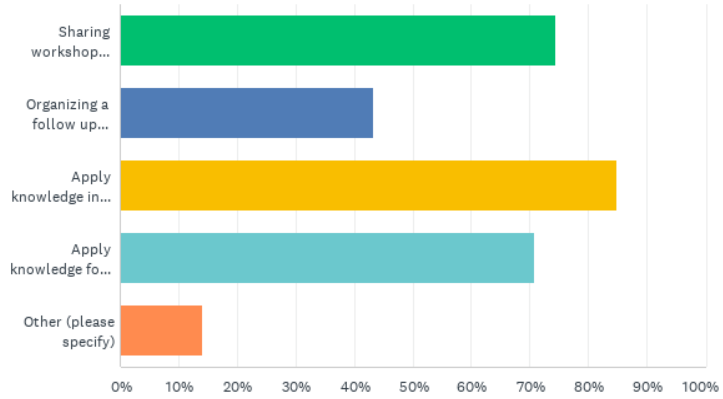


Table 1: Participants' feedback on the training (includes only first 10 responses for each question)

What did you like about the training? Which part of the training was most useful to you?	• The interactive class sessions. People's contributions that I easily related to. • Basic knowledge on associated gas production and environmental concerns to mitigate possible impacts on public health. • The training was good. Group exercises were most useful for me. • Associated gas production and processing. • I personally enjoyed all the parts of the training, and they were all useful. • Understanding about best available technologies in waste gas management. All sessions of day one.

	• Notes were well presented and available. • The activities that allowed for learning about other countries. • Global Best Practices and Basic Principles of Contingency Planning. • It was interactive with exercises to showcase the knowledge acquired. • Other member countries highlighted different techniques used in their countries to solve various related gas issues.
Which session or part of the training did you find least useful, and why?	• None. All added to curated knowledge base. • Associated gas issues and its mitigation measures i.e procedure of dealing with gas leaking. • Completely none • None • I did not find any least useful session in the training; all are critical sessions. • Online training is not as interactive as in person. • All sessions were important. • I found all three sessions extremely useful. Will apply all knowledge gained.
What do you think could be improved?	• The frequency of such trainings should be increased. • The training meeting should be conducted face to face i.e. three countries doing to together to share experience of gas processing. • Everything was very good; nothing to improve.

	• Associated gas production methods. • More time should be given to the training. Especially for group discussions to draw experiences from other participants. • There is not much that needs to improve since the process and presentations were adequately handled. Maybe more trainings, especially for us in Uganda who just started production. Thank you all. • Making training in person. • Maybe present more regulatory framework. • We could have sessions like this regularly and possibly in-person training for more networking. • The network related issues. • Timing could be a bit more flexible.

Annex 3: Training program outline

Time	Activity	Presenter/Facilitator
Day 1, Wednesday March 23, 2022		
13:00	**Participants log-in and test for audio and video**	Bernice Wilmot Oppong, UNEP
13:30-13:50	**Welcome and Introductions** **Overview of the training and learning objectives**	Marisol Estrella UNEP
13:50- 15:50	**Module 1:** **An Overview of associated gas – its processing and treatment** **Summary description of Module:** • General overview about the process and key phases of processing and treatment • Establish the case for why it is important to establish environmental best practice • Presentation on the environmental considerations at each stage of gas processing and treatment including waste streams that are generated and major causes of waste • Categorize the types of waste as result of the processing itself and the industry in general • Presentation on public health and safety considerations associated with gas processing and treatment **Q&A / Discussions** **Group work**	Esam Wshah, UNEP expert
15:50-16:20	**Break**	
16:20-17:30	• Group work discussions • Daily Reflections • Wrap up Day 1	Esam Wshah, UNEP expert/All

Time	Activity	Presenter/Facilitator
Day 2, Thursday March 24, 2022		
13:00	**Participants log-in and test for audio and video**	Bernice Wilmot Oppong, UNEP
13:30-13:40	**Recap of day 1**	Esam Wshah, UNEP expert
13:40-15:40	**Module 2:** **Preventing and mitigating environmental and public health impacts in associated gas processing and treatment** **Summary description of Module:** An Overview of associated gas- Environmental and social labilities of the treatment of associated gas • Best available technologies to prevent and / or mitigate the potential environmental and public health impacts of associated gas processing and treatment • Case studies **Q&A / Open Discussions** **Group work**	Esam Wshah, UNEP expert
15:40-16:10	**Break**	
16:10-17:30	• Group work discussions • Team Reflections • Wrap-up for day 2	Esam Wshah, UNEP expert/All
Day 3 Friday March 25, 2022		
13:00	**Participants log-in and test for audio and video**	Bernice Wilmot Oppong, UNEP
13:30-13:40	**Recap of day 2**	Esam Wshah, UNEP

Time	Activity	Presenter/Facilitator
	Summary description of Module: An Overview of global standards and the local standards for the treatment of associated gas • Discuss the global standards for the associated gas treatment and this industry in general, with country examples • Discuss national standards and regulatory practices and identify potential areas for improvement	
15:40-16:10	**Break**	
16:10-17:30	Country Action Plans Final Knowledge Assessment and End of Course Evaluations Closing Remarks	Esam Wshah, UNEP expert Marisol Estrella, UNEP

Annex 4: Participant list

Trainee participants

Participant name	Email	Institution type	Country
Mircia Monteiro Martins		Other	Angola
Francisco Mateus Bernardo		Government	Angola
Guilherme De Aguiar Ventura		Government	Angola
Edilson Kavaleka		Government	Angola
Helder Henda Damião Pereira		Government	Angola
Lígia Barroso		Government	Angola
Domingos Morais		Government	Angola
Organtina Adao Gonçalves		Other	Angola
Ragesh Balakrishna Pillai		Private/Industry	Bahrain
Ramiro Jaimes		Government	Colombia
Anelfi Balaguera Carrillo		Government	Colombia
Emmanuel Adjetey Adjei		Government	Ghana
Linda Ansu-Kyeremeh		Government	Ghana
Sandra Serwaa Kyere		Government	Ghana
James Kwesi Akussah		Government	Ghana
Nana Yaa Appiah		Government	Ghana
Godwin Kwesi Asiedu		Government	Ghana
Edith Enyonam Acheampong		Government	Ghana
Justina Nkansah		Government	Ghana
Samuel Kofi Agbetsiafa		Government	Ghana
Tushar Siddharth Pradhan		Government	India
Deepi Ashok		Private/Industry	Indian
Ahmed Saleh		Government	Iraq
Eva Mukiri Kaburu		Private/Industry	Kenya
Ekamais Jackson Lojore		Government	Kenya

Tiapukel Ikayo		Government	Kenya
Jonathan Gichuru		Civil society/NGO	Kenya
Joseph Mutende		Government	Kenya
Boaz Ekiru Lokatukoi		Government	Kenya
Dr Tom Nyangau Nyachieo		Private/Industry	Kenya
Doreen Achieng Alwala		Civil society/NGO	Kenya
Muthuri Moreen Karwitha		Private/Industry	Kenya
Susan Akinyi Omwa		Government	Kenya
Francis Ekaale Ekales		Government	Kenya
Cyprian Maundu		Private/Industry	Kenya
Fidensio Mutethia Muthuri		Private/Industry	Kenya
Ngithaja Lokuto Sylvester		Civil society/NGO	Kenya
Chacha Paul Jackson		Government	Kenya
Kevin Ojiem		Government	Kenya
John Koyier Barreh		Private/Industry	Kenya
Urias Andy Taylor		Academia	Liberia
Urias Andy Taylor		Academia	Liberia
Hariharan Veraperumal		Private/Industry	Malaysia
Felix Paipe		Academia	Mozambique
Martinho Fernando Mafumo		Government	Mozambique
Martinho Fernando Mafumo		Government	Mozambique
Fuad Gaya		Government	Nigeria
Umar Mukhtar		Government	Nigeria
Muhammad Kamaludeen Muhammad		Government	Nigeria
Nmdpra-Sufiyanu Mohammed		Government	Nigeria
Aisha Njidda		Government	Nigeria
Dr. Yetunde Anyanya		Government	Nigeria
Rukaiyah Gubio		Government	Nigeria
Mariam Morgan Rabiu		Government	Nigeria

Sinime, Matthias Emmanuel - Paulker		Government	Nigeria
Sufiyanu Mohammed Jingi		Government	Nigeria
Musa Abdulkadir Mohammed		Government	Nigeria
Lucy Onoriode Okeke		Government	Nigeria
Uchenna Ebulue		Government	Nigeria
Olufemi Ajayi		Government	Nigeria
Umar Mukhtar		Government	Nigeria
Uchenna Ebulue		Government	Nigeria
Ayoebi Arenyeka-Idolor		Government	Nigeria
Muhammed Qaribu Ibrahim		Government	Nigeria
Owan David		Government	Nigeria
Ismail Muhammad Ville		Government	Nigeria
Rukaiyah Gubio		Government	Nigeria
Mary Eke Donald		Government	Nigeria
Miguel Angel Quevedo Beltrán		Academia	Peru
Miguel Angel		Academia	Peru
Foster Dave Edekor		Private/Industry	Qatar
Samba Ka		Academia	Senegal
Abdulkadir Noor Abow		Government	Somalia
Faisal Mumin		Government	Somalia
Mahmud Mohamed		Government	Somalia
Mubarak Abdulkadir Warsame		Academia	Somalia
Dahir Abdirahman Abdi		Government	Somalia
Kareiman Altayeb		Academia	Sudan
Epaphroditus Canute Sabuni		Government	Tanzania
Hamid Fadhil Makame		Government	Tanzania
Edith Makungu		Government	Tanzania
Ismail Selemani Mbani		Government	Tanzania
Vintee Kallideen-Ramdath		Government	Trinidad & Tobago

Ruel Fordyce		Government	Trinidad & Tobago
Gillian Stanislaus		Government	Trinidad and Tobago
Ashlyn Bute		Government	Trinidad and Tobago
Marvin Pierre		Government	Trinidad and Tobago
Tracey Oliveira-Harris		Government	Trinidad and Tobago
Sheronne De Roche		Government	Trinidad and Tobago
Suelan Chin		Government	Trinidad and Tobago
Sally Maharaj		Government	Trinidad and Tobago
Renata Waithe		Government	Trinidad and Tobago
Shelanna Ajodha		Government	Trinidad and Tobago
Alicia Laurent-Wing		Government	Trinidad and Tobago
Shanmatie Persad		Government	Trinidad and Tobago
Shanta Crooks		Government	Trinidad and Tobago
Delicia George		Government	Trinidad and Tobago
Atwongyeire Jane Rose		Government	Uganda
Elino Omachar		Academia	Uganda
Viola Mugisha		Government	Uganda
Isaac Israel Godfrey Ntujju		Government	Uganda
Nsereko Patience		Government	Uganda
Mwesigwa Vincent Ateenyi		Private/Industry	Uganda
Nyawere Patience		Government	Uganda
Namubiru Mable Kibikyo		Government	Uganda
Namubiru Mable Kibikyo		Government	Uganda
Patience Nyawere		Government	Uganda
Akoth Sisiria		Private/Industry	Uganda
Sarah Naigaga		Government	Uganda
Chelangat Scholar		Civil society/NGO	

Resource persons

Name	Email	Institution
Esam Wshaw		UNEP
Anne-Grethe Kolstad		Norwegian Environment Agency
Marisol Estrella		UNEP
Bernice Wilmot Oppong		UNEP
Taylor Blair		UNEP

Annex 5: Group work assignments (days 1 and 2)

Day 1 group work

Combined individual contributions

Participant name, group, or country	**EIA approval checklist**
Akoth Sisiria	1. Does the EIA describe concerns of the public and indigenous communities? 2. Is the project well described giving background information? 3. Are the EIA objectives informative enough to guide assessment and impact (social, environment [physical and biological, public health) identification? 4. Is the scope well defined covering all aspects (socioeconomic, environmental)? 5. Are the local and national legislations, standards, and guidelines 9NEMA) followed. Are the international standards and best practices considered? (Compliance with all applicable standards). 6. Are the project activities well described (detailed) in relation to existing environment (physical/biological) and social conditions (socioeconomic, land use, indigenous knowledge etc? 7. Are the methods well stated to assess all environment (physical & biological) and social aspects? Are credible experts contracted? Are stakeholders consulted? Is the processing technology appropriate? Are safety measures in place etc? 8. Are the residual/cumulative impacts predicted & described? Are the mitigation measures and management actions in place following mitigation hierarchy (avoid, minimise, restore & offset)? Is net gain (no net loss) programme in place for biodiversity and the general environment? 9. Are the management plans (physical, biological, social, waste, gas leak contingency plan, national gas leak plan etc.) with set procedures in place to address the different project aspects.

