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INDIAN CARBON MARKET SIMULATION TRAINING EXERCISE REPORT

JOSH MARGOLIS

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The author extends gratitude to the Environmental Defense Fund for providing project participants the opportunity to use CarbonSim.

Finally, recognition and thanks are due to those who participated in this exercise. Yes, these individuals gave generously of their time and gained valuable knowledge from these exercises. But they also demonstrated the understanding that their collective future will be shaped by their choices.

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EXECUTIVE SUMMARY

In February 2023, the Asia Society Policy Institute (ASPI) and the Council of Energy, Environment and Water (CEEW) – with the support of the International Emissions Trading Association – collaborated with the author of this report to deliver three carbon market simulation exercises in India that were run for the benefit of approximately **215 participants**. This report describes the results of that collaboration and includes the following findings, conclusions, and recommendations:

- The **purpose of the exercise** was to provide an intensive opportunity for key emissions trading system (ETS) stakeholders in India to increase their knowledge and experience of how an ETS is designed and works through practical in-person simulation workshop sessions and associated training presentations. This exercise was also intended to contribute to building support for the development of an ETS, generating "champions" in key stakeholder groups, and accelerating the development of an ETS in India.
- **Participants** included government officials and policymakers who are charged with developing and administering an emissions trading system as per India's Energy Conservation (Amendment) Bill, 2022, which lays the foundation for the Indian Carbon Market (ICM), emitting companies that may be subject to the requirements of ETS regulations that may be promulgated, ETS service providers, offset developers, and members of civil society. Participants were located in, had the responsibility for operations located proximate to, and/or had the ability to travel to the sites of the three exercises in New Delhi, Mumbai, and Ahmedabad.
- The training was **administered using the CarbonSim** software to three groups of participants who gathered for one day: approximately **80 participated in New Delhi, 70 in Mumbai, and 65 in Ahmedabad**. CarbonSim is a multiuser, multilingual, artificial intelligence–enhanced experiential learning tool that has been used by more than 3,500 ETS stakeholders. A total of three simulation exercises were run. At the end of each of the three-hour exercises, the top finishers – as measured by their compliance status and low marginal cost of control – were recognized and provided with nominal awards.
- **The goal of the effort – to foster ETS-related discussions and increase ETS literacy – was realized.** Coming into the simulation, although participants generally supported India's use of carbon markets, they appeared to have a rudimentary understanding of its component parts. As a result of the presentations, the simulation exercises, and conversations, participants markedly increased their understanding of how carbon markets can be designed and administered in order to help realize key environmental, economic, and social goals. All participants said that they either "learned something and it was a good use of their time" (31.8%) or that they "learned quite a bit and would recommend it to their colleagues" (68.2%).

All participants said that either they learned something and it was a good use of their time, or they learned quite a bit and would recommend it to their colleagues.

- As a result of the exercises, **participants learned a number of lessons**. Most notably, participants gained an understanding of the basic tenants of carbon portfolio management and came to appreciate that an ETS affords a great deal of flexibility and provides a means to both cost-effectively reduce carbon emissions and generate profits. Importantly, participants also came to appreciate that

effective program design and administration can affect environmental and economic outcomes.

- This activity was intended to provide a valuable initial knowledge- and experience-building opportunity among a limited selection of key stakeholder groups in the early stages of development of the Indian Carbon Market. This goal was successfully achieved, as demonstrated in this report. The available resources and time constraints were insufficient to provide comprehensive capacity building among a significant proportion of ETS stakeholders in India. Achieving this larger goal would require a much more extensive exercise that considers learning from these workshops.

NOTE TO THE READER:
After each of the three sessions, participants were asked to "offer a word or short phrase to describe your feelings about this session." Some 85 responses were submitted and a selection of these comments is provided throughout the report in light green text boxes. The full list of these comments is included in Appendix A

INTRODUCTION

This report summarizes the details and results of the carbon market and emissions trading system (ETS) simulation training workshops that were delivered in India between February 15 and 21, 2023. Provided in the report is information on the following:

- Purpose of the training
- Participant demographics
- How the training was conducted
- Participant's ETS knowledge gained as the result of the exercise
- Project outcomes, lessons learned, and next steps
- Participant responses to the exit survey request: "Offer a word or short phrase to describe your feelings about this session"
- Simulation tool description

PURPOSE OF THE TRAINING

The objective of the exercise was to provide an intensive opportunity for key ETS stakeholders in India to increase their knowledge and experience of how an ETS is designed and works through practical in-person simulation workshop sessions and associated training presentations.

The activity was designed and delivered to enable more detailed consideration of the ETS policy, contribute to more informed discussions about ETS design elements and decision-making, foster more awareness of the compliance responses, and provide a better understanding of the benefits of an ETS in promoting cost-effective greenhouse gas mitigation and generating investment funds for low carbon action. If the above is achieved, the project should also contribute to building support for the development of an ETS, generate "champions" in key stakeholder groups, and accelerate the development of an ETS in India.

As documented in this report, these goals have been achieved.

Excellent session. Thanks for organizing it has improved my understanding of carbon trading.

