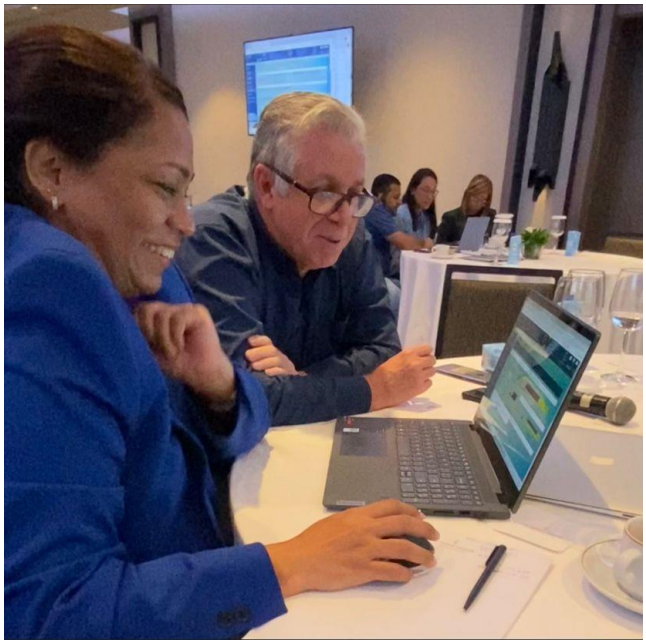

DOMINICAN REPUBLIC CARBON MARKET SIMULATION TRAINING EXERCISE REPORT

November 14, 2023

ABSTRACT

Report on how a carbon market simulation training exercise was used to train ~40 government and industry and enterprise representatives, significantly increase ETS literacy, foster conversations, lay the groundwork for further engagements, and increase the number of participants that believe that an ETS would be 'very useful' or 'indispensable' to the Dominican Republic's efforts to meet its Nationally Determined Contribution.

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Prepared for:
Consejo Nacional para el Cambio Climático y Mecanismo de Desarrollo Límpio

With support from:
United Nations Framework Convention on Climate Change and its RCC Caribbean

PRESIDENCIA DE LA REPÚBLICA DOMINICANA
Consejo Nacional para el Cambio Climático

RCC Caribbean
Collaboration for Climate Action

DOMINICAN REPUBLIC

CARBON MARKET SIMULATION TRAINING EXERCISE REPORT

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Thanks is also extended to Alan Ramirez (Technical Director for Climate Change – Consejo Nacional de Cambio Climático y Mecanismo de Desarrollo Límpio), Ana Dominguez Lopez (Regional Expert on Article 6 and Carbon Pricing - RCC Latin America), and Mayra Santaella (Team Lead - RCC Caribbean) and their teams. The support – professional, logistical, and financial – provided by these individuals was crucial to the success of this project.

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Recognition and thanks are due to those who participated in this exercise, in particular, officials from the Ministry of Environment and Natural Resources and the Ministry of Energy and Mines. These individuals gave generously of their time and gained valuable knowledge from these exercises. And they demonstrated that they understand that their collective future will be shaped by the choices that they make.

Finally, recognition and gratitude is extended to the Federal Ministry for Economic Affairs and Climate Action of Germany, which enabled this activity by the funding made available through the project “Collaborative Instruments for Ambitious Climate Action” (CIACA) as part of its International Climate Initiative (IKI).

EXECUTIVE SUMMARY

On September 26 and 27 of 2023, a series of carbon market simulation exercises were run in Santo Domingo in the Dominican Republic for the benefit of ~40 participants. This report includes the following findings, conclusions, and recommendations:

- The **purpose of the exercise** was to provide essential knowledge and hands-on practice for policy makers and other stakeholders to help them understand how carbon credits and allowances trading works, how they can effectively engage in emissions trading system (ETS) related discussions regarding mandatory and voluntary carbon markets, and the basic principles of carbon portfolio management. As a result of these discussions and practical experience, it is expected that such discussions may increase the likelihood of a successful roll-out of an ETS.

- **Participant demographics** included the National Council on Climate Change, the Ministry of Environment and Natural Resources and, the Ministry of Energy and Mines and emitting companies that may be subject to the requirements of ETS regulations that may be promulgated by the Dominican Republic as per regulations. Approximately 57% of the participants were female.

  The training was **administered using CarbonSim,** a multi-user, multi-lingual, artificial intelligence-enhanced tool that is owned by the Environmental Defense Fund. To date, CarbonSim has been used by over 4,000 ETS stakeholders to improve ETS literacy, build capacity, increase support for, and foster conversations that can serve to improve the quality, and speed the roll-out of ETS programs. In the training, each participant had the opportunity to complete two different simulations – a 'practice' and a 'competitive' simulation. At the end of the two-day exercise the top finishers in the 'competitive' simulation – as measured by their compliance status and low marginal cost of control – were recognized and provided with nominal awards.

  The goal of the workshop– to foster ETS-related discussions, increase ETS literacy, and build support for the use of well-designed ETSs – was realized. Coming into the simulation exercises, participants generally had a rudimentary understanding of carbon markets and did not have strong views as to the utility of carbon markets to the Dominican Republic. Throughout the simulation exercises, participants engaged in numerous conversations, markedly increased their understanding, and came to appreciate the importance of carbon markets. In fact, as a result of the training there was an absolute increase of ~24% of participants who said that an ETS would be 'very useful' or 'indispensable' for the Dominican Republic to meet its nationally determined contributions (NDC).

  As a result of the training there was an absolute increase of ~24% of participants that said that an ETS would be 'very useful' or 'indispensable' for the Dominican Republic to meet its NDC. Also, 100% of participants reported that they would recommend it to their colleagues. Some 83% reported that they found the two-day event was indispensable and 17% said that the event was somewhat useful.

Further, 100% of participants reported that they would recommend it to their colleagues. Some 83% reported that they found the two-day event was indispensible and 17% said that the event was somewhat useful.

- **As a result of the exercises, participants learned several lessons.** Participants learned the basic principles of carbon portfolio management and came to appreciate that an ETS can provide a great deal of flexibility and a means to both reduce carbon emissions and accomplish secondary goals including, facilitating a clean energy transition, increasing green jobs, fostering offset-related emission reductions outside of the ETS, addressing environmental justice concerns, and allowing greenhouse gas entrepreneurs to generate profits. Importantly, participants also came to appreciate that program design and administration – particularly when ETS parameters are adjusted as it is administered – can affect the environmental, economic, and social outcomes.

- Several **next steps** could be considered by the project sponsor to support a potential ETS rollout in the Dominican Republic. These include:

    - Running additional simulations that are targeted at key sectors (e.g., high emitting industries, trade associations, prospective carbon offset suppliers, and ETS administrators).
    - Running simulations that are paired with more intensive training on key topics (e.g., inventory development, auction design, the use of risk-hedging derivatives, and monitoring, reporting, and verification [MRV], etc.).
    - Collaborating with other national and sub-national jurisdictions – in particular, those in the Caribbean and Latin America that have an interest in launching and/or are running their own ETS.
    - Running additional simulations for the benefit of students at undergraduate and graduate schools that have a focus on sustainability, climate policy, and climate finance.

  In light of the fact that the Dominican Republic has limited temporal and financial resources, the project sponsor may wish to encourage Dominican Republic stakeholders to act under the presumption that further capacity building efforts will be most successful if they have a primary goal of encouraging participants to work towards an ETS that enables emitters to achieve necessary and timely emission reductions in the most cost-effective fashion with the greatest co-benefits.

1.0 INTRODUCTION

This report summarizes the details and results of the carbon market and ETS simulation training workshops that were delivered in the city of Santo Domingo in the Dominican Republic on September 26 and 27, 2023. This report provides information on:

- Purpose of the training – Section 2.0
- Participant demographics – Section 3.0
- How the training was conducted – Section 4.0
- Participant satisfaction and ETS knowledge gained through the exercise – Section 5.0
- Simulation tool description and results – Section 6.0
- Project outcomes, lessons learned, and next steps – Section 7.0

2.0 PURPOSE OF THE TRAINING

The purpose of the training was to provide participants with knowledge that will allow them to understand:

- How ETS functions and gain an increased appreciation of key terms.
- That effective ETS market design and administration will drive environmental, economic, and social results.
- Principles of carbon portfolio management.
- The power and limits of an ETS.
- Basic elements of how environmental markets work.
- How to use the carbon market simulation tool, CarbonSim.
- How and why carbon market simulations can be used to build capacity and speed the roll out of an effective ETS.
- Key differences between an ETS, a carbon tax, command and control, and business as usual (no regulation).

As a result of these discussions, it is expected that the lessons learned through this training and the ETS-related discussions amongst participants may serve to increase the likelihood of more fruitful discussions between participants and the successful roll-out of an ETS. As documented in this report, these goals have been achieved.

3.0 PARTICIPANT DEMOGRAPHICS

Participants in the carbon market simulation included commercial bank associations, the National Council for Climate Change and Clean Development Mechanism, policymakers, and emitting companies (from a variety of sectors, including cement, electricity, and steel.) that may be subject to the requirements of ETS regulations that may be promulgated by the Dominican Republic, and ETS service providers that may assist participants to meet and capitalize on their ETS-related responsibilities and opportunities. Generally, participants were either located in – or had the responsibility for operations proximate to Santo Domingo. Information regarding the self-reported demographics of these participants indicates that the participants were predominantly female - 57%.

4.0 HOW THE TRAINING WAS CONDUCTED

Prior to the simulation, participants were provided a variety of ETS and CarbonSim-related resource materials. These included a glossary of key ETS and CarbonSim-related terms, a CarbonSim 'cheat sheet,' and access to a set of CarbonSim training videos created prior to the commencement of this project.

At the commencement of the simulation participants were surveyed[1] (see Section 5) regarding their ETS-related knowledge and attitudes towards ETS. They were then provided with lectures[2] that focused on the principles of both ETS and CarbonSim. Following the lectures, participants were encouraged to form two- or three-person 'teams.' Each team was assigned to manage a virtual company within each CarbonSim exercise. Once formed the teams were assigned to tables, each of which included from one to three total teams (or two to six participants).

Figure 1. Participants making crucial decisions on abatement investment options

The exercises were administered by the CarbonSim administrator – Josh Margolis as shown in Figure 1. The administrator established and adjusted the simulation to reflect the parameters for the exercises and curated the exercise. Notably, the administrator stopped and started the simulation on an as needed basis, called out key market-related events (both prior to, during, and at the end of each virtual year), summarized the results of the exercises, and trouble-shot the system (as needed) to ensure smooth operation.