	10. Are the monitoring programmes/procedures well set? How about auditing programme? 11. Are the recommendations feasible? 12. Are cited materials referenced? 13. Are tables appended?
Aisha Amour	Answer Checklist can be defined as standard lists of the type of impacts associated with a particular type of project. For example, of a project of TEN in Ghana (Tweneboa, Enyenra, Ntomme) the purpose of their project was to do exploration, production and installation of Ghana's oil and gas prospects. Therefore, the type of impacts in this type of project are direct mainly to environments since their purpose were to develop the Tweneboa, Enyera and TEN hydrocarbons field located in deep water approximately 60 km offshore in Ghana. Associated type of impacts in this project are: · Emissions to atmosphere Examples are air pollutants, greenhouse gases emission such as CO2, CO, SOX, NOX, volatile organic compounds (VOC), particulate matter from drilling, completion, installation and during operational phase. · Impacts on water The impacts here can be found and affect all aquatic ecosystem found in the area where activities of exploration occur such as killing of fishes due to disturbance and addition of chemicals etc. · During the exploration phase, impacts can result from direct and indirect (sound and traffic) and direct physical (anchor chains, drill cuttings and drilling fluid) disturbance.

	· Also, during production phase direct impacts can occur as pipeline are laid and the volume of discharge produced in water increase. · Lastly during decommissioning phase can result a series of direct impacts on the sea floor and can re-introduce contaminants to the environment.
Esam (reflections at end)	For brand new projects, there are requirements for EIA different than from expanding a current project. Need to know at what stage of the project and what class it should be (how detailed it should be. E.g., 3 pages or 300 pages). Government must approve individuals or companies to do an EIA. They must be qualified to do it. Main things taken care of in assessment: humans, water, air, earth, other living partners (all other organisms). EIA must be divided by what it's impacting (health impacts, nature impacts). Need to designate where/who the EIA should be directed at (e.g., specific location in country). If you change location, you need a new EIA. It's attached primarily to the location. Checklist info: Need to assess the quality/suitability of company doing the EIA. Need to assess where it will be located and the entities (human settlement, ecosystems) present there. Also assess the gas process (e.g., will waste be utilized?) How should problems in the process be mitigated/handled? How comprehensive is the emergency plan? Am I (as the government) aware of the pre-existing government standards for this industry?
UNALM – Miguel Angel Quevedo Beltrán	Did the EIA Report identify (Description and Location) the chemical products to be manufactured, processed, or otherwise used for the Project considering the current national regulation and international law the voluntary the proponent has adopted? Did the project develop the alternative analysis of options regarding the location of facilities and infrastructure of the project, as well as the thermal energy and electric power required? Did the project consider the analysis of the management options for the gas emissions such as Sulphur, CO2, water, metals, and other carcinogenic elements regarding the treatment methods, the national current regulation and population that can be affected?

	Did the project consider the analysis of the management options for the wastewater emissions regarding the location, the features of the effluents (chemical and physical composition, volume, source), treatment methods, waste management and disposal? Did the Project consider the probable modifications in traffic for the transportation of material, equipment as wells other components necessary to implement the project, that consequently will generate impacts? Did the project consider in the probable reduction of the air quality in the influence area where the project will be executed regarding the project's phases, the national current regulations, the population that can be affected (health and safety) as well as the impacts related (Acid rain, air pollution because of gases and Particulate matter)?
Work 1, 23 March 2022 Colombia ANH (National Hydrocarbons Agency) team Anelfi Balaguera Carrillo Ramiro Alonso Jaimes Villamizar	Topics that I would consider including in the EIA. · Regulatory Framework. · The EIA Process, Approach and Methodology. · The EIA team. · Project Description of gas production with estimate hydrocarbon production of the Pembina's project. · Personnel requirements for the operation of de Pimpina's project. · Air quality baseline before the project. · Air quality monitoring after entry into operation. · Life cycle of the Pimpina's project. · Decommissioning and abandonment the project.

	· Social management plan.
NEMA Kenya Selelah Okoth	See document (listed in table already)
LUCY OKEKE, NMDPRA NIGERIA	1. Background of Project: Reason for EIA; Class of EIA, Detailed information about the project or activity; Highlight any previous engagement with regulator; Overview of project location and Key Objectives. 2. Project description: List various project activities to be undertaken as part of project. 3. Approval status of scope of work 4. Consideration of alternatives 5. Project description conforms with scope detailed in TOR 6. Proof of Environmental Baseline Study 7. Completeness and reasonableness of Impact identification methodology 8. Identified impacts correlation with project activities; human, earth, air, water, biodiversity/creatures etc. temporary, permanent, duration of impacts a. Air quality and pollution b. Land contamination c. Waste management d. Biodiversity impacts e. Socio-economic impacts; demographics, quality of life f. Climate change

	g. Water pollution 9. Ranking of various impacts significance methodology for completeness 9. Proposed mitigation measures; completeness and effectiveness
Dr. Aung Myo Hsan, Marine Science Association Myanmar (MSAM)	1) Policy, Legal and Institutional Framework a. Policy and Legal Framework including existing applicable laws and rules, International Conventions, Treaties and Agreements, and National and International Standards and Guidelines; and b. Contractual and other Commitments 2) Project Description and Alternatives Selection a. Description of the selected alternative(s) by project phase (pre-construction, construction, operation, decommissioning, closure and post-closure); and b. Comparison and selection of the preferred alternatives. 3) Description of the Surrounding Environment a. Setting the study limits b. Methodology and objectives c. Legally protected national, regional or state areas, including without limitation: (i) forest conservation areas (including biodiversity reserved areas); (ii) public forests; (iii) parks (including marine parks); (iv) mangrove swamps; (v) any other sensitive coastal areas; (vi) wildlife sanctuaries; (vii) scientific reserves; (viii) nature reserves; (ix) geophysically significant reserves; and (x) any other nature reserve nominated by the Minister d. Biological Components: Descriptions and maps on fauna and flora including abundance, spatial distribution of rare, endangered and vulnerable species and species of economic and health/nutritional values, and maps and description of valued or sensitive environmental areas and habitats

	4) Baseline studies a. Air Quality b. Water quality c. Hydrogeology d. Oceanography e. Aquatic Ecology f. Wildlife and Biodiversity g. Terrain and Soils h. Land Use and Management i. Historic Resources j. Socio-Economic Assessment 5) Impact Assessment and Mitigation Measures a. Methodology b. Identification, Assessment and Mitigation. For each project phase (pre-construction, construction, operation, decommissioning, closure, and post-closure) i. Identification and assessment of potential environmental impacts ii. The design, layout, functioning, management and implementation of appropriate impact and risk mitigation measures iii. Characterization and assessment of any residual impacts and risks and comparison with applicable regulations, standards and guidelines

	iv. Comprehensive monitoring plan c. Relevant maps, aerial photos, satellite images in proper scale clearly indicating the location of sources of adverse impacts, the spatial and temporal distribution of such impacts and with reference to the description of the surrounding environment, the components that are likely to be impacted and the nature of the impacts. 6) Cumulative Impact Assessment If there are any cumulative impacts on environment then the followings shall be addressed: a) Methodology and Approach b) Identification and assessment of the potential cumulative impacts c) Determination of the leverage and influence that the project may have over the significant and project related cumulative impacts d) Description of measures to mitigate the project's contribution to the cumulative impacts 7) Environmental Management Plan a. Summary of impacts and mitigation measures b. Overall budget for implementation of the EMP c. Management and Monitoring sub-plans by project phase (pre-construction, construction, operation, decommissioning, closure and post-closure) d. Content of each Sub Plan • Objectives • Legal requirements • Overview maps and site layout maps, images, aerial photos, satellite images • Implementation schedule • Management actions

	• Monitoring plans • Projected budgets and responsibilities 8) Public Consultation and Disclosure If there are any public concerns, the consultations and activities to address these concerns shall be included in this section.
Alliance of Biodiversity and CIAT, Jonathan Girchuru	a. Assessment of Environmental and Social Risks Impacts (Both positive and negative) b. Legal Framework and Policy Instruments c. Stakeholder Engagement and Information Disclosure d. Grievance Mechanism e. Land Acquisition, Restrictions on Land Use and Involuntary Resettlement f. Biodiversity Conservation and Sustainable Management of Natural Resources g. Waste Management System h. Labour and Working Conditions i. Community Health and Safety/ Environmental Health and Safety (EHS) j. Combined Benefits of the project to the community k. Mitigation Measures l. Monitoring and Evaluation m. Decommissioning n. Environmental and Social Management Plan

	Relevant documents · Title deed of the land in which the project will be located · Change of user approval · Approved architectural plans · Certificate of incorporation · Pin certificate for the company · Machine detail sheets · EIA public participation/stakeholder engagement questionnaires · Minutes of community engagement meetings · List of attendants of the meetings · Firm of expert registration certificate and practicing license · Lead expert NEMA EIA/EA license · EIK license for lead expert · Sketch map to the site
KEVIN OJIEM	1. PROJECT DESCRIPTION Sufficiency of project description i.e. key components; a) Pembina information; b) processing technology; c) amount and source of energy required for the Project; d) water supply and disposal requirements, including process water and potable water requirements; e) proposed method to transport product to markets; and f) development plan and schedule

	2. PROJECT SITE SUITABILITY Where is the project located? Economic and environmental sense not forgetting public health issues; a) existing infrastructure, leases and clearings; b) processing/treatment facilities; c) other project buildings and infrastructure (e.g., pipelines, access roads and utilities); d) temporary structures; e) transportation and access routes; f) on-site hydrocarbon storage; g) on-site sulphur storage; h) containment structures such as retention ponds and storage ponds (e.g., lime sludge, stormwater runoff, boiler blow-down); i) water wells/intakes, pipelines, and storage structures; j) sources of aggregate resources, borrow material and other construction material and locations of any stockpiles that will be developed; and k) waste storage area and disposal sites. 3. REVIEW OF RELEVANT LEGAL FRAMEWORK In Kenya, we have COK 2010, EMCA 2015 and its regulations, Petroleum Act 2016 etc. 4. POTENTIAL NEGATIVE ENVIRONMENTAL/SOCIAL IMPACTS The potential negative impacts explored by the EIA expert in all the phases of project development; Air pollution, noise pollution, ecological considerations, soil erosion, solid waste, oil spills and leaks, security, water consumption, waste water management, vegetation loss and occupational health and safety etc. This includes the negative social impacts such as negative socio-cultural interactions and availability of grievance redress mechanisms. 5. MITIGATION MEASURES The practicability of the mitigation measures formulated. 6. PROJECT ALTERNATIVE SITE, TECHNOLOGY AND MATERIALS A comprehensive discussion and justification of selected options 7. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