PARTICIPANT DEMOGRAPHICS

As shown in Figure 1, participants in the carbon market simulation exercises included: government officials and policymakers who will be charged with developing and administering the ETS (as per India's Energy Conservation [Amendment] Bill, 2022, which lays the foundation for the Indian Carbon Market [ICM]); emitting companies that may be subject to the requirements of ETS regulations to be promulgated; ETS service providers; offset developers; and members of civil society. Participants were located in, had the responsibility for operations located proximate to, and/or had the ability to travel to the sites of the three exercises in New Delhi, Mumbai, and Ahmedabad.

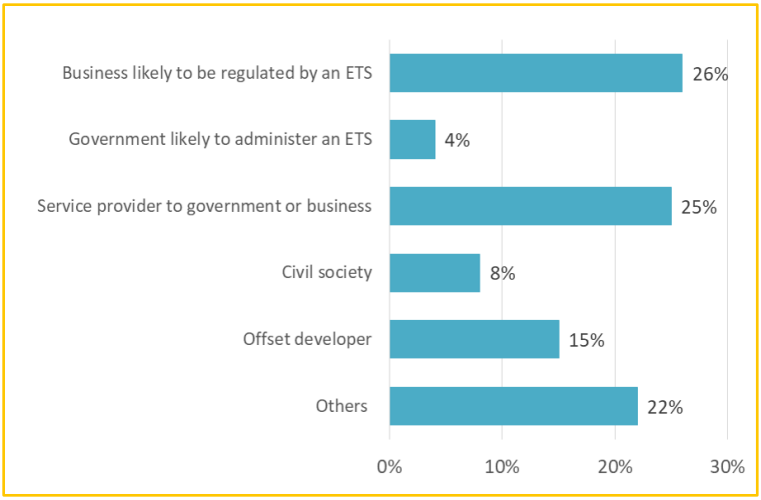


Figure 1. Participants included those who will likely develop and administer, be subject to, provide related services, develop offsets, and be affected by a forthcoming ETS (self-identified).

As shown in Figure 2, a total of 72.8% of participants reported that they had no experience or functional knowledge of carbon markets (29.8%) or only some knowledge of carbon markets/pricing (43%).

Three separate trainings were conducted – one in New Delhi (Feb. 15, 2023) with approximately 80 participants, a second in Mumbai (Feb. 17, 2023) with about 70 participants, and a third in Ahmedabad (Feb. 21, 2023) with about 65 participants. In total, approximately 215 stakeholders were trained. Owing to the popularity of the sessions, the workshops were significantly oversubscribed, and a limited number of seats were given to each organization to ensure a diverse range of organization involvement.

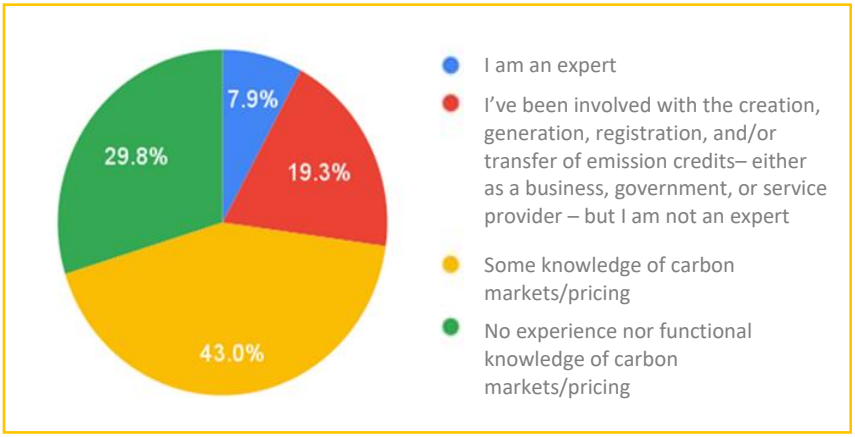


Figure 2. Participants' carbon market experience

Informative and interactive session to get perspective of ETS and how it works for carbon.

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.

On the day of the training sessions, participants were provided with the following:

- One or more tone-setting keynote lectures from experts including the Bureau of Energy Efficiency's Saurabh Diddi, the Indian Institute of Technology Bombay's Professor Trupti Mishra, the Indian Institute of Management Ahmedabad's Professor Amit Garg, and Ahmedabad University's Professor Minal Pathak.
- An overview of Indian carbon markets from CEEW's Vaibhav Chaturvedi (Figure 3).
- A survey of global carbon markets provided by ASPI's Alistair Ritchie (Figure 4).
- An opportunity to ask questions of and engage in a dialogue with the prior speakers.
- The carbon market simulation curated by CarbonSim administrator, Josh Margolis (Figure 5) with the help of several CEEW and ASPI CarbonSim tutors.
- A post-simulation exercise lessons learned and award ceremony.

A wrap-up opportunity to ask further questions and engage in a dialogue with prior speakers and one another.

Figure 3. CEEW's Vaibhav Chaturvedi

Figure 4. ASPI's Alistair Ritchie

Figure 5. CarbonSim Administrator, Josh Margolis

Prior to commencing the simulation, participants were provided with an overview of the benefits that can be gained from the experience – a summary is provided in Box 1.

Within each group, two- (or sometimes three-) person "teams" were created. Each team was assigned to manage a virtual company within each CarbonSim exercise. The representatives generally consisted of

As someone with basic knowledge, I found this to be a good introduction into the issue.

individuals from government, enterprises, offset developers, ETS service providers, or civil society stakeholders.