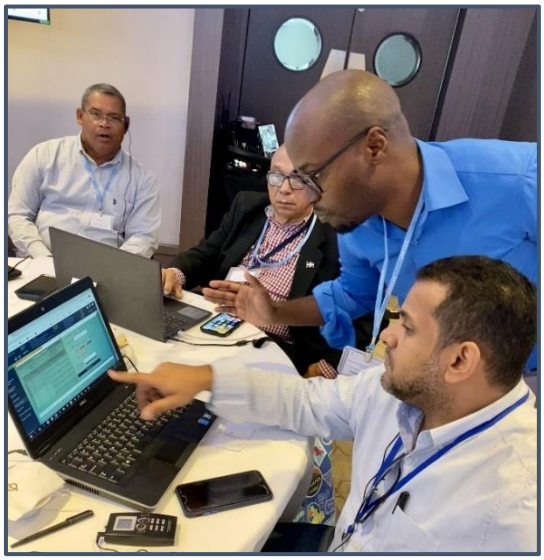


Figure 2. Participants trading allowances in the exchange market

Shown in Figure 2, Patrick Munyaneza, Regional Expert on Article 6 and Carbon pricing for RCC Caribbean, served as overall workshop manager for the project and overall onsite coordinator for the training event.

The exercises were run with the help of seven tutors. By virtue of training administered prior to the exercises these individuals earned the title of 'tutors' after they gained a familiarity with CarbonSim, the registration process, its various screens, challenges to new users, and carbon portfolio management strategies. These tutors were

[1] For each questions participants were surveyed twice – once at the start of the exercise and once at the end.

[2] The lecture included the following PowerPoint presentation: i) Carbon Pricing. A climate change instrument; ii) ETS. An overview; iii) ETS Critical Elements; iv) Roadmap for the Implementation of ETS in the Dominican Republic; v) Mexico ETS (ETS Design); and vi Introduction to CarbonSim.

assigned to work with groups of participants, typically numbering four to six participants or two to three teams. The primary role of the tutors was to guide participants as they registered/logged-in and navigated the screens as they created and adjusted their respective carbon portfolio management strategies. Additionally, the tutors occasionally – provided liquidity/assistance to participants on an as needed/requested basis. The tutors also worked in tandem with, and provided feedback to, the CarbonSim administrator.

Finally, before and after the simulations participants attended ETS-topical lectures provided by several experts, including Nelly Cuello and Paloma Vazquez from MexiCO2. The learning opportunities provided in both the simulation and the lectures reinforced and likely contributed to the success of the exercises.

As shown in Figure 3, the exercises were run in two parts – one three-year 'practice' simulation on day one and a second six-year 'competitive' simulation on day two.

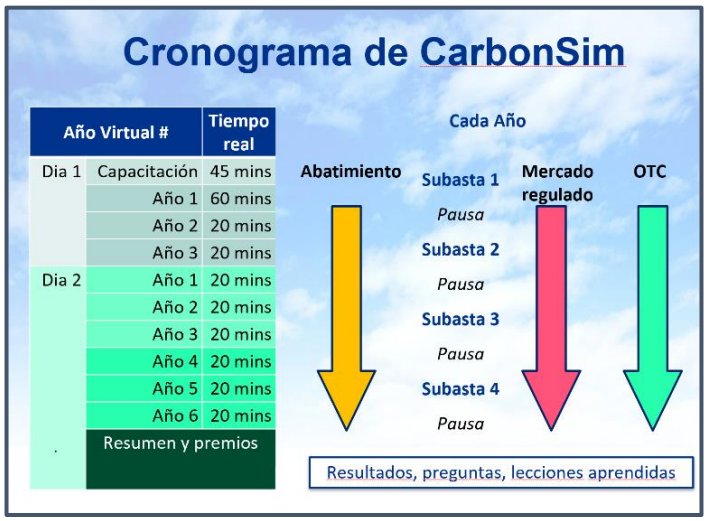


Figure 3. The CarbonSim exercises were run over two days

The purpose of the day-one practice simulation was to familiarize participants with each other and the workings of (and screens associated with) CarbonSim as well as to provide them with an introduction as to basic ETS and carbon portfolio management terminology (e.g., cap, trade, allowances, offsets, marginal abatement control cost curve, auction, exchange, over-the-counter market, banking, etc.). Participants were encouraged to experiment and to make mistakes. And CarbonSim tutors were directed to liberally provide assistance, both when requested by participants and at such time as the tutors thought participants may require help.

In general, at the end of each of the three virtual years the administrator stopped the game and reviewed the systemwide results and the leaderboard. During the first year of the 'practice' simulation the game was stopped frequently, both so that the administrator could make teaching points as well as to answer questions. The exercise was run over the course of three hours.

The second 'competitive' simulation was run on day two and consisted of six virtual years. Participants were provided with the opportunity to apply the lessons that they learned from the first day practice exercise and advised that the top performers – those complied at the lowest marginal cost of control – at the end of the simulation would be recognized in an award ceremony.

In comparison to the day one 'practice' session, the day two simulation:

- Started with a review of the results of the day one practice simulation (as provided in Figure 4).
- Consisted of six virtual years (vs three in the practice session).
- Ran without stoppage during each virtual year (vs multiple – and time consuming – teaching point and Q&A stops during year one of the practice session).

- Provided participants with end of year results only after years one through four and then after the final year six (vs after each year in the practice session).

Figure 4. Day one practice simulation results summary

#	Team	Company Name	Unit	Cost		Rank		Year 3	
				Year 1	Year 3	Year 1	Year 3	Compliance	Abatements
1	Maribel	EMPRESA NACIONAL PETROLIFERA	29	$26.25	$12.78	2	1	1	2
2	ADSJ	ACERO DOMINICANA	24	$33.57	$13.97	5	2	1	2
3	Miguel Justo	CENTRAL DE GENERACIÓN PUNTA CANA	22	$12.49	$14.46	1	3	1	1
4	Maria	PUNTA CANA POWER PLANT	20	$33.80	$15.92	6	4	1	2
5	Peguero	CIMENTOS DOMINICANA	2	$27.86	$16.30	3	5	1	2
6	Keraro	CENTRAL DE GENERACIÓN PUNTA CANA	27	$33.96	$17.11	7	6	1	2
7	Fede Nel	DOMINICAN POWER	9	$34.84	$18.53	8	7	1	2
8	Julia Alexandra	SANTO DOMINGO POWER PLANT 1	35	$32.92	$22.53	4	8	1	2
9	Luis Morillo	CENTRAL DE GENERACIÓN SAN JUAN	28	$58.32	$28.60	9	9	0	2
10	Radhames Lora	BARAHONA ELEC	30	$200.27	$58.11	10	10	0	2
				$49.43	$21.83			80%	1.9

Figures 5, 6, and 7 show participants actively engaged in the simulation.

Figure 5 Participants and tutor managing carbon portfolio.

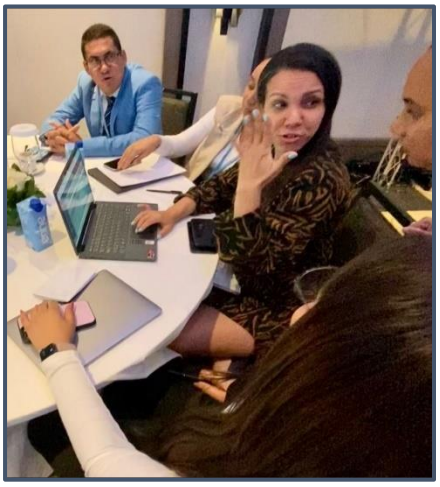


Figure 6. Participants debating next steps.

Figure 7. Participants and tutor reading the market.

At the conclusion of the competitive simulation (and at the end of the second day) an awards ceremony was held. During the ceremony the top finishers from each group were recognized, applauded, and awarded with nominal tokens. As shown in Figures 8, the award ceremonies closed with a group photo.

Figure 8. Participants, tutors, lecturers, and the CarbonSim tutors gathered for a group picture at the conclusion of two-day training

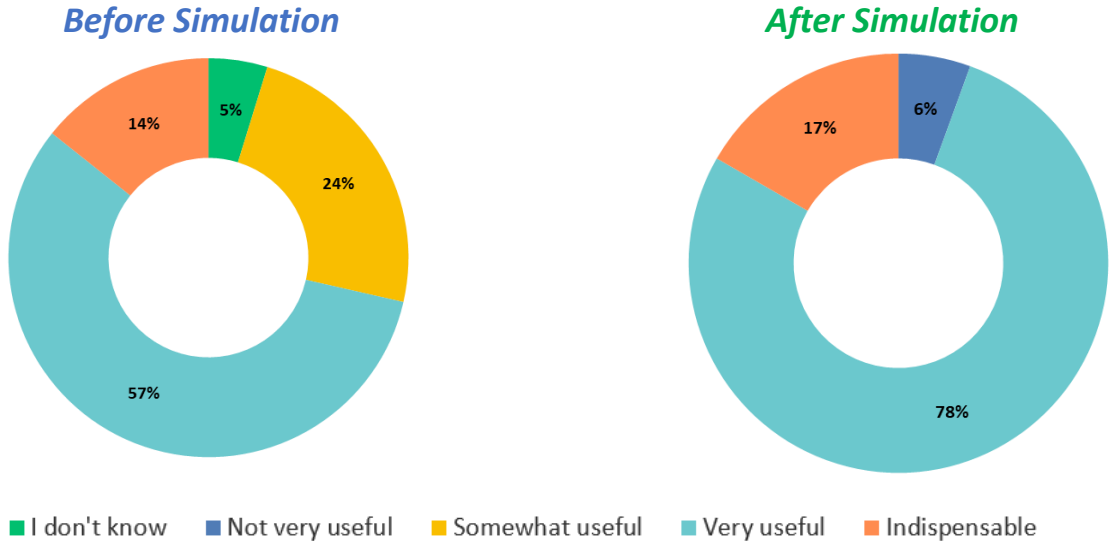
5.0 PARTICIPANT SATISFACTION AND ETS KNOWLEDGE GAINED THROUGH THE EXERCISE

To gauge the value and efficacy of the workshop and simulation participants were asked to answer a series of questions before and after the two-day event. These questions generally asked participants to self-report their familiarity with key concepts – such as the meaning, purpose, key differences between, and the utility of the key terms and concepts provided in Figure 9.