	Presentation of the EMMP in a way that can be considered adequate 8. OTHER SECTORAL CONCERNS A. PUBLIC PARTICIPATION Involvement of all stakeholders and community B. LAND ACQUISITION AND COMPENSATION Land as an emotive issue in Kenya requires amicable handing to avoid derailing the project. C. WASTE MANAGEMENT Proper waste management 9. MONITORING OF THE EMMP · Environmental Audits & Health and Safety assessment (Frequency and reporting)

Day 2 group work

Group 1

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**	**Focal points / lead institutions**
Land	Regulatory framework (e.g. waste management)	Involving different stakeholders-AIA studying (private, public, ONGs, institutions)	Environmental Management Authority/Council
Incidents and Oil Spills	Contingency and emergency response Plans	Proper coordination of stakeholders	Environment and Energy institutions/ and private sector
Air pollution	Evaluation of BAT Adoption of BAT for air quality control Assurance of meeting standards set by the government	Administrative Controls	Ministry of Environment, Environmental Management Agency/ private sector
Water pollution	Meeting the standards through regulatory framework Evaluation of BAT Adoption of BAT for air quality control Assurance of meeting standards set by the government	Identifying different sources of water and evaluate the BAT for management	Environment Institution, Ministry of Energy/private sector

Public health	Pollution dilution	Research can be considered for	Environmental Management Authority/Council/ private sector
Displacement of wildlife	Assessing the cause of wildlife displacement		Institute of wildlife/ONGs, private sector
Conservation areas	Identifying the protected and conservation areas		
Solid waste and hazardous waste	Providing regulation and procedures for waste management		
Groundwater contamination	Minimize the use of chemicals, proper testing of underground waters		
Habitat fragmentation			

Group 2

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**	**Focal points / lead institutions**
1.Sulphur	-dilution is not a solution -government and institutional policies on sulfur emission reduction to the environment	Sulphur reduction process by producing sulfur powder -Benchmarking with existing facilities working on minimizing sulfur emission	Research institutions, Government, and Investors

2. Water (produced water)	-Integrated wastewater Management	Treatment for re-injection to enhance oil recovery	Investor and Government
3.Carbon Dioxide (CO2)	Consider not only the costs but also the health and environmental benefits	Transformation of CO2 into Methanol -use for EOR	Universities, Government and Enterprise
4.Heavy metals	-Maybe we should use waste management procedures -Bioremediation	Install technology to remove heavy metals from waste streams prior to disposal/release to the environment Treat recovered waste sludges as hazardous and dispose appropriately	Investor
5.NOx		Reinjection to the well. Use of an Amine Unit	
Hydrocarbons (methane, propane, butane, pentanes)		Process for use as LPG	Investor

Group 3

Impurities	**Major environmental impacts**	**Checklist for Emergency Prevention and Response Plan Procedure for Accidental Gas Leaks**

Sulphur	1. Acid rain	Risk Assessment before, during and after the emergency occurs. Location where the Accident occurred. Available Procedures to be followed. Instructions to act in the emergency procedure. A communication procedure to follow during the emergency. A clear organization to act before, during and after the emergency. A clear designation for the responsibilities to act in the emergency. A clear procedure about How the external Organizations can assist the emergency. Clear prevention measures that can help to avoid accidents (safety guidelines for occupants, safety Rules for contractors and Others conducting Natural Gas Related Work).
Sulphur, Carbon Dioxide CO2, NOx	2. Alteration of Habitats	
	3. Land use change	
Sulphur, CO2, NOx, Heavy metals	4. Air pollution	
Sulphur, CO2, NOx, Heavy metals	5. Water Pollution	
Sulphur, NOx	6. Degradation of biodiversity	

		There should be an Inter-agency awareness even before it occurs.

Group 4

List of impurities:
Carbon dioxide
Sulphur dioxide
Hydrogen sulphide
Water vapour
Mercury
Lead and other air toxics

Group 5

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**	**Focal points / lead institutions**
CO2	Reduction of emission into the air	Conversion into useful pdts, CH3OH	Investor/Government
Sulphur	Sulphur recovery plan	Conversion into solid useful for other pdts H2SO4	Investor/Government
H2O	Water recovery	Treatment of water for other economic purposes	investor/Government
Produced Water	Water Management	Treatment for disposal. Treatment for Injection	Investor/Government

Oil Spill	Oil Spill Response	Dispersants use for scattered spills to be rectified/replaced with other solution	Oil Spill Response Manufacturing companies or Scientist

Group 6

Major environmental impacts	***Question 3*** Key Elements of the emergency and response plan:	**Impurity**	**Possible Use**
1. Hydrogen Sulphide	Gas sensors Alerts in the event of a gas leak/Audible/lighting alarms Automatic shutoff valves	Hydrogen Sulphide	Sulphur powder; sulphuric acid; agricultural products (fertilisers)
2. NOx	Evacuation plans: Muster points; Drills	NOx	Reinjection to assist in EOR
3. Carbon Dioxide	Incident command system - Notification of government entities Surrounding community alerts/plans for evacuation	Carbon dioxide	Reinjection to assist in EOR; methanol production; fire extinguishers
4. Water	Containment (response and resources) Safe room/shelters	Water	Recovery of heavy metals for sale; irrigation; industrial use
5. Hydrocarbons (oil droplets)	Personal gas monitors (PPE); respirators Administrative controls	Hydrocarbons (Oil droplets)	Recovered and reused in the system

Group 7

Impurities in APG
Methane
Oil

Carbon dioxide
Carbon monoxide
Hydrogen sulphide
Nitrogen oxide and volatile organic compound
Sulphur dioxide
Water
Helium
NGLs
Particulate matter
Butane
Hydrates
Mercaptans
Propane
Isopentenyls

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**	**Focal points / lead institutions**
1.Wasting valuable resources	1. Adopt Waste Strategy to Reduce, Reuse, Recycle, Energy recovery, Disposal	Identify Waste Streams and Sources of Waste Assess Mitigation Plan Revisit mitigation plan regularly Recovery/processing	Regulators, operators, contractors
2. Air Pollution	1. Adopt the BAT and do an evaluation 2. Identify Concentration Standards of emissions or in the absence of one, initiate the standard	Put a safety plan in place Regulations/ Standards Stringent laws Gas leak contingency plan Ensure TOR is adhered to	Regulators, approved consultants, Operators, Educational bodies, Universities
4.Soil Pollution	1. Implement the oil spill contingency plan	Put in place an emergency preparedness plan to respond into an oil spill	Regulators and operators
5.Biodiversity Loss	1. EIA commitments 2. Management plans	International standards and best practices	Government regulator

	3. Baseline Assessment must be done 4. Strict adherence to country regulations and guidance		
6.Water Pollution	Water treatment plans		Certified consultants
Toxic	Establish guidelines	Waste management guidelines	
Oil pollutes water and air	EIA guidelines	Conformance with safety and environmental guidelines	EIA, environmental regulators
Public health concerns	Local/national health and safety guidelines	International standards	Regulators, operators, contractors
Part 2: Key elements of an effective emergency prevention and response plan for accidental gas leaks			
Gas leak contingency plan for inside/outside building			
Gas Accident prevention program - good housekeeping practices, notification/alarm/alert system			
Incident management system in place			
Restrictions on smoking, use of open flames			
Awareness programme to educate workers			
Lock-out/tag-out system for maintenance activities			
Developing safe working procedures			
Proper maintenance and training of engineers			
Follow manufacturer's instructions in the care and operation of equipment			
Use personal or area monitoring equipment			
Use of trained, competent personnel			

Group 8

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**
1. CO2 emissions	Contingency Plan	Capture and reuse Re-inject to the reserve to increase pressure

2. Sulfur		
3. Wastewater	Contingency Plan Enhanced treatment	Continuous Monitoring of water volumes and level of contamination
4. Heavy metals		
5. Hydrogen sulfide		

Group 9

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**	**Focal points / lead institutions**
CO2 Emissions	A Contingent Plan in place	Capture, Reuse and re-inject it	Plants, factories, Operators and
Water	Enhanced treatment commitment and water quality check in place.	Continuous monitoring of water volume and pollution levels Phyto Restoration treatment	National Environment Management Authority/Council
Sulfur	A contingency plan in place	Recovery and reuse as sulfur blocks or sulphuric acid	National Environment Management Authority/Council and National Chemical Authorities
Hydrogen Sulfides	Standard Operating Procedures	Chemical treatment	National Environment Management Authority/Council/ National Chemical Authority
Nitrogen Oxides	SOP	Chemical treatment	
Land			National Environment Management Authority/Council
Key elements which should be part of an effective emergency prevention and response plan for accidental gas leaks			
2a) Prevention			

Automatic Shut off valves
Gas sensors
Contingency Plan
Standard Operating Procedures-
Safety guidelines for occupants
Safety rules for contractors, plumbing company etc.
Training of the personnel in case of leaking and accidents
2b) Response
Safety procedures of dos and don'ts such as not switching on or off any electrical gadget among others
Notification procedures including the contact number
Evacuation Plan
Standard Operating Procedures
Response procedures when gas leak occurs and trapped a building
Incident command center which would coordinate with government agencies such as fire

Group 10

Major environmental impacts	**Necessary commitments from project management**	**Additional steps to be taken**	**Focal points / lead institutions**
1. Noise pollution	Regulatory framework EIA terms	Monitoring Mitigation measures	Ministry of environment Ministry of Health Scientific laboratories
2. Air quality	Regulatory framework EIA terms	Monitoring Mitigation measures	Ministry of environment Ministry of Health
3. Water quality	WOH regulations National regulation	Monitoring	Ministry of environment Universities

Major environmental impacts	Necessary commitments from project management	Additional steps to be taken	Focal points / lead institutions
1. Noise pollution	Regulatory framework EIA terms	Monitoring Mitigation measures	Ministry of environment Ministry of Health Scientific laboratories
		Mitigation measures	Ministry of water resources
4. Emissions and leaks	Regulatory framework Environment management EIA terms safe standards	Monitoring Mitigation measures	Ministry of environment Ministry of energy
5. Climate change	EIA terms Regulatory framework	Monitoring	Ministry of environment
6. Biodiversity		Monitoring	Ministry of environment Research institutes Universities

Annex 6: Group action planning (day 3)

Day 3 group work

In groups, participants identified at least 2-3 priority challenges they would like to see addressed in their countries.