The exercises were administered by the CarbonSim administrator, Josh Margolis. Before and during the simulation, the administrator, in consultation with the ASPI and CEEW representatives, established and adjusted the simulation to reflect the parameters for the exercises and curated the exercise. Some of these adjustments are highlighted in Box 2.

The administrator stopped and started the simulation on an as-needed basis, called out key market-related events (prior to, during, and at the end of each virtual year), summarized the results of the exercises, and engaged in troubleshooting to ensure the system's smooth operation.

The exercises were run with the help of six CarbonSim tutors: CEEW's Vaibhav Chaturvedi, Nishtha Singh, Aman Malik, Chetna Arora, and Naveen Bali and ASPI's Alistair Ritchie. 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 assigned to work with groups of participants, typically numbering six to eight participants or three to four teams.

The primary role of the tutors was to guide participants as they registered/logged in and navigated the screens while they created their respective carbon portfolio management strategies. Additionally, the tutors occasionally provided market liquidity for the virtual market and assistance to participants on an as-needed basis. The tutors also worked in tandem with, and provided feedback to, the CarbonSim administrator.

Box 1. Benefits gained by various types of participants

CarbonSim participants gain a better understanding of the unique characteristics, risks, and opportunities that are the hallmarks of carbon markets. They come to understand that environmental and economic outcomes are a function of design choices. Specific benefits that can accrue include the following:

- **Policymakers** learn how the choices that they make – about both program design and administration – can affect the performance of the ETS.
- **Industry carbon managers** learn how to deploy a variety of strategies involving production changes, the use of abatements, and trading to satisfy ETS obligations.
- **Investors** learn how their portfolio companies might be affected by exposure to a variety of ETS designs and the practical decisions that those companies will have to make.
- **Civil society stakeholders** come to appreciate how their interests can be affected based upon ETS design choices.

In a more general sense, simulations can

- Improve stakeholder ETS literacy.
- Build capacity.
- Build support for the policy/reduce opposition from stakeholders.
- Facilitate the testing of design options.
- Reduce ETS rollout time.

This session was an eye opener and a vision to what might come in the future. A real-life learning experience.

Box 2. Customized CarbonSim Adjustments

In consultation with the ASPI and the CEEW, during the simulation the CarbonSim administrator made a number of adjustments on the setup of the simulation exercises to stabilize markets and minimize arbitrage opportunities in the simulations, make the game more interesting, and/or speed the progress of the game. Those parameters that were most frequently adjusted follow:

- Rate of cap reduction target
- Auction floor price
- Offsets allowed for use
- Duration of the virtual year

As shown in Figure 6, the simulation exercises were run over the course of about three hours and included a lecture-based training session that focused on the principles of both emissions trading and CarbonSim.

During the lecture participants were provided with an introduction to a number of key ETS- and CarbonSim-related concepts and terms including the following:

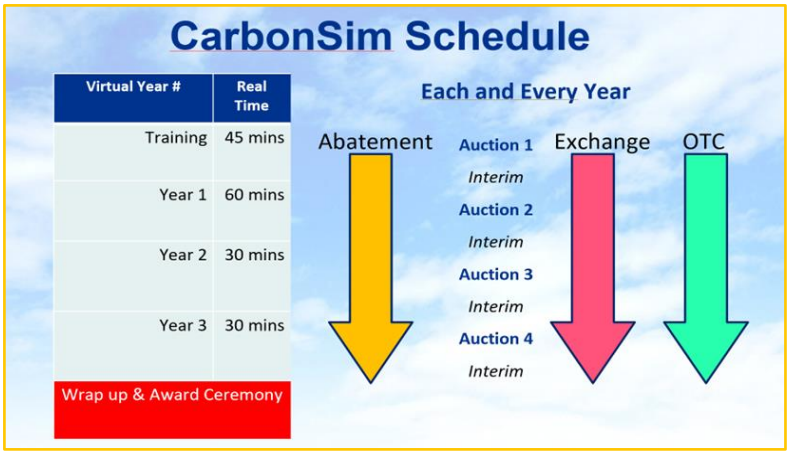


Figure 6. The CarbonSim exercises were run over three hours, included three virtual years, and concluded with a wrapup and award ceremony

- Compliance vs. voluntary market
- Carbon tax vs. cap and trade
- Emissions cap/limit
- Emissions trading/cap and trade
- Compliance obligation
- Compliance instruments
- Emissions allowances
- Emissions offsets
- Allocation
- Business-as-usual emissions
- Long/short position
- Marginal abatement control cost curves
- Auction market (primary market)
- Emissions exchange market and over-the-counter (OTC) market (secondary market)

Following the lecture, participants were asked to form teams and told that each team would be managing a virtual company that was subject to an ETS. Each company started the game "short" – that is, the company

Innovative things can change the carbon market.

had emissions that exceed their permitted allowable target. Absent further action, this shortfall – the gap between actual and allowable emissions – would increase owing to two factors:

- **Business-as-usual emissions would grow** by as much as 6% per year.
- **Companies that ended short would pay a twofold penalty**. For each tonne of emissions that was greater than the quantity of usable allowances and offsets held by the company, a $300 per tonne fine would be levied and one tonne of allowances would be debited from the company's subsequent year account (thereby exacerbating the following year's challenge).