Figure 9. Participants were exposed to, provided examples of, and periodically quizzed about key ETS-related terms

Judging from pre- and post-exercise survey results, participants substantially improved their emissions trading system literacy, ETS terms and related concepts, and appreciation of critical design factors. As a result, participants can carry this knowledge back to their respective organizations and become champions of effective ETS design, development, and administration. ***Reflecting on the two days spent in the exercise, 100% of participants concluded that their time was well spent and that they would recommend it to their colleagues.*** The questions and participant responses are provided in Figures 1 – 10 below.

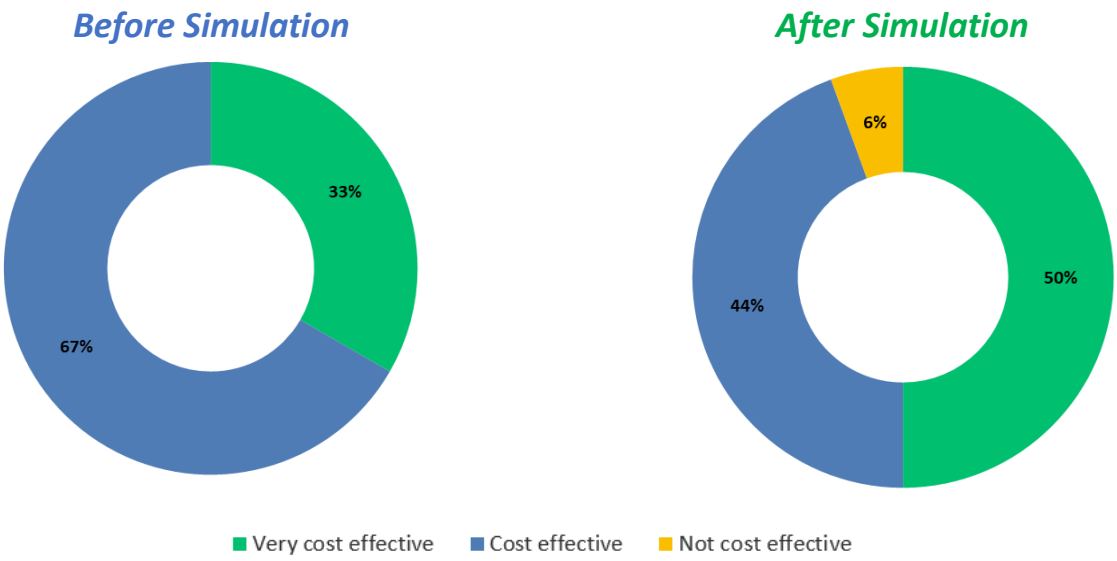
Figure 10. How useful do you think an ETS will be to meet the Dominican Republic´s NDC?



As shown in Figure 10 above, there is a strong likelihood that the training resulted in an increased level of support for the implementation of an ETS in the Dominican Republic. Prior to the training, 71% said

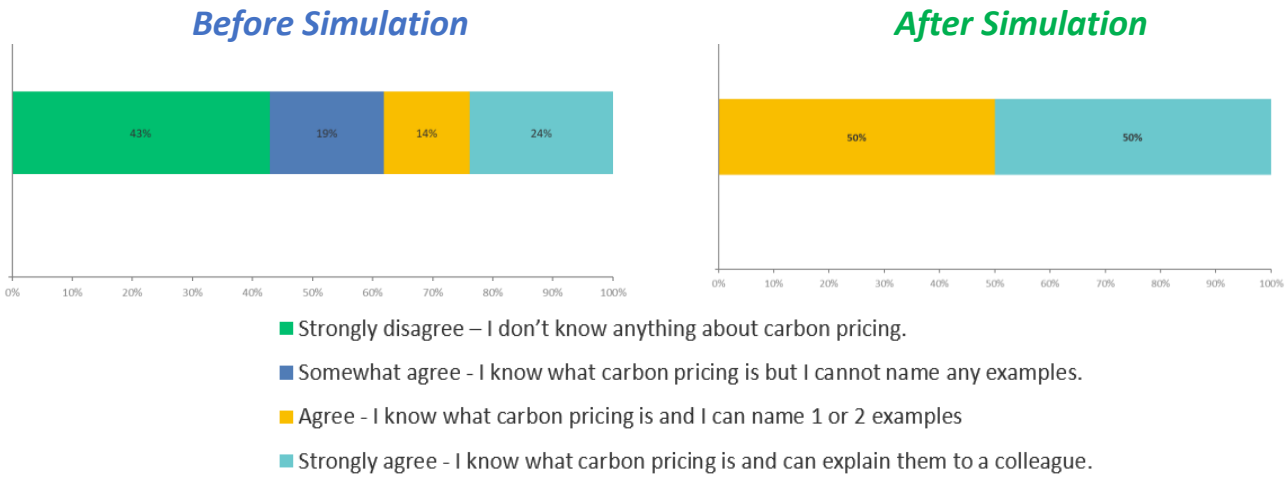
that an ETS would be 'very useful' or 'indispensable' for the Dominican Republic to meet its NDC. Post training this number grew to 95% -- an absolute increase of ~24%.

Figure 11. How cost-effective might an ETS be to reduce the Dominican Republic´s emissions?



As shown in Figure 11 above, participants gained an appreciation as to how policymakers could use a well-designed ETS to deliver their objectives. Before the exercise, 33% reported that they believed that an ETS would be cost effective for the Dominican Republic to reduce its emissions. After the exercise this number grew to 50%, an absolute increase of 27%. Interestingly, after the simulation exercise 6% of participants believed that an ETS would NOT be a cost-effective way for the Dominican Republic to reduce its emissions. This compares to 0% before the exercise.

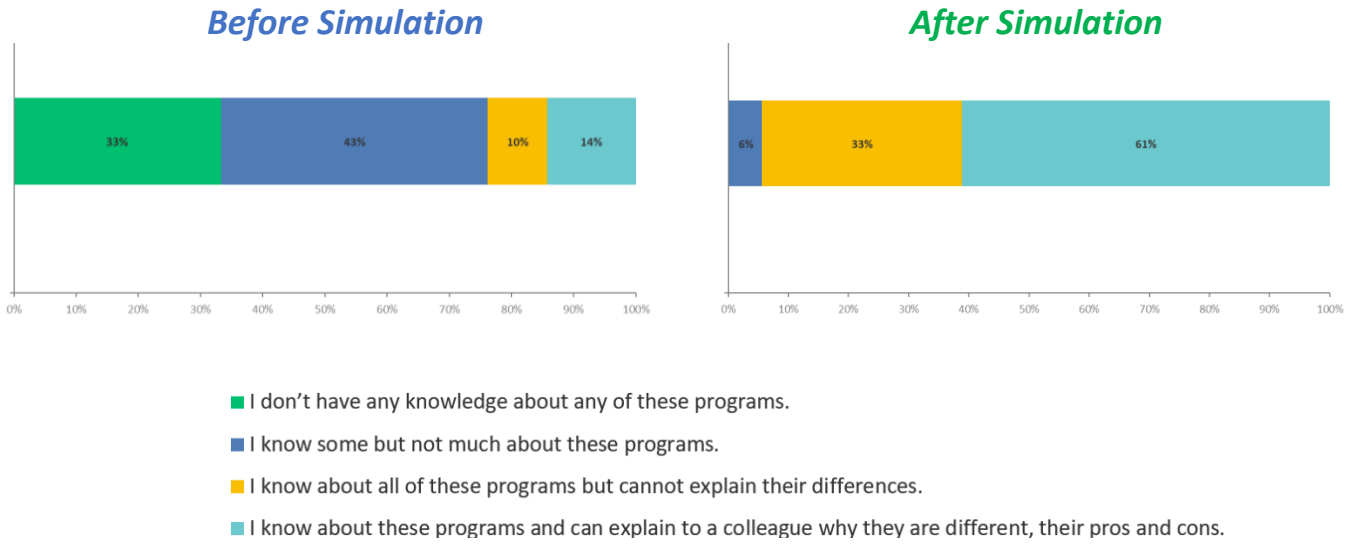
Figure 12. To what degree do you agree with the following statement? I know what "carbon pricing" is and I can name one or more regions with existing carbon pricing system.



As shown in Figure 12 above, participants improved their knowledge about "carbon pricing." Before the training 43% said did not know anything about carbon pricing and 19% reported that they know about carbon pricing but cold not name any examples.

After the training the number of participants reporting no or little knowledge about carbon pricing dropped to zero (an absolute drop of 43% and 19%, respectively). Further, the number of participants that reported knowing what carbon pricing is and also (a) having an ability to name one or two examples or (b) being able to explain them to a colleague grew from 14% to 50% and 24% to 50%, respectively.

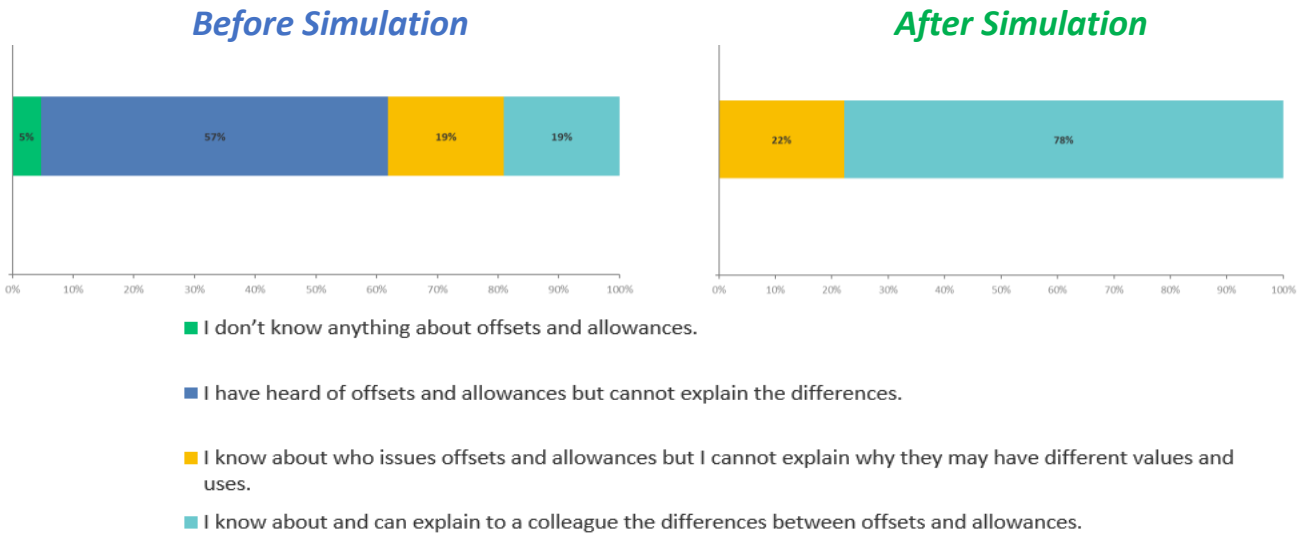
Figure 13. Can you explain the fundamental differences between an Emissions Trading System (ETS), the voluntary carbon market (VCM), the compliance carbon market, a carbon tax, and the renewable energy certificate (REC) market?