Group 1

Priority challenge for action	Current efforts	Additional steps to be taken	Focal points / lead institutions
1. Inadequate regulatory frameworks	The government is working on laws/regulations to guide oil and gas sector	Involve experts around the world. Experts in the sector of Oil and Gas	Parliament and County Assemblies, Energy and Petroleum Regulatory Authority, DOSH
2. Inadequate technology/No Oil and Gas waste management facility	Research on best available technologies to manage and treat associated gas	Increased funding for research work	Government, Higher learning/Research institution, Investor
3. Inadequate specific technical expertise in the management of associated gas	Training and capacity building of locals to enhance local content	Increased funding and collaboration with institutions in Oil and Gas sector	Government, investor, and communities
6. Political interference			

Group 2

Priority challenge for action	Current efforts	Additional steps to be taken	Focal points / lead institutions

1. Lack of training to respond to spills in the population	People are more aware of spills, they are trying to get more informed about environmental topics by social media, due the independent organizations and the government The government was promoting collaboration with the international and national public as well private organizations	Promotion of more training programs	Ministry of Environment Ministry of Energy and Mines
2. Lack of resources to respond to spills in the population	Access to international cooperation to respond to the spills The legislation was improving The government was promoting collaboration with international and national public and private organizations The government was improving enforcement procedures through legislation	Look for easier access to funding as well as equipment, personal, research and materials	Ministry of Environment Ministry of Energy and Mines
3. Flaring	Management through local legislation and permit conditions The taxes and penalties are stronger	Increase and improve the monitoring verification reporting system for emissions	Ministry of Energy and Energy Industries Environmental Management Authority. Ministry of Planning and development

			Ministry of Environment. Ministry of Petroleum Resources
4. Inadequate Regulating Frameworks and Standards for Oil and Gas	The parliament is working in the review of the legislation, and we are waiting for the response		

Group 3

Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**
STOP GAS FLARING IN NIGERIA AND STICK TO 2025 TARGET TO ELIMINATE FLARING IN 2020, NATURAL GAS VALUED AT 1.24B USD WAS LOST FROM FLARING, EQUIVALENT TO ELECTRICITY USAGE FOR 804 MILLION NIGERIANS	GAS FLARE COMMERCIALISATION PROGRAMME, A GAS TO POWER INITIATIVE WAS LAUNCHED IN 2016 ADOPTION OF THE FLARE GAS (PREVENTION OF WASTE AND POLLUTION REGULATION IN 2018 PASSAGE OF THE PIA IN 2021 ADOPTION OF THE EGASPIN (ENV. GUIDANCE AND STANDARDS FOR THE PETROLEUM INDUSTRY)	INVEST FUNDS COMMITTED TO (ABOUT 3.5B USD TO GENERATE 2.5 GW OF POWER, CREATE 300,000 JOBS, PROVIDE CLEAN ENERGY TO 6 MILLION HOUSEHOLDS, AND 450,000MT OF LPG TO OVER 4MILLION HOUSEHOLDS) 2. CAPACITY BUILDING IN GREEN SKILLS ESPECIALLY IN THE PUBLIC SECTOR	IOCS, NMDPRA, NATIONAL UPSTREAM PETROLEUM REGULATORY COMMISSION, NATIONAL ENVIRONMENTAL STANDARDS & REGULATIONS ENFORCEMENT AGENCY

2. Management of GHG emissions from oil and gas industry (Trinidad & Tobago)	Inter-agency Committee - Carbon Capture and Utilization Storage for EOR	Continued stakeholder discussions and by-in from oil and gas operators	Environmental Management Authority, Ministry of Energy, Ministry of Planning, Oil and gas operators
3. Lack of and/or inadequate environmental standards (emissions, water, waste)	Amendments of environmental laws to address the standards	Sharing lessons learnt so far to guide the amendments	Upstream Petroleum Regulator, Standards body, Occupational safety and health bodies, research institutions
5. Aggravation of non-inclusion of members of host communities in the projects carried out	Liaising with leaders of host communities to foster a successful completion of projects	Inclusion of several group members/leaders of the different leadership groups in the community Engaging members in group talks/programmes to enlighten them of the benefits of the project	

Group 4

Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**
Lack of Training	Increased trainings		
Community Awareness	Increased trainings, Education		Universities, Schools, Government Agencies, Community Centers, Religious Institutions, Political Leaders

Lack of technology	Partnerships agreements	Innovation	Investors, Private firms
Government Regulatory Standards			
Lack of Funding		Request for need and importance	Private firms, Government, NGO
Community Development	Policy for local content, Increased trainings		Municipal, NGO, Public Organization

Group 5

Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**
1. Stop Gas Flaring	Procedures, Laws	Reduce flaring Treatment for fuel / Injection	Investor / Government
2. Inadequate Technology Managing waste	Consult expert Provide proper waste management systems	Prepare procedures by making laws and ensure strict compliance	Investor / Government
3. Regulatory Frames			
4. Lack of expertise			

5. Lack of specific regulatory framework of CO2, NOx, and SOx	Elaborate specific legal framework		Government involving private, ONGs, institution, agencies
6. Lack of financial resources to get BAT			

Group 6

Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**
1. Occupational health and safety	Legislation	Continuous training and modification of practices (update of SOPs)	Regulator responsible for OSH, MOH, Operator, contractor
2. How to deal with fugitive emissions	Air Pollution control legislation	Monitoring regime depending on type of emission and severity	Regulator, operator, contractor
3. Flaring/venting	Use of enclosed flare; repurposing gas emissions e.g fire extinguisher filling; sulphur solids	Legal Framework prohibits flaring except in exceptional circumstances; reuse of associated gasses via BAT for that country	Operator, regulator
4. Nonexistent codes/laws in emerging oil/gas economy	Developing necessary documents; using regulations from other countries with similar	Consulting relevant authorities (stakeholders), international guidelines/standards	Regulator, operator

	climate/issues; utilising international regulations		
5. Conducting research on marine/terrestrial environment by oil and gas production	-Trainings and workshops without participants of relevant organizations, -Weak networking	-Networking -Public awareness about oil and gas	Universities, research institutions, environmental conservation departments.
6. Inadequate Research (environmental and health) about local conditions	Now it Is presented from the academy without a coordinated effort	Generate lines of study from the government	University or state scientific entities; linkages with external universities with studies in the relevant areas
7. Limited technology, knowledge/expertise in handling emissions/leaks	Training; Make training a requirement for the operator	Partnerships to build local capacity	Operators, regulators, contractors, universities
8. Inadequate reporting of incidents (technical and simple reports for both experts and community)	Simplifying the technical terms/reports for local community to understand	Engaging Education institutions	Regulators, operators, JV partners

Group 7

Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**

1. Waste	Waste Management Rules, 2021 in Trinidad and Tobago	Permitting Process	Government, Ministry of Planning and Development, Environmental Management Authority
2. Air	Air Pollution Rules, 2014 in Trinidad and Tobago	Permitting Process	Government, Ministry of Planning and Development, Environmental Management Authority
3. Water	Water Pollution Rules, 2019 in Trinidad and Tobago	Permitting Process	Government, Ministry of Planning and Development, Environmental Management Authority
4. Oil Spills	EIA Act of 2004, Nigeria		
5. Climate change	The regulations to be proposed are being studied, Columbia	Efforts between operators and state	Energy ministry Environment ministry

Group 8

Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**
Flaring	Capping the amount that can be flared per day	Polluter Pay policy	EPA, Ghana
Condensate (Isopentane)	Currently they are being stored by the companies	Encourage companies to sell to some companies	EPA, Ghana

4. Lack of and/or inadequate environmental standards (emissions, water, waste)	Amendments of environmental laws to address the standards	Sharing lessons learnt so far to guide the amendments	Environment Agency, Upstream Petroleum Regulator, Standards body, Occupational safety and health body, research institutions
5. The operator being technically ahead than the regulator	Enhance technical capacity building	Utilizing opportunities such as NORAD/OfD and UNEP trainings to enhance capacity Sponsor technical officers to benchmark and share experiences in other parts of the world	Environment Agency, Other regulators within the region, networks with experts in Oil and Gas

Group 9

Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**
1. Pipeline vandalisation	Provision of more security operatives to help combat theft and vandalism	Allocation of adequate technology, equipment to security agencies	
2. Flaring	Build local gas-fired power plants to supply power for hydrocarbon operations, local industrial uses, residential electrification, or injection into the grid	Liquefying and storing associated gas	

3. Iso-Pentane flaring	Investment in iso-pentane stabilisation plant	Stabilise isopentane to be used for power generation	EPA
4. Condensate	Loaded in BRVs and sold to clients		