To resolve the shortfall, participants were encouraged to develop, implement, and adjust a carbon portfolio that could consist of the following elements:

- **Implement abatements** – that is, control measures, operational adjustments, and/or fuel switching, all of which are presented on a marginal abatement control cost curve to reduce emissions and free up allowances for possible later banking, use, or sale.
- **Participate** (alongside participants and bots) **in government-sponsored auctions** to purchase allowances.
- **Participate in an exchange** to either purchase or sell allowances and/or offsets from/to other human participants or bots. (Note: In CarbonSim there can be up to 38 human-controlled virtual companies and 204 artificial intelligence– or bot-controlled companies. Bot-controlled companies, like their human counterparts, are programmed to bring their companies into compliance in the most cost-effective fashion.)
- **Participate in an over-the-counter market** to purchase or sell allowances or offsets from/to other human participants.

Participants were further advised that they must resolve the shortfall with a limited capital budget and by the end of each virtual year. Finally, before commencing the simulation, participants were encouraged to develop, implement, and adjust (as necessary) a portfolio of the emissions and allowance/shortfall in the most cost-effective fashion.

Open-hand year one. Participants were guided through the first virtual year of the simulation in an open-hand fashion. The primary purpose of this first year was to familiarize participants with the workings of (and screens associated with) CarbonSim and to provide context necessary to better understand the key terms and concepts. During this open-hand round, the game was stopped frequently, both to allow the administrator to make teaching points and to answer questions. Also CarbonSim tutors were directed to liberally provide assistance, both when requested by participants and at such time as the tutors thought participants might benefit from help. At the end of the first year, the game was stopped and assessment was made as to both overall system and individual team performance (as reflected in the leaderboard). Because of its stop-and-start nature, the open-hand year one (along with the end-of-year review) generally took about 45 to 60 minutes to complete.

Excellent team and tremendous efforts went in hosting the event. Truly appreciate the learning experience.

Compared to year one, **the second and third years** of the simulation were conducted in an accelerated fashion. Participants were left largely on their own to solve their shortfalls and otherwise manage their carbon portfolios in the most cost-effective fashion. On an as-needed basis, tutors engaged with theparticipants – often to address questions, but sometimes to seek out, conduct, and execute over-the-counter trades with teams. Figures 7 through 14 show participants actively engaged in the simulation.



Figures 7, 8, and 9: New Delhi participants.


Figures 10 and 11: Mumbai participants.



Figures 12, 13, and 14: Ahmedabad participants.

Exciting experiential learning session.

At the conclusion of each of the three simulation exercises, an **awards ceremony** was held. All participants from all the groups gathered in the same room and the top finishers from each group were recognized, applauded, and awarded with nominal tokens. As shown in Figures 15, 16, and 17, the award ceremonies – and the exercises themselves – closed with a group photo.

Figure 15: New Delhi group photograph.

Figure 16: Mumbai group photograph.

Figure 17: Ahmedabad group photograph.

It was really insightful and the operational flavour brought in with the stimulation.

PARTICIPANT ETS KNOWLEDGE GAINED THROUGH THE EXERCISE

Judging from pre- and post-exercise survey results, participants substantially improved their knowledge about emissions trading terms and related concepts – in particular, regarding the following:

- Compliance vs. voluntary market
- Compliance obligation
- Compliance instruments
- Emissions allowances
- Emissions offsets
- Allocation
- Business-as-usual emissions
- Long/short position
- Marginal abatement control cost curves
- Auction market (primary market)
- Emissions exchange market (secondary market)

As shown in Figure 18 and Table 1, coming into the exercise, fewer than 50% of participants indicated that they understood key terms/concepts at a level that would allow them to explain them to a colleague. After – and arguably because of – the exercise, the absolute increase in those who considered themselves sufficiently knowledgeable to explain the concept grew by between 19% and 48%.