Judging from pre- and post-exercise survey results in Figure 13 above, participants substantially improved their knowledge about emissions trading terms and related concepts – the differences between an ETS and the voluntary carbon market (VCM), the compliance market, a carbon tax, and the renewable energy credit (REC) market. Before the exercise 33% said that they had no knowledge about these programs, 43% had some but not much knowledge, 10% knew about but could not explain the differences, and only 14% said that they knew about the programs and could explain to a colleague as to how they are different and their pros and cons.

After the exercise the number of participants that said they had no knowledge was 0% (an absolute reduction of 33%) and 6% said they did not know much about these programs (an absolute drop of 37%). Further the number of participants that knew about the programs but could not explain their differences grew to 33% (an absolute increase of 23%) and the number that replied that they knew about and could explain the differences and pros and cons to a colleague grew to 61% (an absolute increase of 47%).

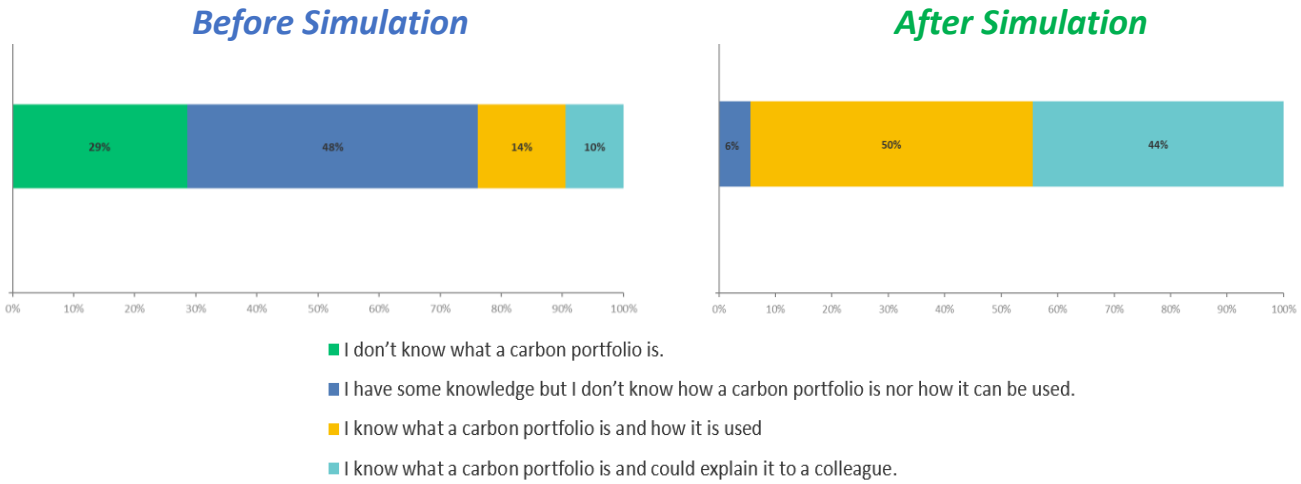
Figure 14. Describe your understanding of offsets and emission allowances.



As shown in Figure 14 above, the exercise increased participant's understanding of offsets and allowances. Before the exercise 5% said they do not know anything about offsets and allowances, 57% said they have heard about offsets and allowances but could not explain their differences, 19% said knew who issues offsets and allowances but could not explain why they may have different values and uses, and a further 19% said that they know about offsets and allowances and can explain to a colleague the differences between both.

After the exercise the number of participants who reported knowing nothing about offsets and allowances dropped to 0% (an absolute decrease of 5%) and the number reporting that they have heard about offsets and allowances but could not explain the differences dropped to 0% (an absolute drop of 57%). Further, the number of participants that said that they know who issues offsets and allowances but could not explain their differences grew from 19% to 22% (an absolute increase of 3%) and the number of participants who said that they know about and can explain to a colleague the differences between offsets and allowances grew from 19% to 78% (an absolute increase of 58%).

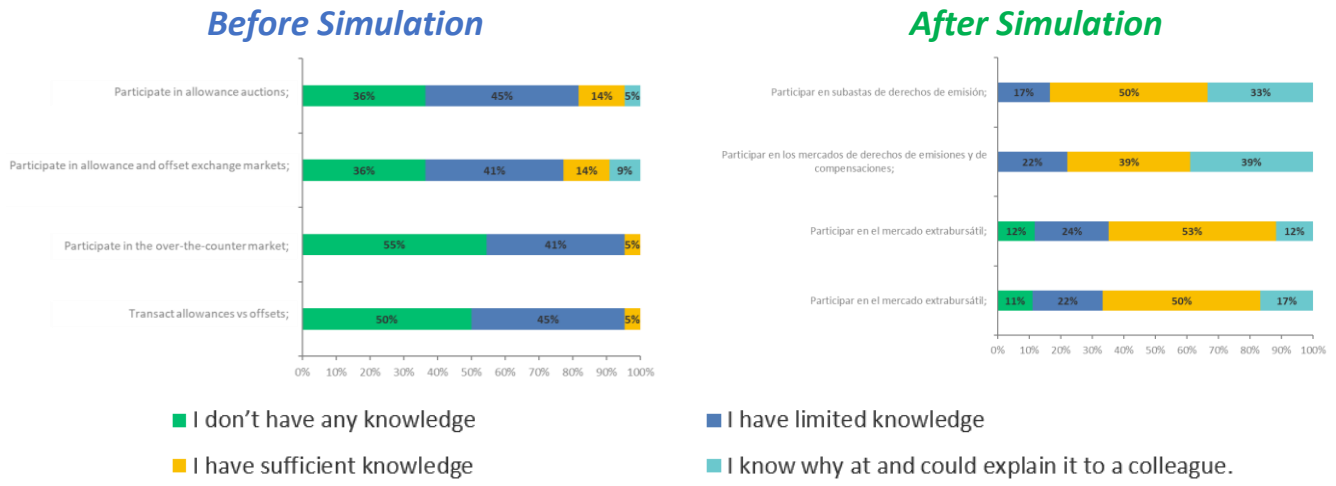
Figure 15. Could you explain the purpose of a carbon portfolio management strategy?



As illustrated in Figure 15 above, the exercise increased participant knowledge about carbon portfolio management. Before the exerise 78% reported that they either did not know what a carbon portfolio is (29%) or had some knowledge but did not know how it can be used (48%). A further 24% said that they knew what it is and how it can be used (14%) and could explain it to a colleague (10%).

After the exercise the percent that reported that either did not know what a carbon portfolio is dropped to 0% (an absolute decrease of 29%) and the percent that said they had some knowledge but did not know how it can be used was 6% (an abosolute decrease of 42%). Also, the percent of participants reporting they knew what a carbon portfolio is and how it can be used grew from 14% to 50% (an absolute increase of 36%) and the number that reported that they could explain the concept to a collegue grew from 10% to 44% (an absolute increase of 34%).

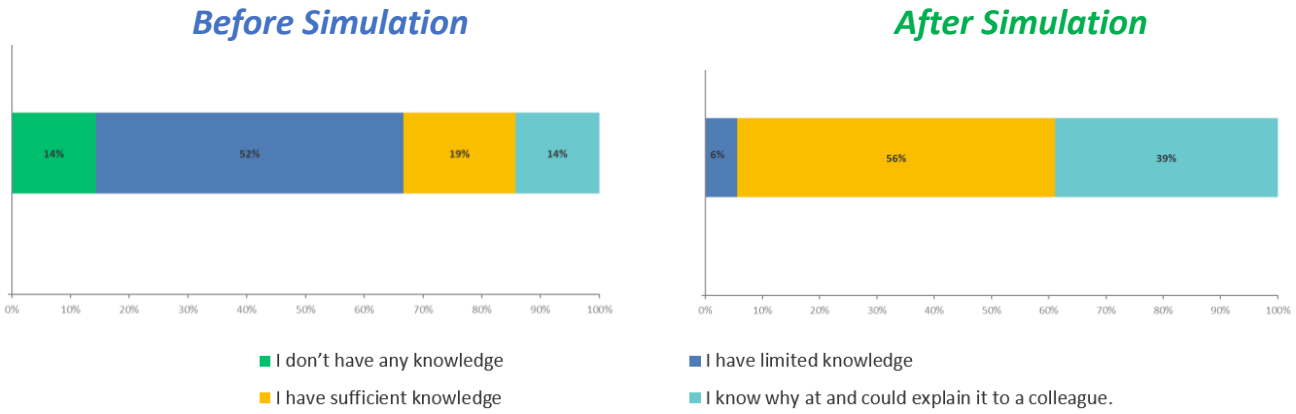
Figure 16. To manage a company's compliance and carbon portfolio do you understand the functions, the differences between, and why a facility may elect to:



As shown in Figure 16 above, the exercise increased participant's knowledge about why companies may want to participate in auctions, exchanges, the OTC market, and the differences between allowances and offsets. Before the exercise the percent reporting that had no or limited knowledge was 81% for auctions, 77% for exchange markets, 96% for OTC markets, and 95% for transacting allowances and offsets. And the percent that reported that they either had limited knowledage or could explain the concept to a colleague was 19% for auctions, 25% for exchanges, 5% for the OTC market, and 5% for allowances and offsets.

After the exercise the number reporting that they had no or limited knowledge about auctions, the exchange, the OTC, and allowances and offsets dropped from 35% to 17% (auctions), 36% to 22% (exchanges), from 55% to 36% (OTC), and from 50% to 33% (allowances and offsets), respectively. Further, the percent reporting that they had sufficient knowledge and those that could also explain it to a colleague increased from 5% to 83% (auctions), from 9% to 78% (exchanges), from 5% to 65% (OTC), and from 5% to 67% (allowances and offsets).