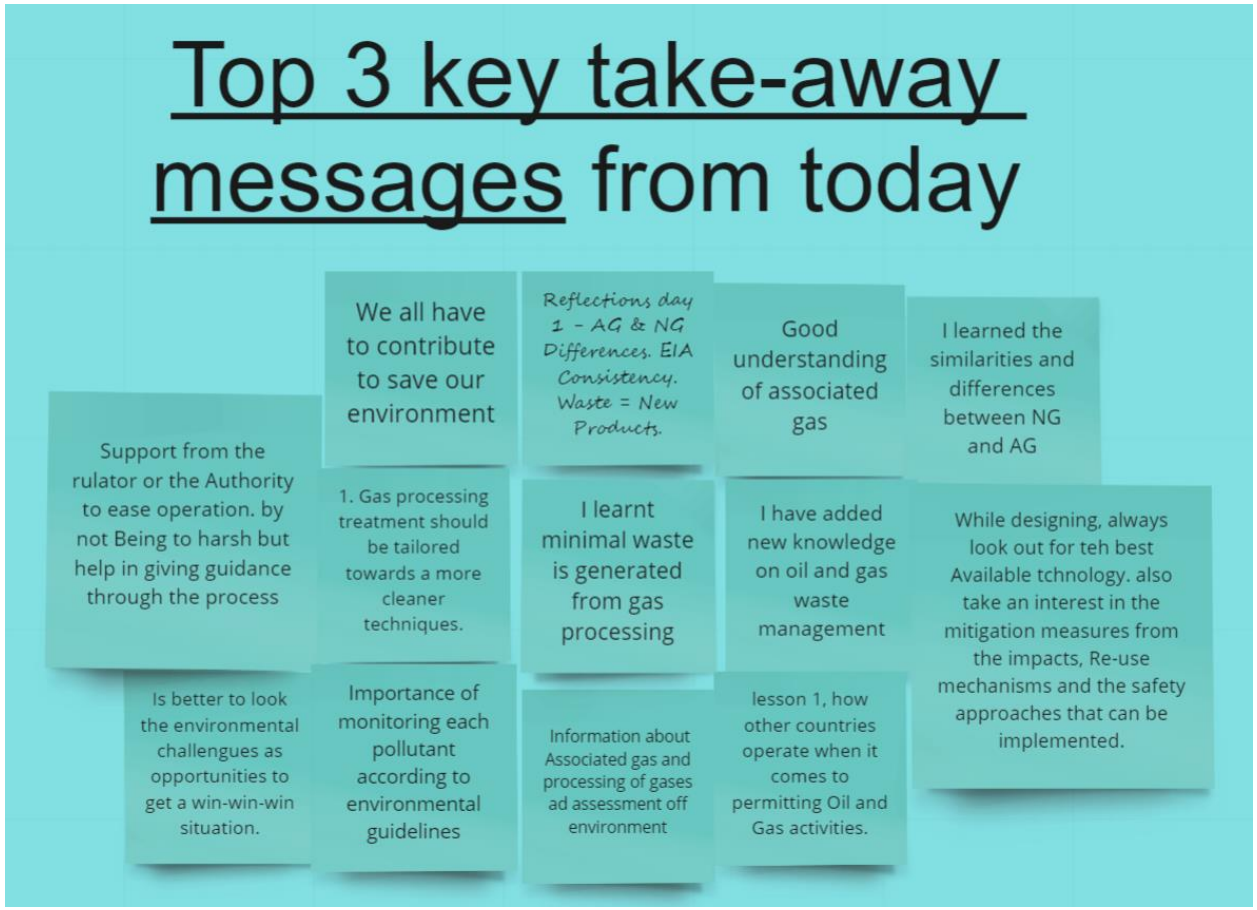
Group 10

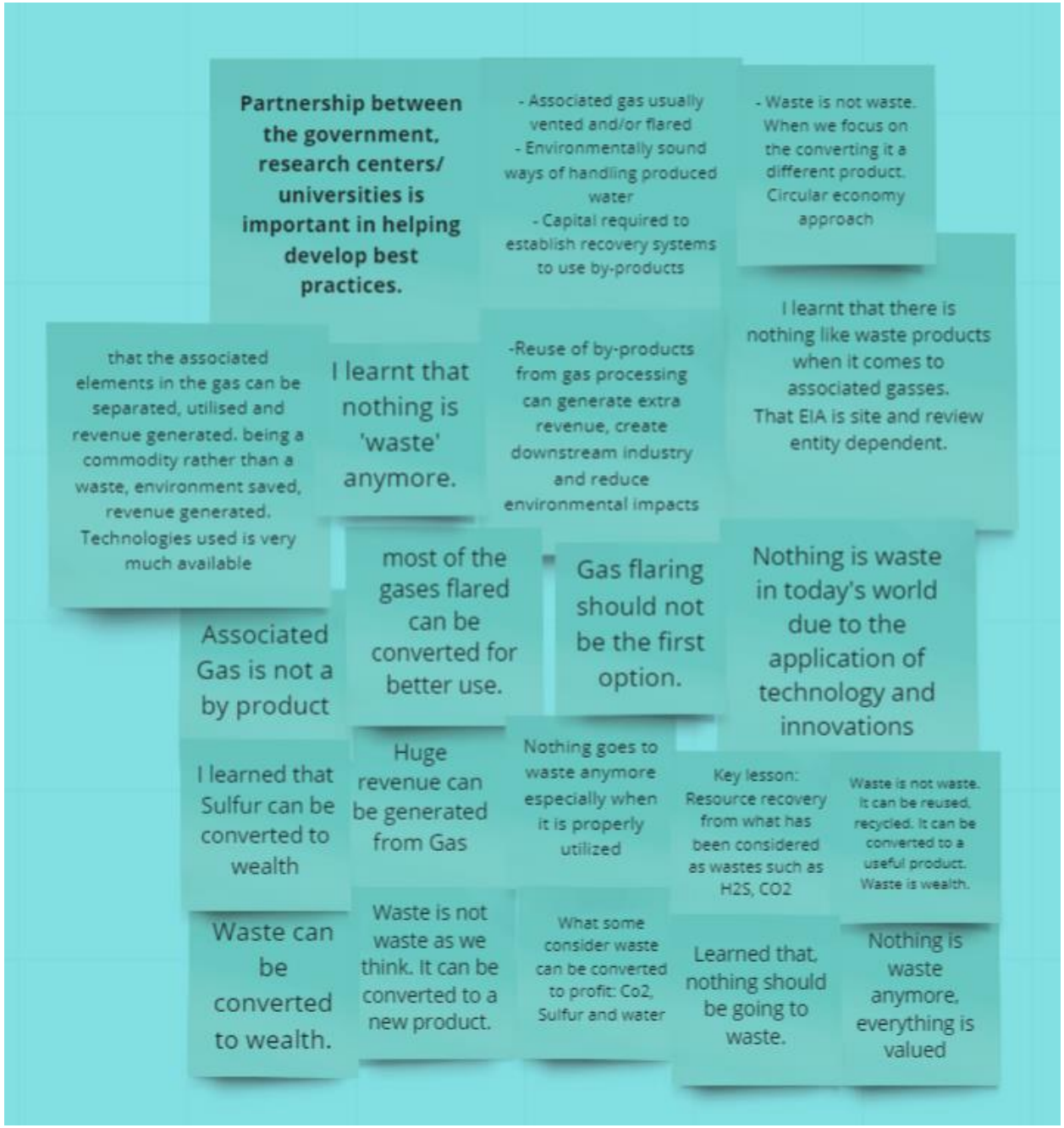
Priority challenge for action	**Current efforts**	**Additional steps to be taken**	**Focal points / lead institutions**
1. Regulations on gas (CO2, NOx and SOx) emissions to the air	Revision and approval of the legislation that could deal with the issue	Start to implement in schools, universities, and media programs of awareness of this problem	Environmental Management Authority, Ministry of Energy, NOCs, Universities
2. Management of effluent from oil and gas development	Revision of Water Pollution Rules (2019), some operators using reinjection of produced water for EOR, Upstream Effluent Management Policy developed	Greater sensitisation of operators, further research into BMPs for effluent management, establishment of EOR Committee	Environmental Management Authority, Ministry of Energy
3. Regulation about leaks	Regulation project in study	Socialization with stakeholders	Ministry of energy
4. New regulatory Agency / laws	Integration of defunct Agency as required in the new Petroleum Industry Act (PIA) - Cultural Change and operational processes.	Reviews and Development of existing policy and laws to reflect current realities. Development and Realignment of framework	NMDPRA (Regulatory Agency)

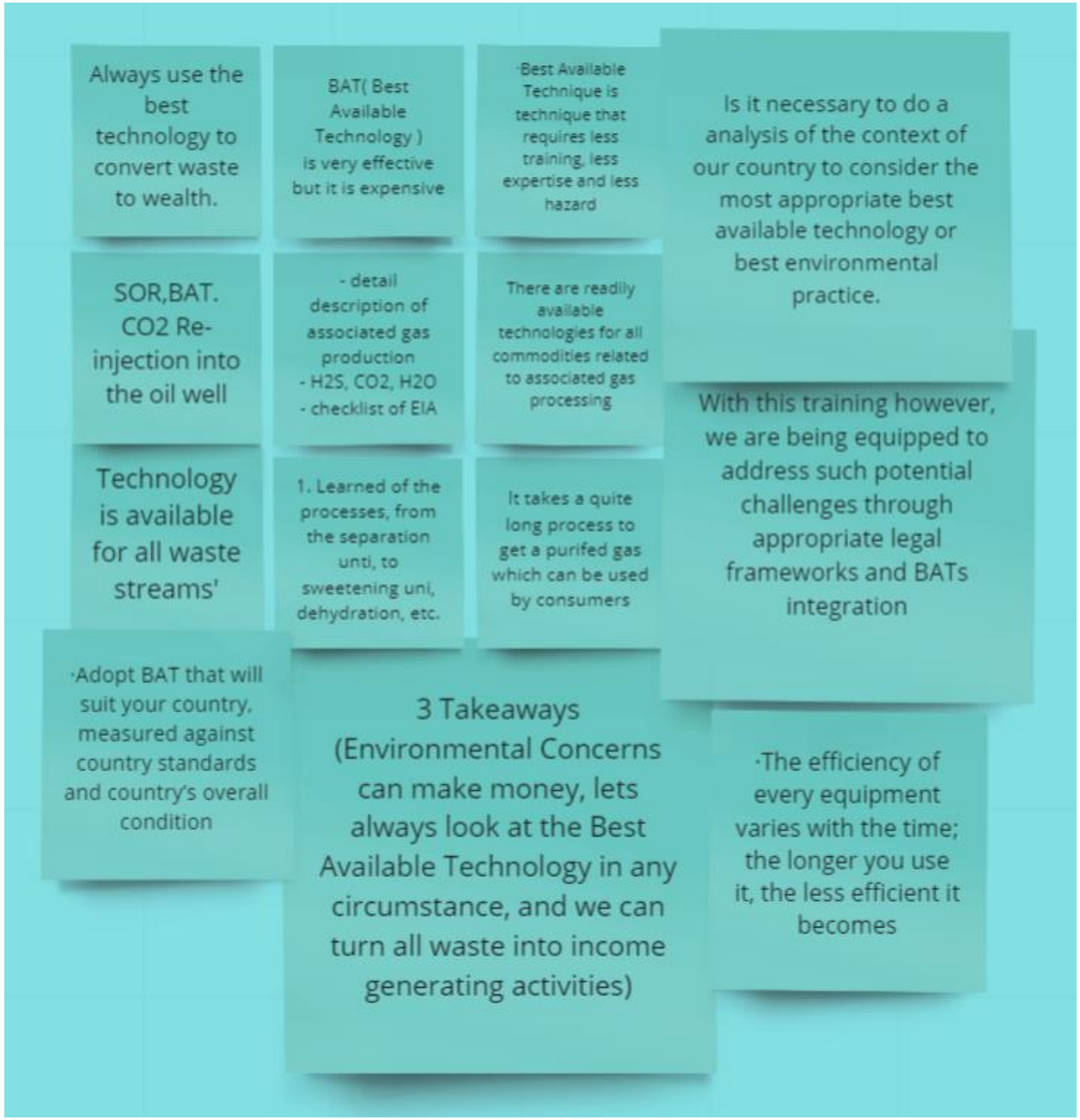
Priority challenge for action	Current efforts	Additional steps to be taken	Focal points / lead institutions
1. Regulations on gas (CO2, NOx and SOx) emissions to the air	Revision and approval of the legislation that could deal with the issue	Start to implement in schools, universities, and media programs of awareness of this problem	Environmental Management Authority, Ministry of Energy, NOCs, Universities
Capacity building to meet current challenges			
5. Education and training	Institut du pétrole		
6. Environmental regulation frameworks			Ministry of environment Ministry of energy Ministry of health
Improve Relationship between industry, government, and universities	Initial science and technology research agreements applied to the oil and gas industry	Project financing	Ministry of energy Ministry of science and technology ANH

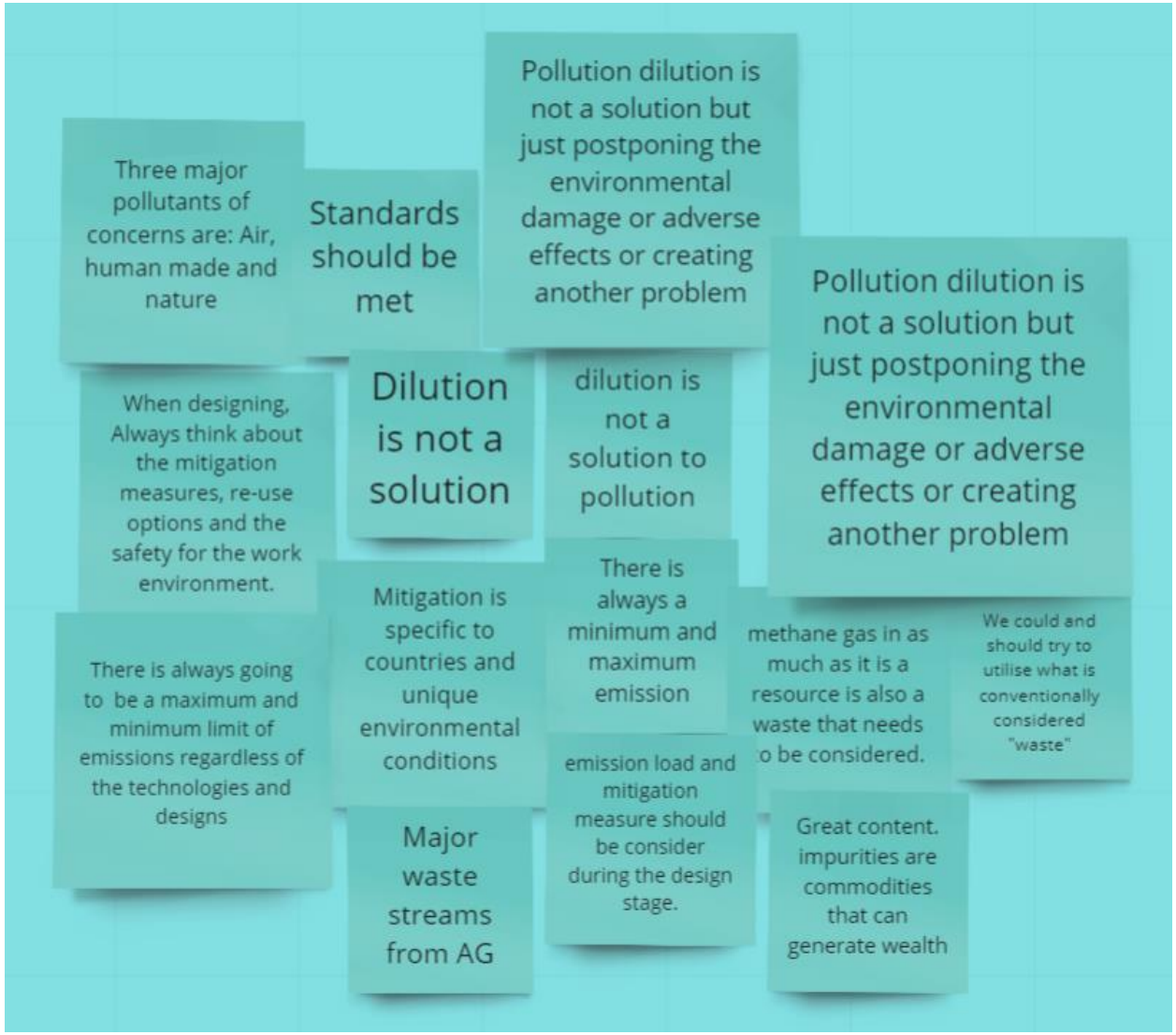
Annex 7: Daily recaps with Miro whiteboard