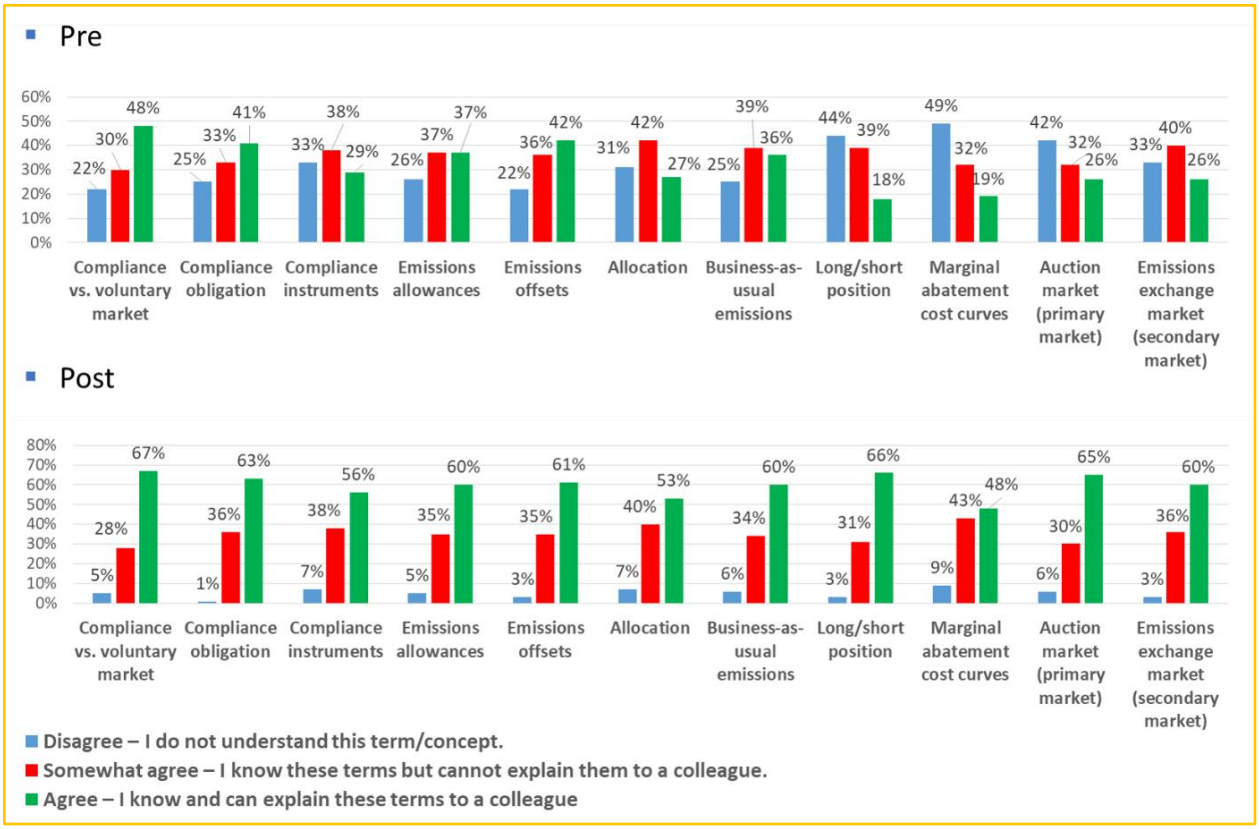


Figure 18: Participant survey data on knowledge of specific terms pre- and post-exercise.

Great experience and practical understanding of trading systems.

Table 1 ranks the terms in the context of the absolute increase in pre- and post-exercise knowledge gained. Participants gained the greatest increase in knowledge for "long/short position" (48% increase), "auction market (primary market)" (39%), "emissions exchange (secondary market)" (34%), and "marginal abatement control cost curves" (29%). Helping participants gain an understanding of these terms, and others noted in Table 1, is fundamental to building capacity and was a primary goal of these exercises.

Table 1. Ranking of Self-Reported Knowledge by Term – Highest to Lowest of Participants Who Agree – "I know and can explain these terms to a colleague"

	Term	Pre-Exercise Survey	Post-Exercise Survey	Delta or Absolute % Increase
1	Long/short position	18	66	48
2	Auction market (primary market)	26	65	39
3	Emissions exchange (secondary market)	26	60	34
4	Marginal abatement control cost curves	19	48	29
5	Compliance instruments	29	56	27
6	Allocation	27	53	26
7	Business-as-usual emissions	36	60	24
8	Emissions allowances	37	60	23
9	Compliance obligation	41	63	22
10	Emissions offsets	42	61	19
11	Compliance vs. voluntary market	48	67	19

As shown in Figure 19, as a result of the exercises participants increased their familiarity with carbon pricing programs. For example, coming into the exercise only 41.2% of participants agreed with the statement that they knew what carbon pricing was and could name one or two examples. After the exercise the total increased to 67.4%.

This was very useful session and helped me understand different markets, as well as carbon portfolio management strategy. This session will be very useful to market participants and service providers.

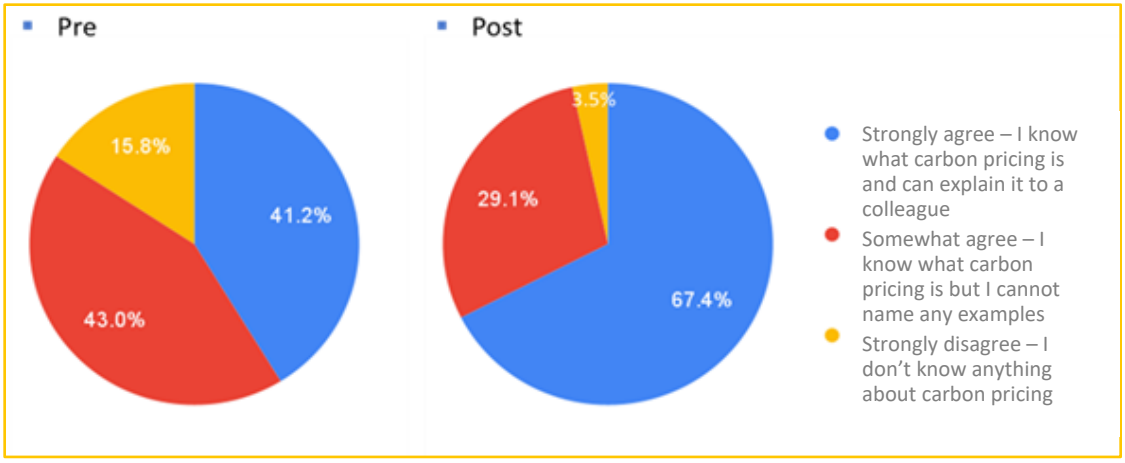


Figure 19: Participant survey data on overall knowledge of carbon pricing.