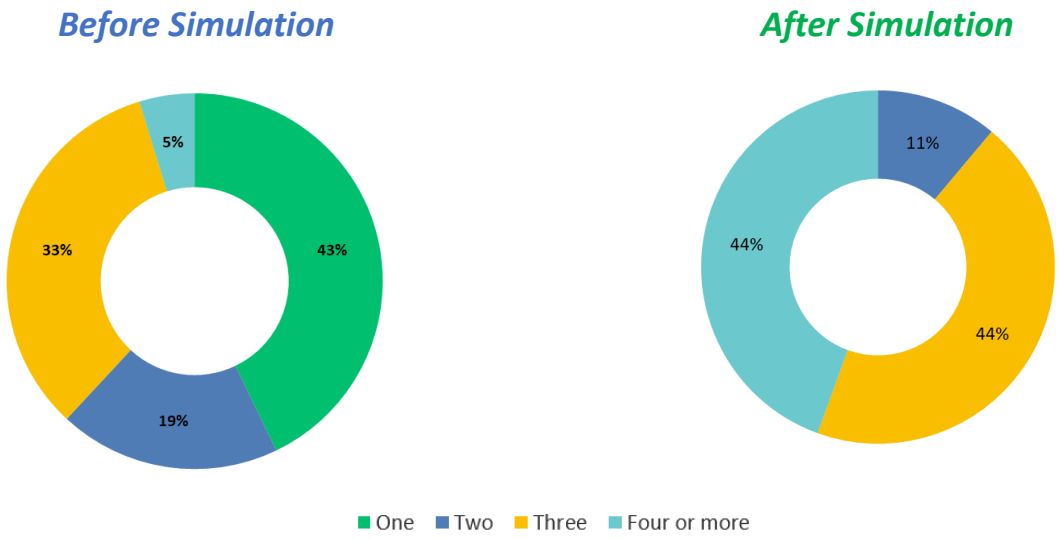
Figure 17. Do you understand why and how the design of an ETS can affect a region's ability to reduce emissions, do so in a cost-effective fashion, while also supporting near- and long-term climate objectives?



As summarized in Figure 17 above, the exercise served to increase participant understanding of how the design of an ETS can affect a jurisdiction's ability to reduce emissions, in a cost-efficient fashion, and while supporting near- and long-term climate objectives. Before the exercise 66% reported that they had no (14%) or limited knowledge (52%) about this topic. And 35% reported that they had sufficient knowledge (19%) or could explain the concept to a colleague (14%).

After the training, the number of participants that reported that they had no knowledge or limited knowledge dropped to from 14% to 0% and from 52% to 6%, respectively. And the number that reported having sufficient knowledge or an ability to to explain the concepts to a colleague increased from 19% to 56% and from 14% to 39%, respectively – an absolute increase of 37% and 25%, respectively.

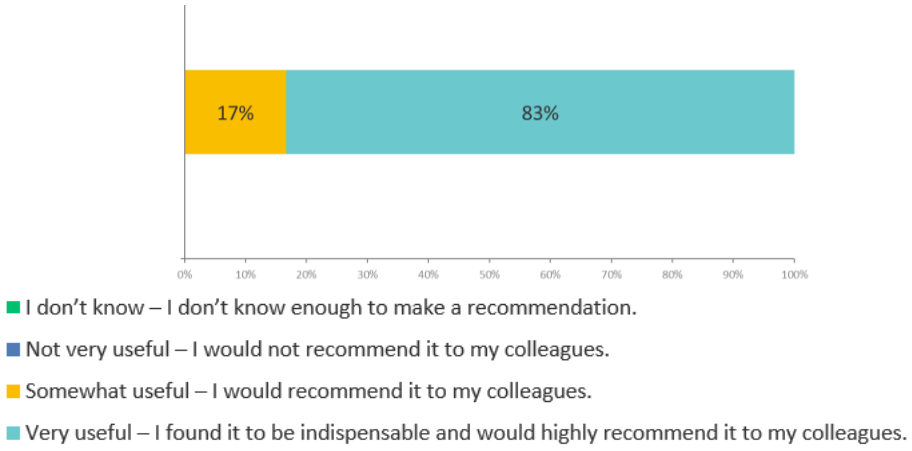
Figure 18. How many factors can you name that would increase (or reduce) the efficacy of an ETS?



As show in Figure 18 above, the exercise increased participant knowledge of the number of design factors that can increase the efficacy of an ETS. Before the simulation, some 62% believed that one (43%) or two (19%) could affect the efficacy of an ETS. Further, 38% believed that three (33%) or four (5%) factors could affect the efficacy of an ETS.

After the simulation, some 88% believed that three (44%) or four (44%) design factors could affect the efficacy of an ETS – an absolute increase from 11% (from 33% to 44%) and 39% (from 5% to 44%) respectively.

Figure 19. Do you think this simulation and training was helpful and a good use of your time?



Reflecting on the workshop, as shown in Figure 19, after the exercise 100% of participants reported that they would recommend it to their colleagues. Some 83% reported that they found the two-day event was indispensible and 17% said that the event was somewhat useful.

Figure 20. Offer a word, a short phrase, or a sentence that describes your feelings about this session.

As a final request, participants were asked to offer a word, phrase, or sentance that describes their feelings about the two day event. Figure 20 provides a word cloud, which is a textual data visualization that allows the

reader to see at a glance the words that are the most frequently used by participants to describe the session. The larger – and darker-colored – words were those that were more frequently repeated.

In addition, the following phrases were shared by a selection of participants:

- *"Carbon Markets are required to reduce GHG emissions."*
- *"Excellent. I have acquired valuable knowledge for myself and my country."*
- *"It is a tool of great utility to achieve climate goals."*

The information, and that provided in Figures 10 - 20, support the conclusion that the training delivered on the stated objectives and was positively received by the participants.

6.0 SIMULATION TOOL DESCRIPTION AND RESULTS

This section of the report describes the CarbonSim tool and provides screen shots of the results of the second six virtual year simulation of the competitive exercise that was run on day two.

CarbonSim is an artificial Intelligence-enhanced, multi-lingual, multi-user, carbon trading simulation game. Developed and owned by the Environmental Defense Fund, CarbonSim brings markets to life, teaches the principles of emissions trading, demystifies how to develop, and implement a carbon portfolio management strategy, and demonstrates that results are driven by design.

In a typical CarbonSim session, participants manage virtual companies that are faced with an ETS-related compliance mandate and to do so at the lowest possible cost. In the simulated carbon market, virtual companies from different industrial sectors manage carbon portfolios where they can reduce emissions using abatements (including efficiency improvements, process changes, fuel switches, or emissions controls) that are relevant to their sectors. Players can also participate in government-sponsored allowance auctions, exchanges, or OTC markets. Two different products can be traded – government issued allowances and private sector-created offsets. Both abatements and market-related options have different capital requirements, liquidities, and potential financial returns.

For this project each simulation exercise was run for a prescribed amount of time (typically about three hours) and consisted of a cap and trade/CarbonSim 101 tutorial followed by three or sixvirtual years and a lessons-learned/practical implications discussion. As the simulation progressed participants:

- Came to see how they are performing – both individually, in comparison to their colleagues, and as part of a system.
- Gained a better understanding of the unique characteristics, risks, and opportunities that are the hallmarks of emissions trading systems.
- Were exposed to some fundamentals of carbon portfolio management.
- Learned that environmental and economic outcomes are, in part, a function of design and administration choices.

In support of this project some customizations were made to CarbonSim. Most notably, the number of virtual years was adjusted and fictitious Dominican Republic sounding enterprise names were included. Participants were able to play the game in Spanish in addition to eight other languages. A selection of screen shots from the version used by participants are provided in Figures 21 through 30.