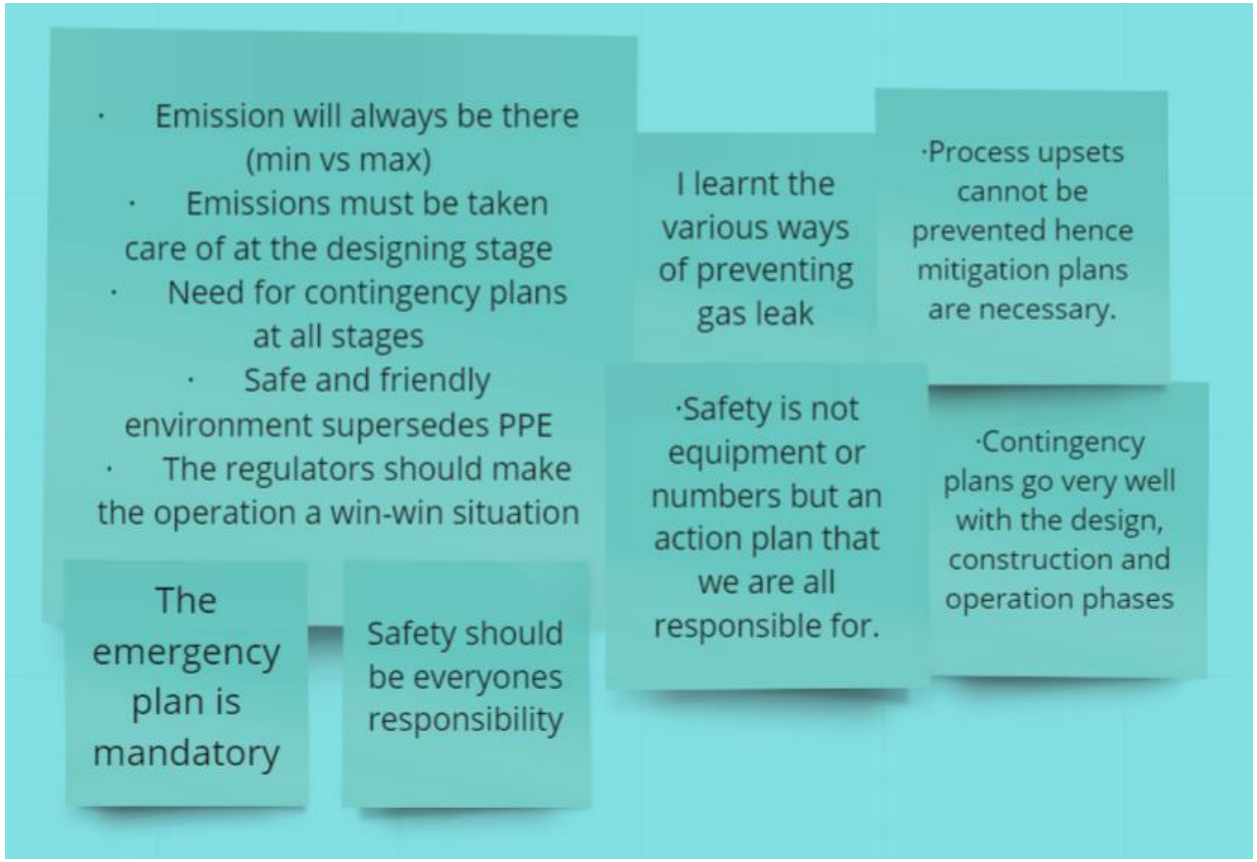
Day 1 reflections




Partnership between the government, research centers/ universities is important in helping develop best practices.
- Associated gas usually vented and/or flared
- Environmentally sound ways of handling produced water
- Capital required to establish recovery systems to use by-products
- Waste is not waste. When we focus on the converting it a different product. Circular economy approach
that the associated elements in the gas can be separated, utilised and revenue generated. being a commodity rather than a waste, environment saved, revenue generated. Technologies used is very much available
I learnt that nothing is 'waste' anymore.
-Reuse of by-products from gas processing can generate extra revenue, create downstream industry and reduce environmental impacts
I learnt that there is nothing like waste products when it comes to associated gasses. That EIA is site and review entity dependent.
Associated Gas is not a by product
most of the gases flared can be converted for better use.
Gas flaring should not be the first option.
Nothing is waste in today's world due to the application of technology and innovations
I learned that Sulfur can be converted to wealth
Huge revenue can be generated from Gas
Nothing goes to waste anymore especially when it is properly utilized
Key lesson: Resource recovery from what has been considered as wastes such as H2S, CO2
Waste is not waste. It can be reused, recycled. It can be converted to a useful product. Waste is wealth.
Waste can be converted to wealth.
Waste is not waste as we think. It can be converted to a new product.
What some consider waste can be converted to profit: Co2, Sulfur and water
Learned that, nothing should be going to waste.
Nothing is waste anymore, everything is valued

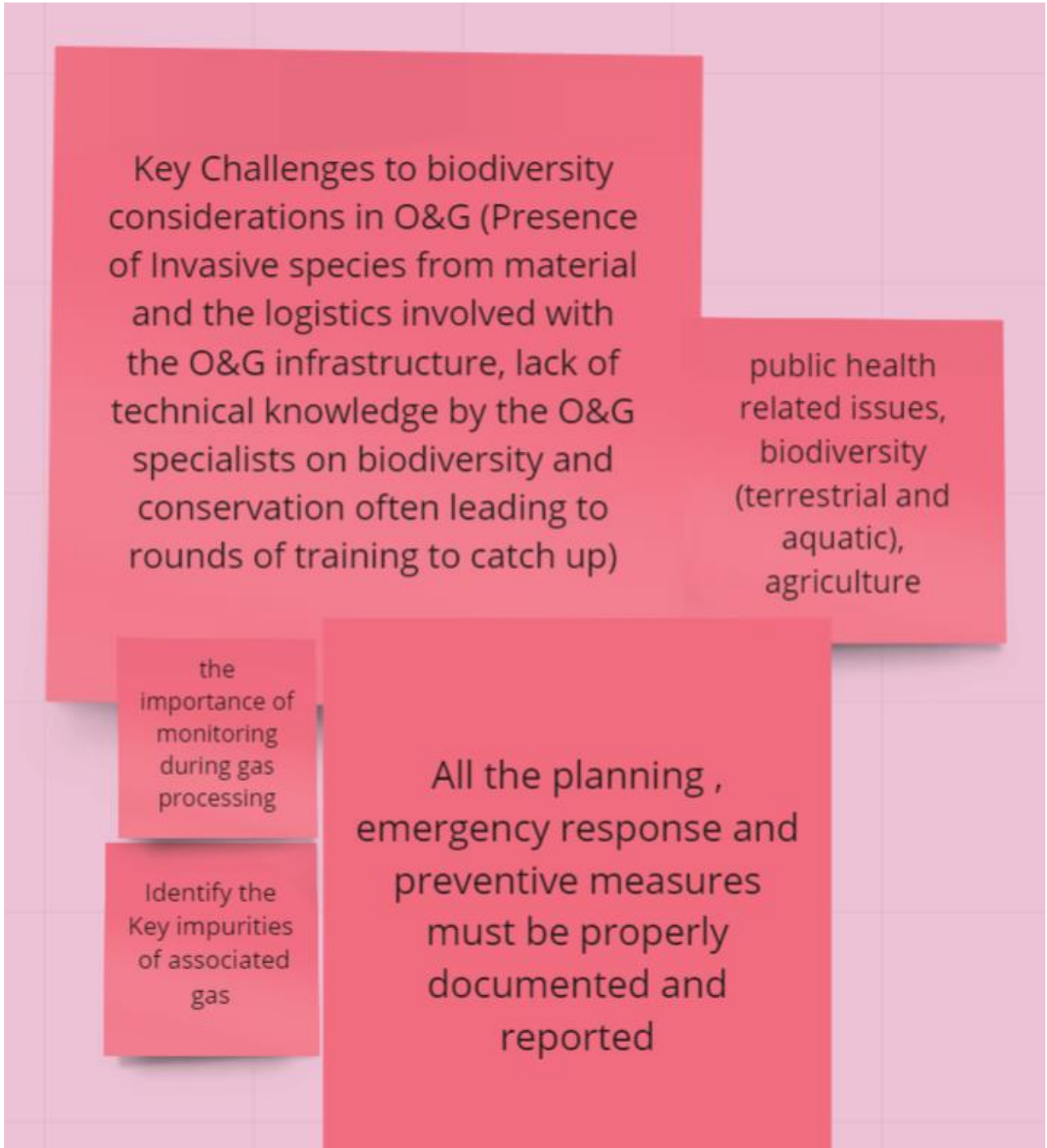

Always use the best technology to convert waste to wealth.
BAT(Best Available Technology) is very effective but it is expensive
·Best Available Technique is technique that requires less training, less expertise and less hazard
Is it necessary to do a analysis of the context of our country to consider the most appropriate best available technology or best environmental practice.
SOR,BAT. CO2 Re-injection into the oil well
- detail description of associated gas production
- H2S, CO2, H2O
- checklist of EIA
There are readily available technologies for all commodities related to associated gas processing
With this training however, we are being equipped to address such potential challenges through appropriate legal frameworks and BATs integration
Technology is available for all waste streams'
1. Learned of the processes, from the separation unti, to sweetening uni, dehydration, etc.
It takes a quite long process to get a purifed gas which can be used by consumers
·Adopt BAT that will suit your country, measured against country standards and country's overall condition
3 Takeaways (Environmental Concerns can make money, lets always look at the Best Available Technology in any circumstance, and we can turn all waste into income generating activities)
·The efficiency of every equipment varies with the time; the longer you use it, the less efficient it becomes