As shown in Figure 20, participants also gained an increased understanding of the purpose of a carbon portfolio management strategy. Before the exercise, 11.4% strongly agreed with the statement "I know what a carbon portfolio is and could explain it to a colleague," and 15.8% said "I know what a carbon portfolio is and how it is used." After the exercise, these numbers grew to 21.6% and 42%, respectively.

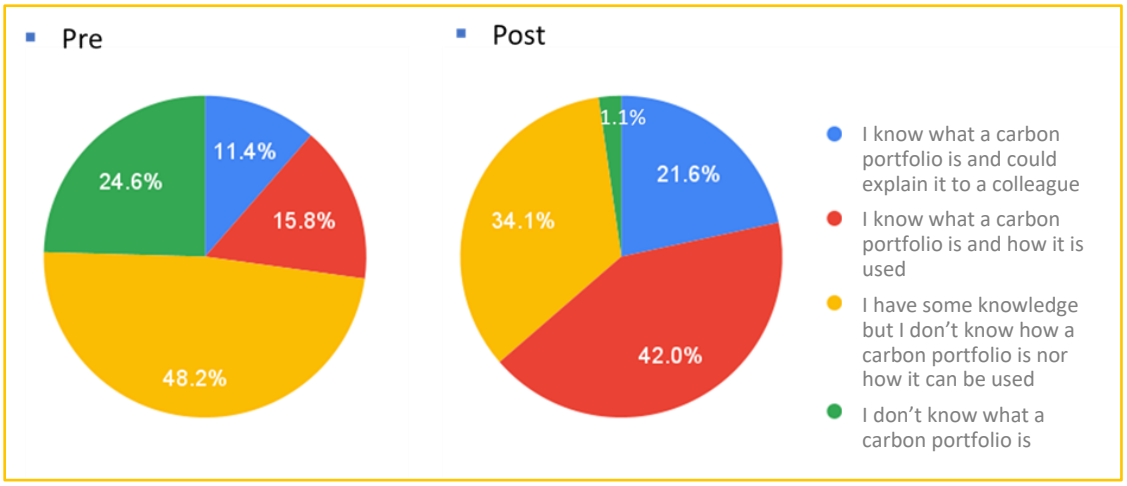


Figure 20: Participant survey data on knowledge of a carbon portfolio, pre- and post-exercise.

As reflected in Figure 21 and Table 2, participants gained a marked increase in understanding of the rationale for accessing the primary and secondary markets, and methods that can be used to manage their carbon portfolio.

As shown Table 2, the absolute increase in knowledge gained as a result of the exercise was between 31% and 39%.

It's a wonderful session.