Figure 21. CarbonSim splash screen

Figure 22. CarbonSim login/registration

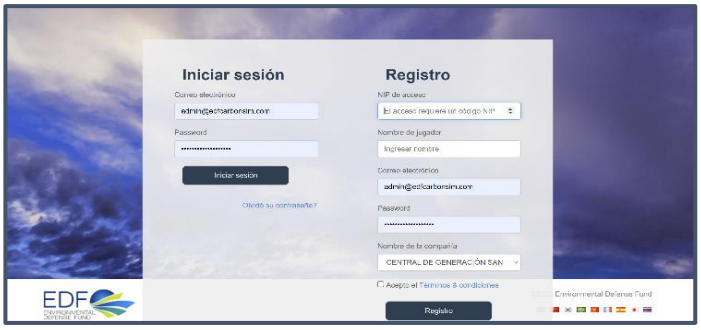


Figure 23. CarbonSim player dashboard

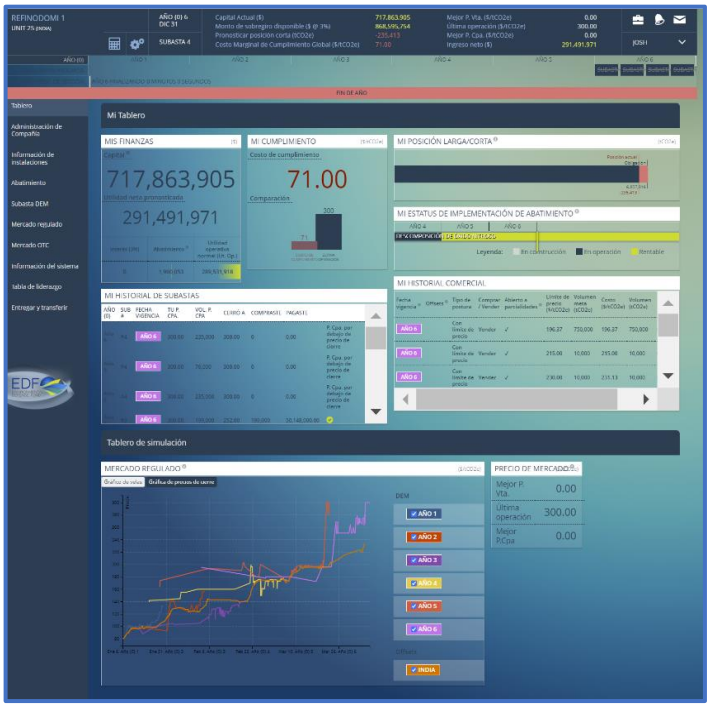


Figure 24. CarbonSim abatement screen

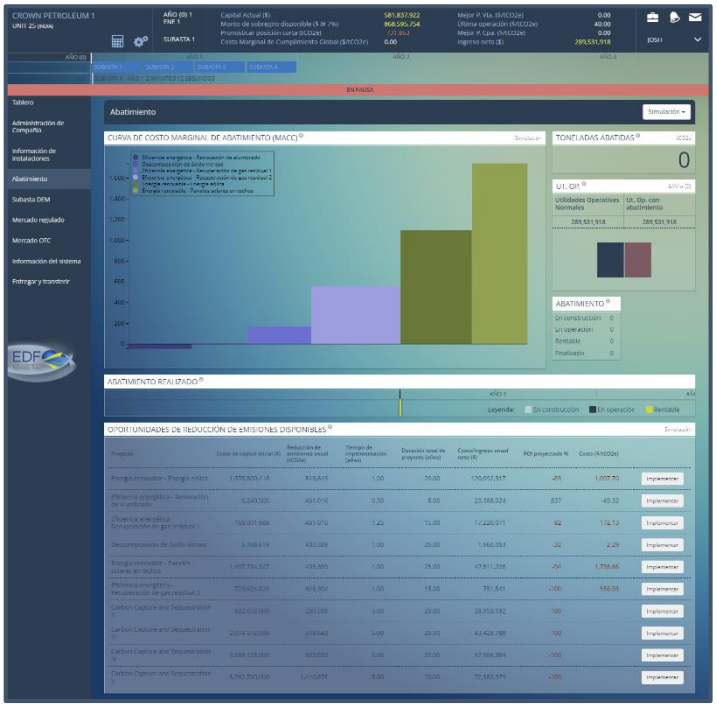


Figure 25. CarbonSim auction order screen

Figure 26. CarbonSim auction results screen

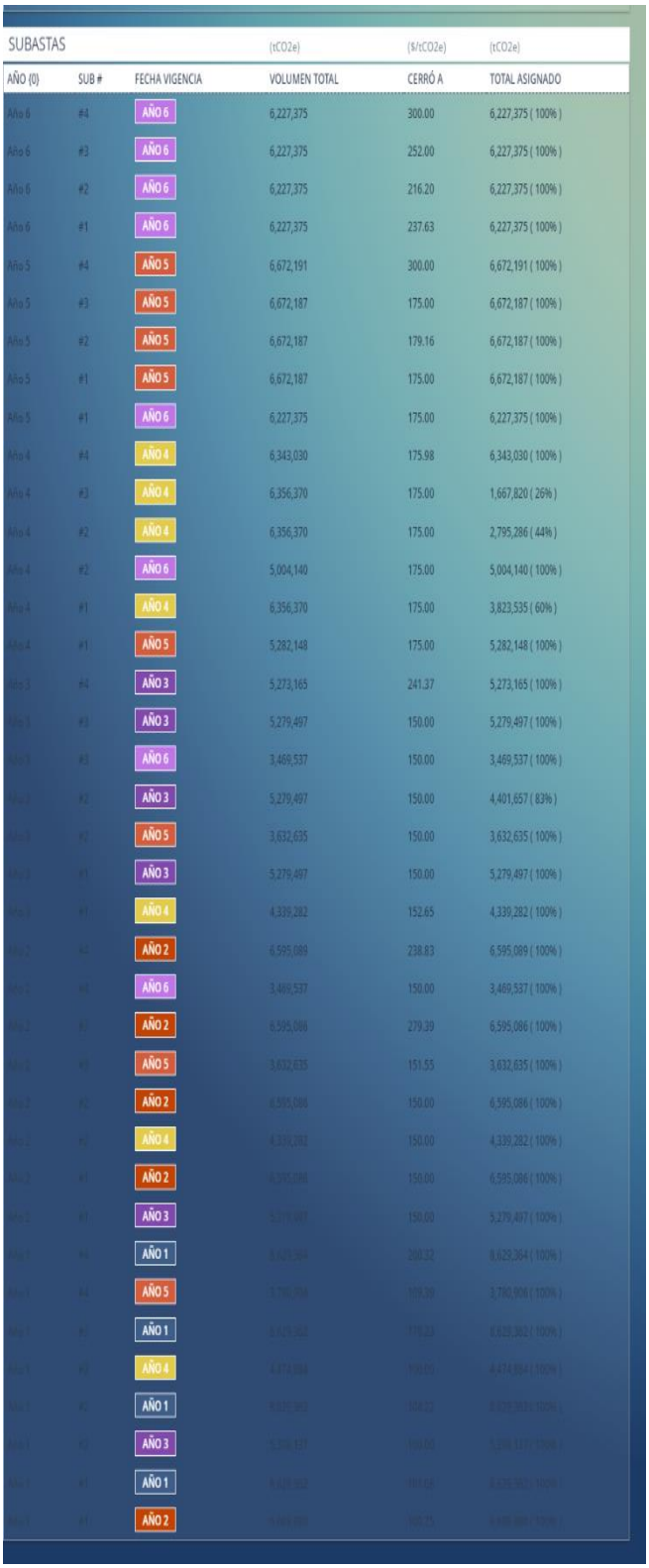


Figure 27. CarbonSim exchange results screen

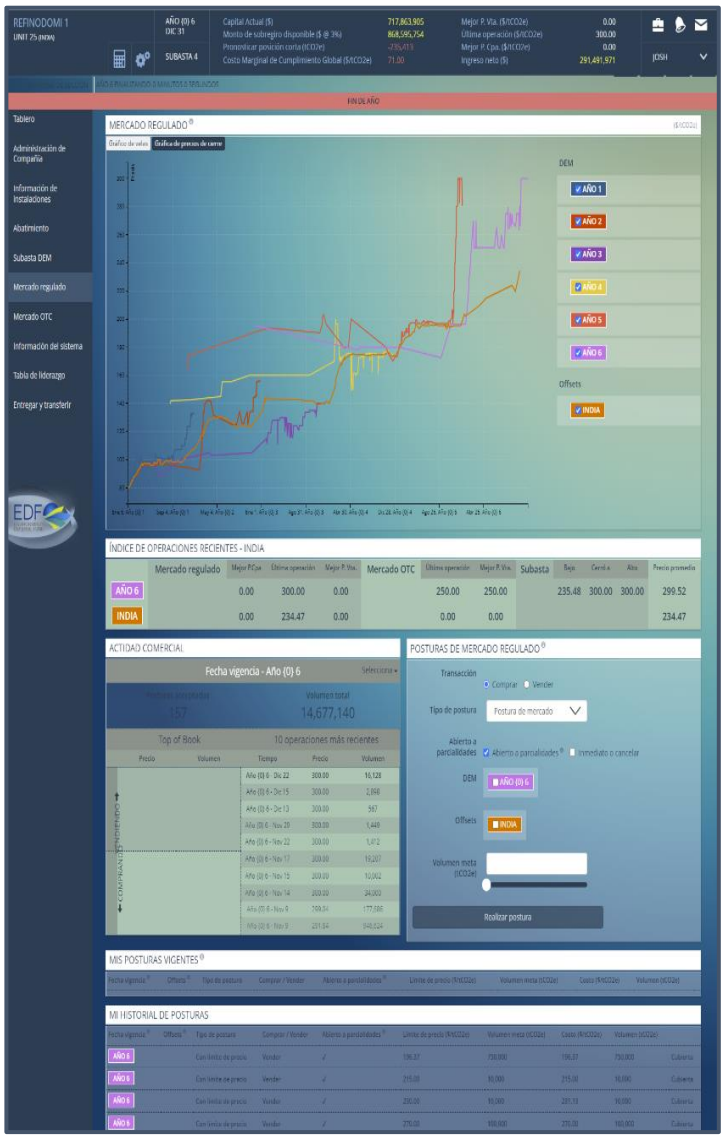


Figure 28. CarbonSim OTC screen

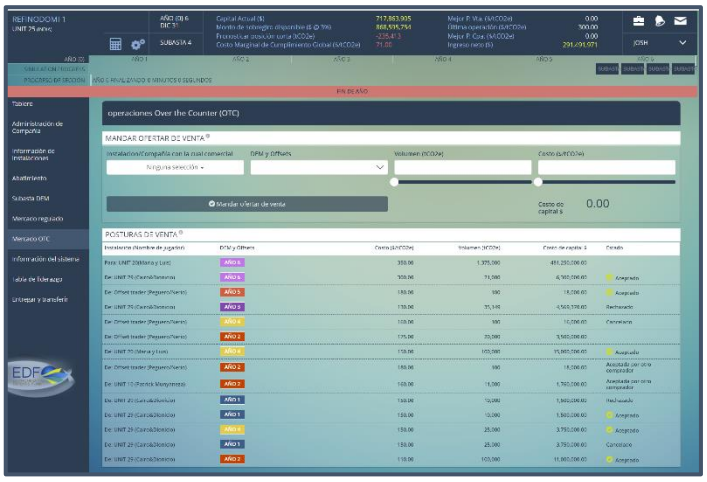
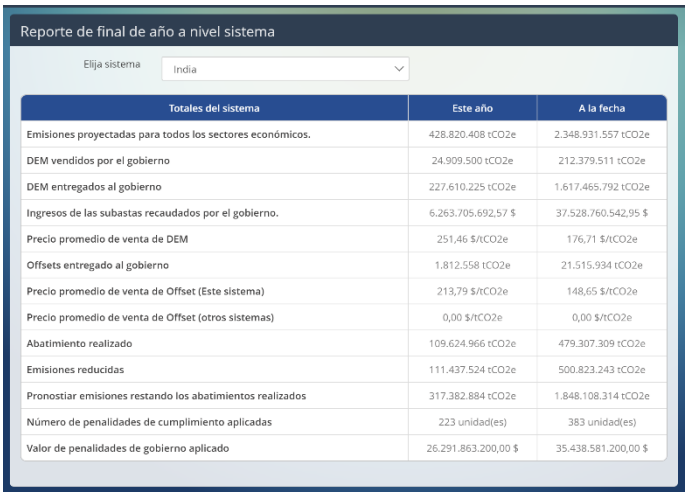


Figure 29. CarbonSim end of simulation system results



Reporte de final de año a nivel sistema

Elija sistema: India

Totales del sistema	Este año	A la fecha
Emisiones proyectadas para todos los sectores económicos.	428.820.408 tCO2e	2.348.931.557 tCO2e
DEM vendidos por el gobierno	24.909.500 tCO2e	212.379.511 tCO2e
DEM entregados al gobierno	227.610.225 tCO2e	1.617.465.792 tCO2e
Ingresos de las subastas recaudados por el gobierno.	6.263.705.692,57 $	37.528.760.542,95 $
Precio promedio de venta de DEM	251,46 $/tCO2e	176,71 $/tCO2e
Offsets entregado al gobierno	1.812.558 tCO2e	21.515.934 tCO2e
Precio promedio de venta de Offset (Este sistema)	213,79 $/tCO2e	148,65 $/tCO2e
Precio promedio de venta de Offset (otros sistemas)	0,00 $/tCO2e	0,00 $/tCO2e
Abatimiento realizado	109.624.966 tCO2e	479.307.309 tCO2e
Emisiones reducidas	111.437.524 tCO2e	500.823.243 tCO2e
Pronostiar emisiones restando los abatimientos realizados	317.382.884 tCO2e	1.848.108.314 tCO2e
Número de penalidades de cumplimiento aplicadas	223 unidad(es)	383 unidad(es)
Valor de penalidades de gobierno aplicado	26.291.863.200,00 $	35.438.581.200,00 $