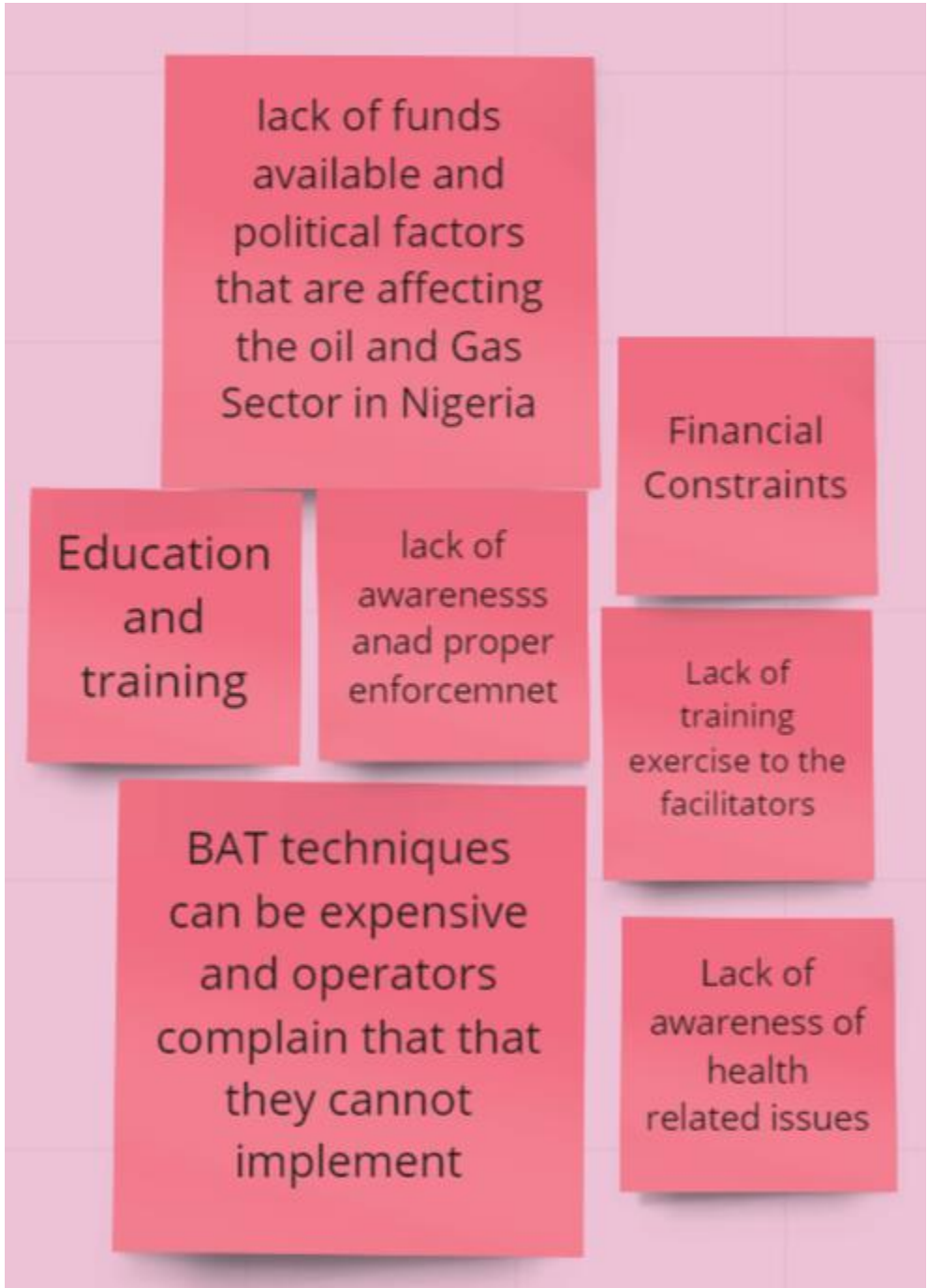

Three major pollutants of concerns are: Air, human made and nature
Standards should be met
Pollution dilution is not a solution but just postponing the environmental damage or adverse effects or creating another problem
Pollution dilution is not a solution but just postponing the environmental damage or adverse effects or creating another problem
When designing, Always think about the mitigation measures, re-use options and the safety for the work environment.
Dilution is not a solution
dilution is not a solution to pollution
There is always going to be a maximum and minimum limit of emissions regardless of the technologies and designs
Mitigation is specific to countries and unique environmental conditions
There is always a minimum and maximum emission
methane gas in as much as it is a resource is also a waste that needs o be considered.
We could and should try to utilise what is conventionally considered "waste"
emission load and mitigation measure should be consider during the design stage.
Major waste streams from AG
Great content. impurities are commodities that can generate wealth


· Emission will always be there (min vs max)
· Emissions must be taken care of at the designing stage
· Need for contingency plans at all stages
· Safe and friendly environment supersedes PPE
· The regulators should make the operation a win-win situation
I learnt the various ways of preventing gas leak
·Process upsets cannot be prevented hence mitigation plans are necessary.
·Safety is not equipment or numbers but an action plan that we are all responsible for.
·Contingency plans go very well with the design, construction and operation phases
The emergency plan is mandatory
Safety should be everyones responsibility

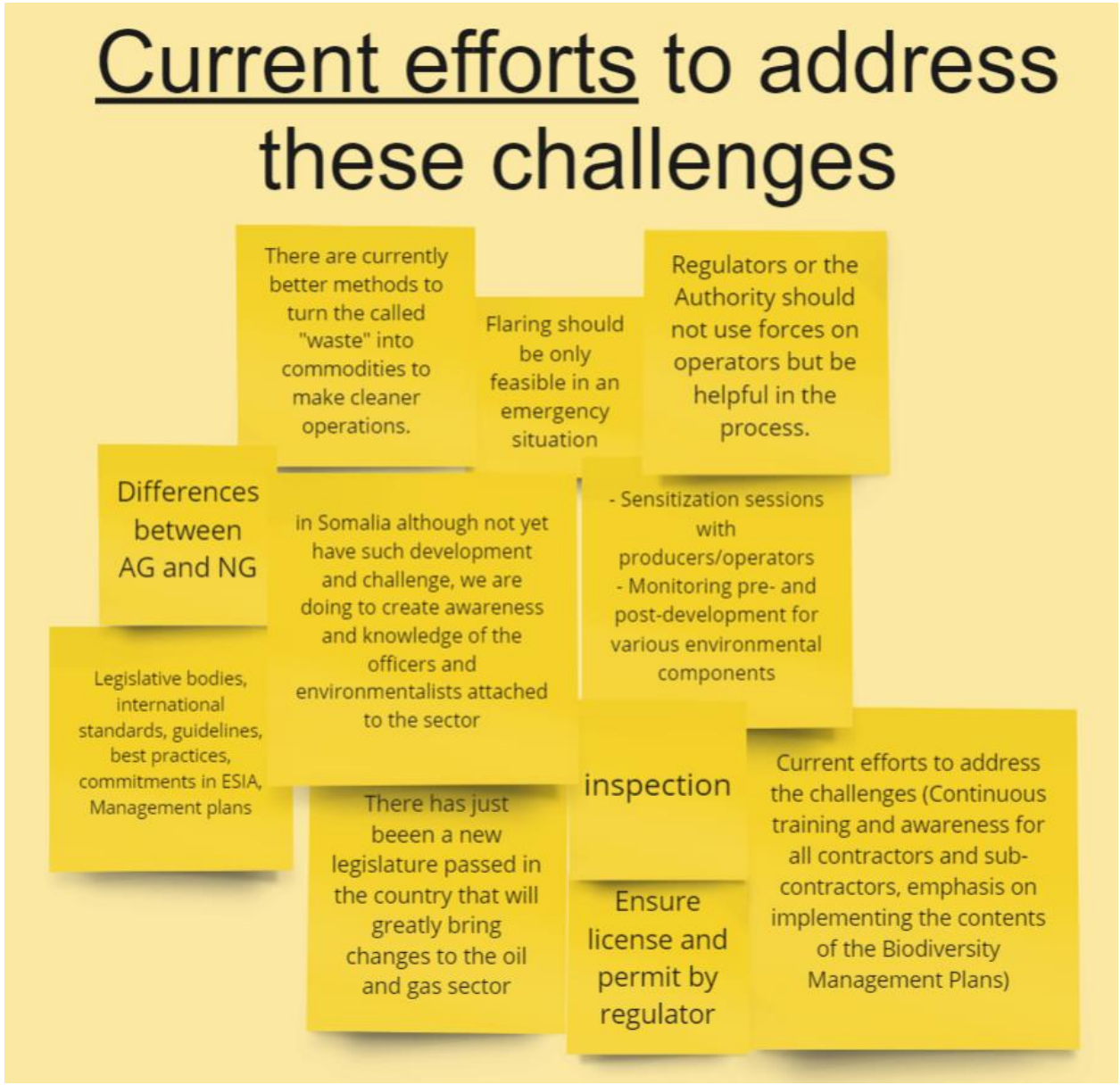

SOPs are living documents
SOP for monitoring and mitigation should be updated according to the operation variable
Three pillars: Government, operators and Scientific Research Institutes
Different mitigation plans differ for different countries; a regulator must do his research before applying a mitigation plan
Block flow diagrams are your best friend
Each country, project and location is unique

Environment, health, or safety challenges regarding gas processing currently faced in your country


Key Challenges to biodiversity considerations in O&G (Presence of Invasive species from material and the logistics involved with the O&G infrastructure, lack of technical knowledge by the O&G specialists on biodiversity and conservation often leading to rounds of training to catch up)
public health related issues, biodiversity (terrestrial and aquatic), agriculture
the importance of monitoring during gas processing
Identify the Key impurities of associated gas
All the planning , emergency response and preventive measures must be properly documented and reported

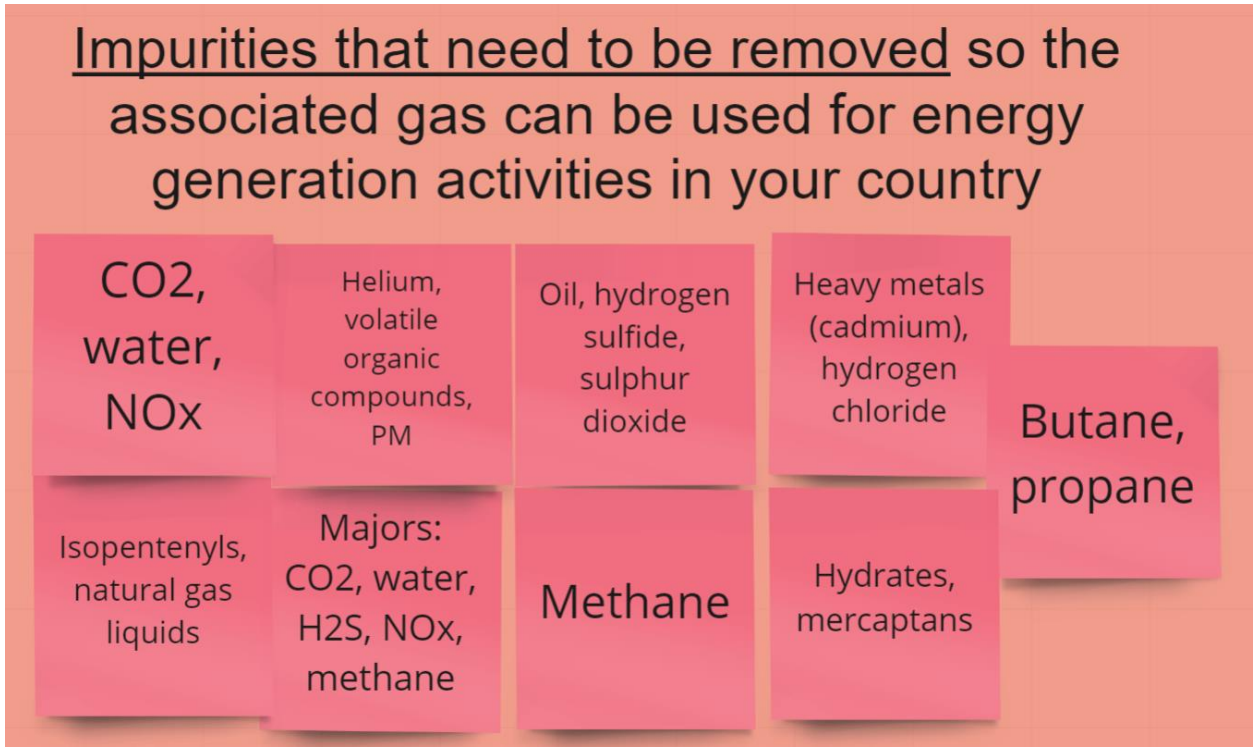

lack of funds available and political factors that are affecting the oil and Gas Sector in Nigeria
Financial Constraints
Education and training
lack of awarenesss anad proper enforcemnet
Lack of training exercise to the facilitators
BAT techniques can be expensive and operators complain that that they cannot implement
Lack of awareness of health related issues