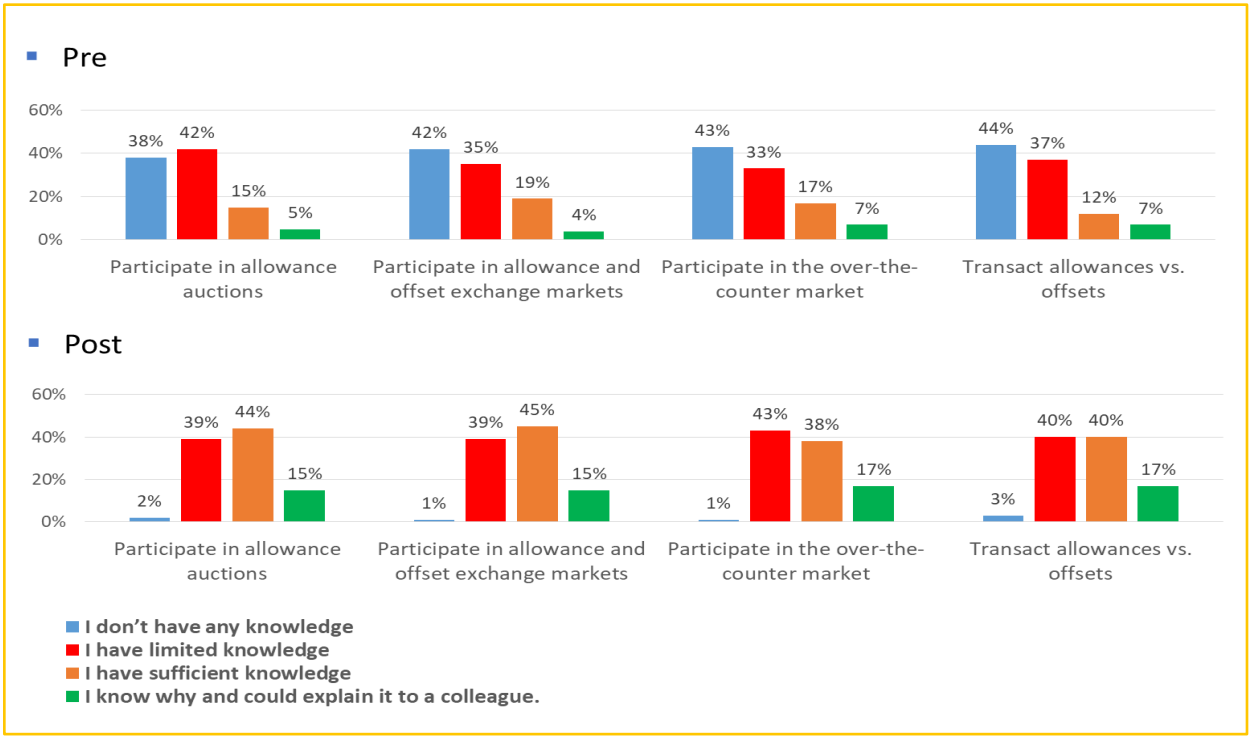


Figure 21: Participant survey data on managing a carbon market portfolio.

Table 2. Ranking of Self-Reported Knowledge by Term – Highest to Lowest of Participants Who Agree with Either "I have sufficient knowledge" or "I know and can explain these terms to a colleague"

	Term	Pre-Exercise Survey	Post-Exercise Survey	Delta or Absolute % Increase
1	Participate in allowance auctions	20	59	39
2	Transact allowances vs. offsets	19	57	38
3	Participate in allowance and offset exchange markets	23	60	37
4	Participate in the over-the-counter market	24	55	31

Very enriching. Hoping India to implement such an ETS soon for transparent price discovery and trading offsets at lowest cost possible.

As shown in Figure 22, participants gained an increased appreciation for how the design of an ETS can affect a jurisdiction's ability to reduce emissions in a cost-effective fashion while supporting near- and long-term objectives. Before the exercise, 20.2% said that they either had sufficient knowledge (14.9%) or knew why and could explain it to a colleague (5.3%). After the exercise, 64.8% said they had sufficient knowledge (39.8%) or knew why and could explain it to a colleague (25%).

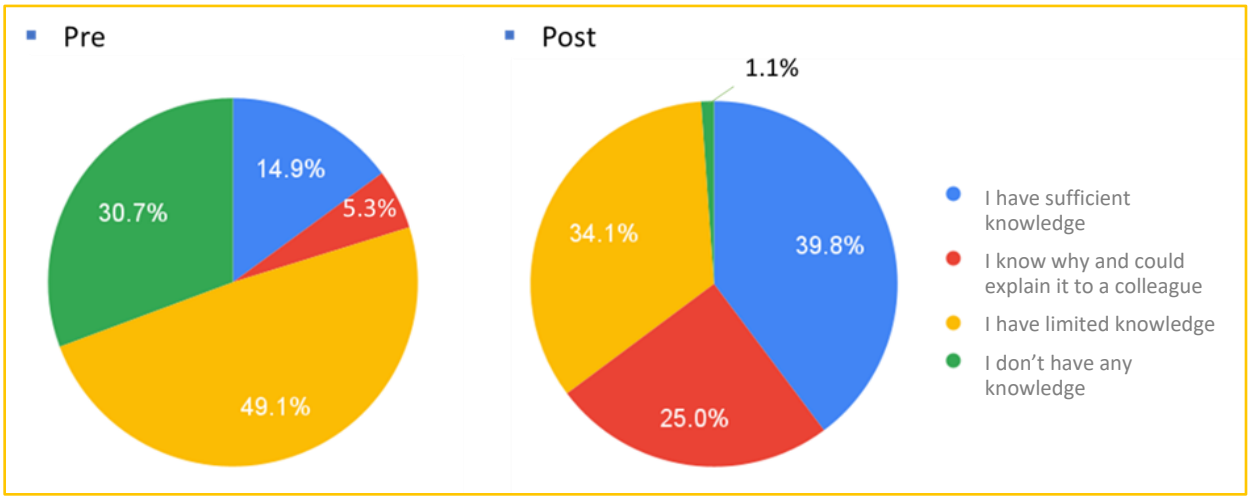


Figure 22. "Do you understand why and how the design of an ETS can affect a jurisdiction's ability to reduce emissions, do so in a cost-effective fashion, while supporting near- and long-term objectives?"

As shown in Figure 23 (which only presents post-exercise survey results), participants found benefit in participating in the exercise. In fact, 100% reported that they would recommend this session to their carbon market colleagues (68.2%) or that they learned something and it was a good use their time (31.8%). No participants responded "No, it was a waste of time."

When further asked to provide a short word or phrase to describe their feelings about the session, participants offered a host of positive words. The full responses are provided in Appendix A. Figures 24, Table 2, and Figure 25 provide different ways to see these results. Figure 24 provides the most frequently used descriptive words that were offered by participants.

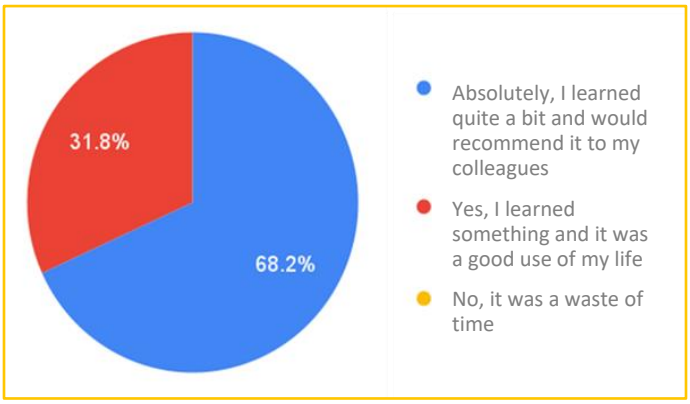


Figure 23: Participant survey data on value of the exercise.