Figure 30. CarbonSim end of simulation leaderboard (portion)

abla de lidergazo año 6

Año actual | Global

Rango	Compañía	Nombre de instalación (Jugador)	Costo Marginal de Cumplimiento Global ($/tCO2e)	Posición larga/corta final (tCO2e)
1	INDIA NATIONAL BANK		-$3.222.543.055,10	0
2	CENTRAL ELÉCTRICA LA ESPANOLA 4		-$27,95	0
3	ELECTRICIDAD DE BARAHONA		4,08 $	-19.120
4	ACERO DOMINICANA		11,10 $	0
5	GAS DE ESPANIOLA		17,14 $	-64.771
6	CENTRAL ELÉCTRICA LA ESPANOLA 2		17,16 $	-324.158
7	VALVERDE ELEC		18,17 $	0
8	MONTE CRISTI ELEC		18,91 $	-12.562
9	CENTRAL DE GENERACIÓN PUNTA CANA		21,13 $	0
10	HATO MAYOR ELEC		21,63 $	-7.847
11	CIMENTOS DOMINICANA		21,94 $	0
12	SANTO DOMINGO POWER PLANT 2		22,48 $	-197.867
13	EMPRESA DE GAS DEPERAVIA		22,82 $	-82.962
14	ELECTROGAS DOMINICANA		22,83 $	-37.429
15	L&R POWER		24,87 $	-94.521
16	CENTRAL ELÉCTRICA LA ESPANOLA 1		25,08 $	-2.412.893
17	HIDROELÉCTRICA DOMINICANA, S.A 1		25,40 $	-426.609
18	HIDROELÉCTRICA DOMINICANA, S.A 2		25,63 $	-77.693

Figure 30. CarbonSim end of simulation leaderboard (continued)

19	EMPRESA DE ELECTRICIDAD EMISSIONES CERO	UNIT 14 (Robot)	25,88 $	-301.305
20	SANTO DOMINGO POWER PLANT 3	UNIT 37 (Robot)	26,41 $	-673.303
21	DOMINICANELEC	UNIT 3 (Robot)	27,46 $	-1.145.749
22	CENTRAL DE GENERACIÓN PUNTA CANA	UNIT 22 (Nelly Cuello)	27,95 $	0
23	EMPRESA NACIONAL PETROLIFERA	UNIT 29 (Cairo&Dionicio)	28,27 $	0
24	CENTRAL ELÉCTRICA LA ESPANOLA 3	UNIT 17 (Robot)	28,95 $	-4.301.757
25	ELECTRO DOMINICANA, S.A.	UNIT 1 (Robot)	28,98 $	-266.492
26	SANTO DOMINGO POWER PLANT 1	UNIT 35 (Gonzalez Ortiz)	30,15 $	-5.802.248
27	CENTRAL DE GENERACIÓN SAN JUAN	UNIT 28 (Robot)	32,41 $	-112.663
28	PUNTA CANA POWER PLANT	UNIT 20 (Maria y Luis)	33,60 $	-1.357.646
29	SANTO DOMINGO POWER PLANT 4	UNIT 38 (Robot)	35,86 $	-85.951
30	SP ELECTRIC	UNIT 8 (Robot)	36,68 $	-3.729.375
31	HIDROELÉCTRICA DOMINICANA, S.A 3	UNIT 13 (Robot)	37,44 $	-14.621
32	REFINODOMI 2	UNIT 26 (Robot)	39,74 $	-2.140.449
33	DOMINICAN POWER	UNIT 9 (Robot)	40,41 $	0
34	BARAHONA ELEC	UNIT 30 (Radhames)	44,25 $	0
35	REFINODOMI 1	UNIT 25 (JOSH)	46,48 $	-235.413
36	CENTRAL TERMICA SAN JUAN	UNIT 19 (Robot)	57,78 $	-95.676
37	ELECTROGAS SANTO DOMINGO	UNIT 23 (Robot)	67,32 $	-1.121.214
38	LOS MINAS POWER PLANT	UNIT 5 (Robot)	74,66 $	-1.531.655
39	ELECDOMI, S.A.	UNIT 10 (Patrick Munyaneza)	96,46 $	-96.900

7.0 PROJECT OUTCOMES, LESSONS LEARNED, AND NEXT STEPS

This section summarizes the major outcomes of the project, adjustments that were made against the original plan, outlines some lessons that have been learned, and suggests potential next steps.

7.1 Project Outcomes

As the result of this effort ~40 ETS stakeholders were trained. Inclusive of the tutor training sessions a total of four simulations were run – two tutor training, one practice, and one competitive session.

Experiences provided through the simulations were augmented by lessons and discussions that were delivered through lectures that were delivered prior to the by several experts and officials..

Information gained through participant surveys – shown in Section 5.0, Figures 10 – 20, suggests that the training significantly improved participant's ETS literacy. It also brought together -- and stimulated discussions amongst representatives from three key sectors – in particular, policy makers that may be charged with developing and administering an ETS, managers of companies that may be subject to the ETS, and ETS service providers.. It is reasonable to conclude that there is a likelihood that such discussions will continue when the representatives return to their organizations as well as with each other in subsequent ETS-related venues.

As shown in Figure 10 there is a strong likelihood that the training resulted in an increased level of support for the implementation of an ETS in the Dominican Republic. Prior to the training, 71% said that an ETS would be 'very useful' or 'indispensable' for the Dominican Republic to meet its NDC. Post training this number grew to 95% -- an absolute increase of 24%.

As a result of the training there was an absolute increase of 24% of participants that said that an ETS would be 'very useful' or 'indispensable' for the Dominican Republic to meet its NDC. Further, 100% of participants reported that they would recommend it to their colleagues. Some 83% reported that they found the two-day event was indispensable and 17% said that the event was somewhat useful.

7.2 Project Adjustments

There was one adjustment that was made. Though not originally called for in the Letter Agreement the the Consultant agreed to include Dominican Republic sounding fictitious sounding names. Owing to careful scoping, planning, and execution adjustments, all deliverables were successfully completed and, as gauged by the survey, project objectives were met, and participants were pleased with the outcome.

7.3 Participant Lessons Learned

Participants learned several lessons as the result of their participation in the practice and competitive simulations. Participants did well if they:

- **Evaluated options and markets before acting**. First reflected on all their options (abatement, auction, exchange, and OTC) before seeking to resolve their long-short position.
- **Abate early in the simulation.** Cost-effective abatements should be implemented as soon as possible (in year 1) because it takes time to build and gain the benefits (measured in reduced emissions/obligations and cost savings).
- **Evaluate key abatement factors before selecting.** Participants did better if, before selecting an abatement option, they evaluated the cost -- both capital and operating -- and returns and the time required for implementation.
- **Comply every year.** Each year, players must acquire appropriate vintage allowances/offsets in an amount that is equal to its emissions. Those players that do not comply may reduce their costs but cannot win.
- **Manage (reduce) cost of control.** Participants should focus on using abatements and the market to reduce costs. Abatements should be used with they can be implemented at a cost lower than through the acquisition of allowances or offsets. Likewise, participants should avail themselves of the primary and secondary markets when compliance can be achieved at a cost that is markedly less than that which can be achieved through the installation of abatements.
- **Don't use too many abatements.** While it may be possible to fully abatement/eliminate all emissions it will be very expensive and likely impossible to win (i.e., complying at the lowest cost). Generally, for three to six year simulations, players should use between one and three abatements.
- **Factor in liquidity before acting.** Participants did better if they understood that allowances and offsets, unlike abatements, are liquid. In other words, once implemented abatements cannot be "unimplemented" and, as compared to allowances and offsets, such costs cannot be easily recovered.
- **Participate in all markets.** Because prices, supply, and demand are different in every market and change throughout the sim it's imperative that players should monitor and engage in all markets as appropriate.
- **Manage 'long' / 'short' positions.** Remembering that the goal is to minimize costs. So, while compliance is the #1 goal, doing so at the least possible cost is the #2 goal. One way to do that is to go long (overcontrol and/or buy more allownances and/or offsets than are needed) when prices are low and sell or later use the surplus when the prices are higher.
- **Understand that orders are good until cancelled.** To avoid sudden end of year long or short positions participants should continuously review outstanding and unfilled orders and cancel them as appropriate when the proper carbon portfolio is achieved.
- **Avoid keyboard errors**. To reduce the chances of making costly mistakes participants should understand and seek to avoid keyboard errors – for example entering a 'buy' order when they meant to enter a 'sell' order (and visa versa).

- **Be patient and don't wait until the last minute to enter an order**. Because the software is not financial grade – and because of potentially unstable/unreliable WiFi service – participants should allow the system plenty of time to respond to commands.

- **Look for market signals before acting.** For example, to get a better sense of the market – and avoid overpaying or underselling the market -- participants did better if they waited for the outcome of the first auction rather than relying entirely on the secondary market to resolve the initial/beginning of the year shortfalls.

- **Be selective when entering and executing orders.** Understand that some bids and offers should be rejected because they are well below or above the market and/or that which may be prudent.

- **Learn how to use – and give preference to -- limit orders.** When accessing and using the exchange, especially in volatile markets, participants were better able to control their costs if they used limit rather than market orders.

- **Be more circumspect when accessing the OTC market.** Participants were able to avoid transacting outside the market – i.e., buying at prices above the auction clearing price and/or paying higher prices than those offered/accepting lower prices than those bid through the exchange – if they carefully reviewed posted OTC offers and verbal bids and compared such orders against other markets (i.e., those in the auction and the exchange) before transacting.

- **Look for – and take advantage of – arbitrage opportunities.** Because prices differ in different markets players may find opportunities to transact at substantially more favorable prices in one market as compared to another.