Current efforts to address these challenges

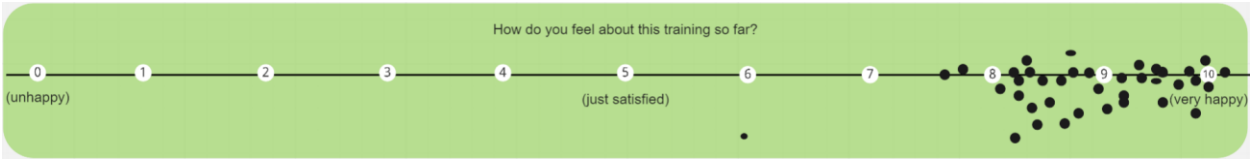



Writing in modifications within the EIA process and the issuance of our permitting process
Guidelines are being developed by responsible authorities, adopting BAT
Development of regulations, policies and standards
Responsibility management
Use of BATS developed by the 3 pillars
Regulation of waste
Training Education
Planning Emergency scenarios (how they happen)
Discussion of emergency response and prevention
Address all the impacts from the block process
Revised legislation for the Water Pollution Rules, 2019.

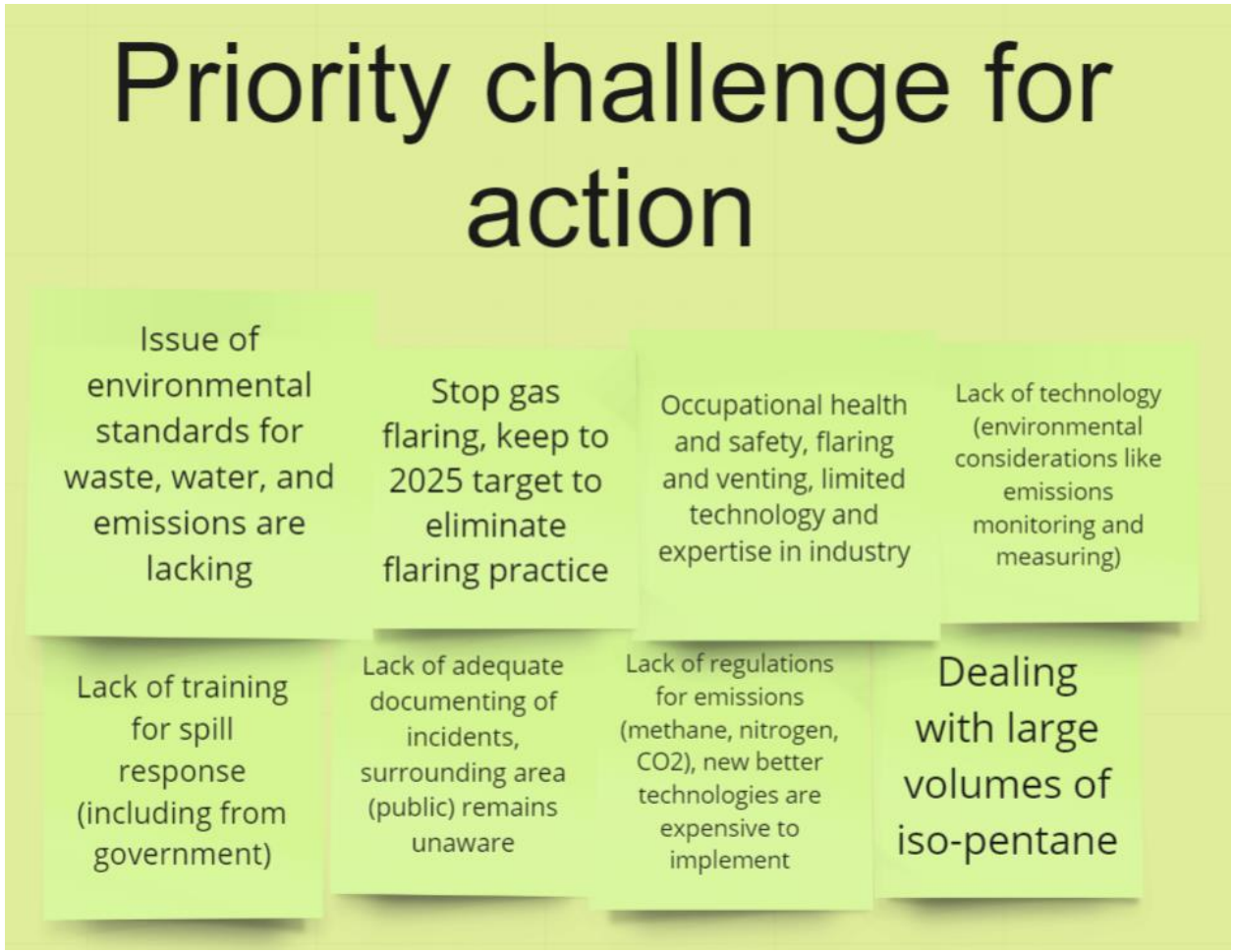
Day 2 reflections

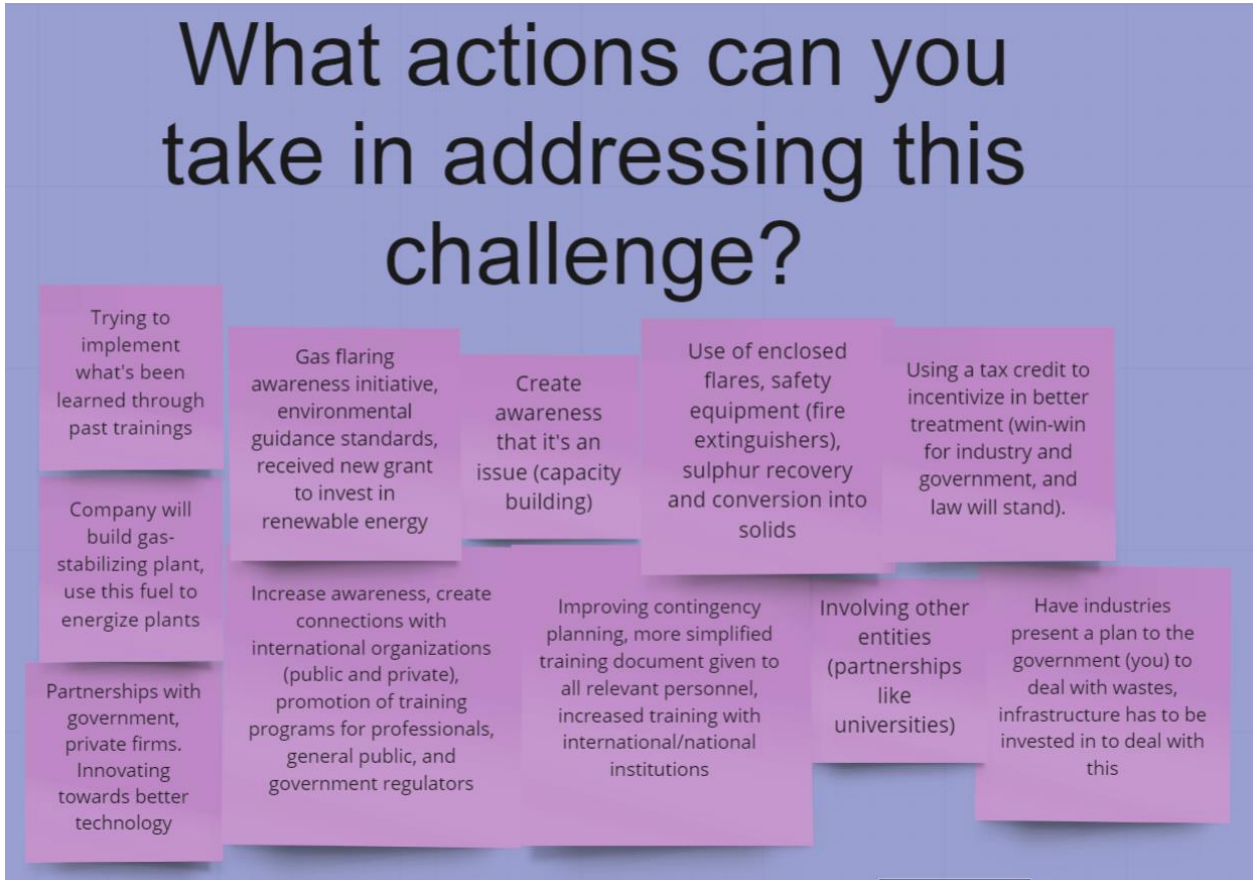



Key elements which should be part of an effective emergency prevention and response plan for accidental gas leaks
Incident command system, evacuation plans, shutting off valves
Have regular gas-leak drills (emergency trainings)
Clear prep measures to avoid accidents, clear communications when accident happens, clear organization and instructions to act before, during, and after emergency, daily reports for spills and leakage
SOPs, awareness generation activities (passing on important knowledge to general public), onsite and offsite plans for industries (action plans for transportation, etc), key documents should be given to government authorities
Risk assessment associated with gas processing, identify sources of accidents, identify responsible persons (what levels, which entities, etc), notifications and reporting (who notifies who, how is it reported), what resources are available to respond to incident
Planning emergency scenarios (how they happen)
Preventative actions, periodic review of emergency plan
Ensuring continuous monitoring and maintenance
On/off-site simulations of incident and accidents
Have gas sensors in place to detect leaks and accidents (monitoring systems - early warning)
Establish multilevel response (according to emergency level), training with state agencies (these personnel need to know how industry-response functions), cooperation between local and national government
Reporting and documentation must be added to all aspects (planning, emergency response), ensures that same accidents aren't repeated, make this documentation available to all entities/personnel, specific periods of time must be reported
Mock drills (simulation exercises) to help come up with solutions
Doing training exercises


How do you feel about this training so far?
0
1
2
3
4
5
6
7
8
9
10
(unhappy)
(just satisfied)
(very happy)

Day 3 reflections




What actions can you take in addressing this challenge?
Trying to implement what's been learned through past trainings
Company will build gas-stabilizing plant, use this fuel to energize plants
Partnerships with government, private firms. Innovating towards better technology
Gas flaring awareness initiative, environmental guidance standards, received new grant to invest in renewable energy
Increase awareness, create connections with international organizations (public and private), promotion of training programs for professionals, general public, and government regulators
Create awareness that it's an issue (capacity building)
Improving contingency planning, more simplified training document given to all relevant personnel, increased training with international/national institutions
Use of enclosed flares, safety equipment (fire extinguishers), sulphur recovery and conversion into solids
Involving other entities (partnerships like universities)
Using a tax credit to incentivize in better treatment (win-win for industry and government, and law will stand).
Have industries present a plan to the government (you) to deal with wastes, infrastructure has to be invested in to deal with this