Participants also learned several lessons that are applicable to those that may develop and administer an ETS, including the following:

- **ETS design, decisions made by the ETS administrator, and capacity building efforts, will likely have an impact on the expected environmental and economic outcomes.** This is particularly true in the context of the following parameters:

    - **Auction floor price**, which in the later years of the simulation tend to be more than average exchange prices, prompted most participants to make the economically prudent decision of abandoning the auction.
    - **Rate of cap reduction**, which, though aggressively progressive, was increasingly manageable as the simulation progressed.
    - **Compliance rate**, which improved over time as players gained more experience with both CarbonSim and the basics of carbon portfolio management.
    - **Market design and monitoring**, to discourage and watch for behaviors that are intended to manipulate the market in a fashion that is inconsistent with the underlying goals of the ETS.
    - **Government revenue generation**, through auctions and fines, which provides elected officials with a means to deliver meaningful benefits to the public.

    - **Sudden ETS rule changes**, which because they were unanticipated represent shocks that have the consequences of increasing risk, disrupting the market, and discouraging participants from relying too heavily on the market.
    - **ETS duration**, which, because it was finite, prompted players to:
        - Avoid abatements that took longer to implement and
        - Liquidate allowances and offsets at prices that were likely below those that may have been spent to purchase them.

- **Capacity building, through efforts such as these simulations, serve to improve participant's ETS literacy, ability to advocate for ETS design features that serve their interests, provide a riskless opportunity to make and learn from mistakes.**

- When reflecting on the lessons learned from this simulation it is important to **consider the very real differences between a real carbon market and that which participants experienced here**. Consider that the simulations described herein:

    - Are imperfect, simplified models of real-life. Important factors that would affect a real market are not reflected in this kind of a simulation.
    - Did not include a futures market nor any other risk hedging instruments.
    - Provided participants with a generous budget and no oversight, approval, nor staff (engineering, accounting, legal, etc.) to assist in (or encumber/act as a check on) the decision-making process.
    - Greatly simplified the abatement implementation and decision-making process.
    - Ran for only three or six years and thus discouraged investments (particularly for abatements) that would normally be prudent over a longer time period.
    - Generally showed a progressive under-subscription (and lowering of revenues generated) in the auction market -- something that is directly tied to the limited duration of the simulation.
    - Did not accurately reflect the impact of non-ETS drivers such as fuel subsidies, disparate sectoral economic growth rates.
    - Allowed (and encouraged) participants to make mistakes -- that resulted in no material consequence to themselves or their companies -- to learn from such mistakes, and to take stock of lessons learned to develop and deploy different strategies.
    - Involved the use of fictitious companies, abatements, budgets, and circumstances such that the costs evident in the simulation should not be interpreted as an indicator of what may happen in a real market.

Because of all the above factors, simulations should not be used simultaneously to train participants and predict how an ETS will play out in real life.

7.4 Recommendations and Next Steps

The following recommendations and potential next steps are offered:

- **Consider engaging those sectors that are most likely to criticize and/or pushback an ETS implementation (such as the most polluting sectors).** A capacity building initiative with a

simulated market and fictitious information is a risk-free situation that can be used to engage, and overcome objections from, those stakeholders and encourage such stakeholders to participate in policy discussions.

- **Consider trainings that are tailored to different levels of complexity and previous knowledge of participants.** In this project participants started with different levels of understanding. Those who knew most pushed to move faster and to more complex issues while the balance of participants still needed basic training and spending more time on understanding concepts and terminology before going into more advanced topics. To better tailor a training to meet participant interests and needs consideration could be taken into grouping participants on their level of previous knowledge.

- **Broaden the type and number of stakeholders involved in simulations.** Though successful this simulation largely involved entities that are likely to be regulated by an ETS and/or service providers. A case can be made to engage three different kinds of participants:

    - Involving those from **different departments** -- from legal, accounting, risk, procurement, and public relations -- will allow for regulated companies to gain a more holistic view of how an ETS can affect their operations. This will, in turn, contribute to a more thoughtful engagement in the policy development process and better prepare them for the realities of an ETS.
    - Inviting those that may be expected **to write the rules for and/or administer an ETS** will provide such individuals with a sensitivity that they may not otherwise have and may, in turn, provide them with insights that result in better policy making.
    - For similar reasons, efforts could be made to **engage civil society members** that may be expected to participate in the policy development process and/or provide on-going programmatic reviews. Their participation in simulations will help them understand how design affects outcomes, why it is in society's interests to provide industry with certainty and investment incentives, how air quality and co-benefit gains can be best secured, and of the need for transparency that allows them to evaluate the performance of both those that are subject to as well as those that administer an ETS.
    - Recognizing both the extraordinary stakes involved and the duration of their ability to affect/be affected by climate policy, training exercises should be delivered to university students, particularly those focused on sustainability, environmental studies, climate policy, climate finance, and business.

- **Consider running simulations that are paired with more intensive training on key topics** – perhaps including offset generation, emission offset protocol development, inventory development, MRV, auction design, the use of derivatives, etc. Doing so may serve multiple purposes including drawing in additional participants, better informing the policy discussions regarding different ETS parameters, as well as to identify key ETS elements that merit further consideration before/as an ETS program is launched.

- To **promote regional ETSs, Caribbean and Latin American countries** -- including Mexico, Chile, Colombia, and Brazil – consider inviting like-minded national and sub-national jurisdictions to participate in joint simulations. Engaging in such efforts can provide stakeholders -- those from industry, civil society, the public, and the government -- with the opportunity to learn together, compare notes, and advocate for policies that serve the interests of the sectors, the countries, and the region.

- To **promote constructive conversations consider working to ensure that future capacity building efforts involve stakeholders from diverse backgrounds**. This may lessen barriers to communication, contribute to a better appreciation of opposing viewpoints, contribute to richer and more meaningful discussions, encourage participants to seek outcome-rich design elements, and lessen opposition to -- and perhaps speed the adoption of -- an ETS.

- **Run additional simulations throughout the policy making process.** Doing so will provide stakeholders with the opportunity to improve their ETS literacy of the participating stakeholders and provide an opportunity to learn that ETS outcomes are a function of design. This will, in turn, gradually improve the quality of the discussions and highlight areas that merit further exploration (through simulations and/or more detailed analysis). And there is a reasonable likelihood that such efforts may improve the quality of decisions that are made and reduce stakeholder opposition to an ETS -- especially when such opposition is based on an incomplete understanding of the component parts of an ETS.

- **Run simulations over a longer period of virtual time.** For a variety of reasons, the simulations run for this project were limited to three to six virtual years. Savvy participants, as a result, elected to only implement abatements with very short-term paybacks and/or severely discounted allowances and offsets that could have been used for compliance obligations in later years. When simulations are run over a longer time period -- *ceteris paribus* -- participants will: (a) implement more abatements; (b) rely upon such abatements to a greater degree to achieve compliance; (c) not steeply discount the value of creating and holding allowances and offsets that they would have sold at fire sale prices in a shorter term simulation; (d) rely less upon offsets; and (e) take a more reflective/less reactive approach -- one that may well involve interactions with others within their organizations.

- **Run simulations in controlled settings, in addition to the uncontrolled simulations for capacity-building purposes.** In running these sorts of simulations, care should be taken when attempting to deduce the impact of differing policy designs from simulations that involve untrained stakeholders in these sorts of circumstances. As compared to actual market participants their real-world counterparts, simulation participants are much more likely to take outsize risks and/or engage in what may be considered, in real life, fiscally imprudent behavior. As such, researchers should be extremely cautious when using simulation results as a predictor for that which may occur in real life. However, if conducted in a controlled fashion -- either with sophisticated artificial intelligent driven bots and/or humans operating under strict protocols -- such simulation runs can provide results that help policymakers: (a) understand how

participants react when faced with different market designs; and (b) develop methods and/or policies that serve to promote, or guard against, certain behaviors.

- **Run simulations designed to examine the effects of a greater number of alternative scenarios** (e.g., methods of allocations using, for example, benchmarking and grandfathering), potentially further tailored to the Dominican context. Those of primary interest may be those associated with the:

    - Use and potential interaction with carbon taxes.
    - Alternative approaches to treating offsets.
    - Impact of the co-benefits of emissions trading.
    - Consideration of other climate, energy, or fiscal policies.
    - International carbon markets -- in particular, those associated with aviation, shipping, and/or linking with other Caribbean and Latin American countries (e.g., Mexico, Colombia, Chile, and Brazil), other regions (e.g., sub-nationals that participate in the Western Climate Initiative [e.g., California, Quebec], Washington State, the Regional Greenhouse Gas Initiative, or the European Union's Emissions Trading System).
    - Inclusion in the simulation of risk-hedging instruments like futures contracts.
    - interactions with others within their organizations.

- In light of the fact that the Dominican Republic has limited temporal and financial resources, act under the presumption that such capacity building efforts will be most successful if they have a primary goal of **encouraging participants to work towards an ETS that enables emitters to achieve necessary and timely reductions in the most cost-effective fashion with the most co-benefits.**

ANNEX: SIMULATION EXERCISE AGENDA

Ejercicio de simulación del Sistema de Comercio de Emisiones
Emissions Trading Scheme: Simulation Exercise

Practical Information

- **Date**: Tuesday, 26 September 2023 and Wednesday, 27 September 2023
- **Venue**: Hotel El Embajador. Av. Sarasota 65, Bella Vista | Santo Domingo, República Dominicana.

Agenda

Day 1 - Tuesday, 26 September 2023	
Time	**Topic**
08:00 08:30	• Registration and coffee
08:30 09:00	• Welcome Remarks • Workshop Activity • Survey
09:00 09:30	• Carbon Pricing. A climate change instrument. • ETS. An overview
09:30 10:30	• ETS Critical Elements. An Overview • Roadmap for the implementation of ETS in DR
10:30 10:45	**Coffee Break**
10:45 11:30	• Group Discussion
11:30 12:30	• ETS Example (Mexico ETS set up)
12:30 13:30	**Lunch**
12:30 16:45	• Workshop Activity • CarbonSim. An introduction • ETS Simulation

16:45 17:00	**Coffee Break**
17:00 17:05	• Closing Remarks

Day 2 – Wednesday, 27 September 2023	
Time	**Topic**
08:30 09:00	• Welcome • Day 2 Overview • Workshop Activity
09:00 10:00	• National MRV System
10:00 10:15	• **Coffee Break**
10:15 13:00	• CarbonSim. Competitive 6 years Simulation
13:00 14:00	• **Lunch**
14:00 15:30	• CarbonSim. Competitive 6 years Simulation
15:30 16:15	• Post Simulation Discussion
16:15 16:30	• **Coffee Break**
16:30 17:00	• Workshop Evaluation • Award Ceremony • Closing Remarks