Wonderful event.

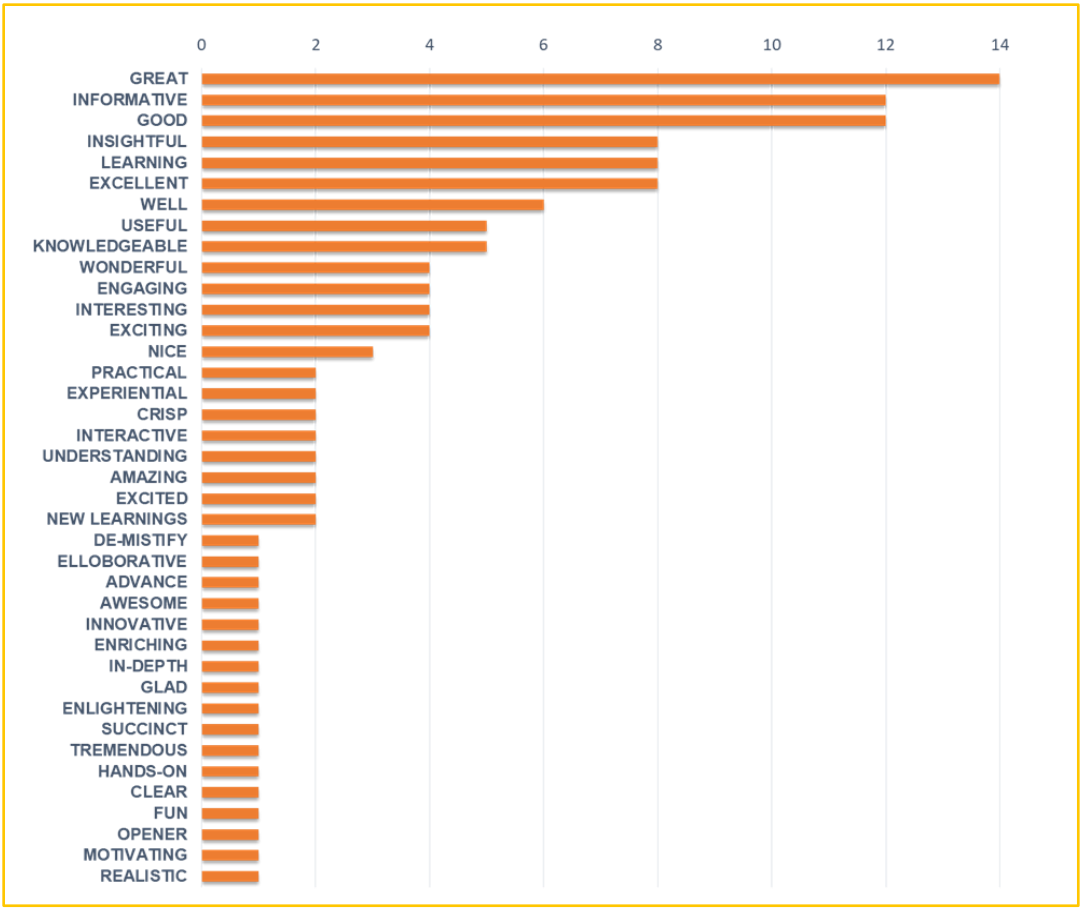


Figure 24: Frequency of words used by participants to describe the session.

Table 3 provides further insights into the general comments, immediate impacts and outcomes, and specific likes as reported by the participants.

Table 3. When Asked to Provide a Short Word or Phrase about the Session Participants Offered a Number of Responses			
General comments	Good	Enlightening	Quite interesting
	Great	Very useful	Fun and informative
	Excited	Good Insight	Insightful. Thank you
	Thank you	Interactive	It's a wonderful session
	Exciting	Very useful	Engaging and informative
	Exciting	Great session	Realistic and motivating
	Excellent	It was great	Good knowledgeable sessions
	Excellent	Good workshop	Interesting and informative
	Excellent	Great exposure	It was a wonderful experience
	Excellent	Great learning	Knowledgeable; excellent session

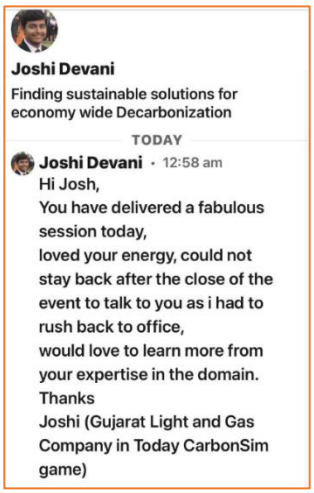
Table 3. When Asked to Provide a Short Word or Phrase about the Session Participants Offered a Number of Responses			
General comments	Very good	Session is good	It was awesome with much learning
	Very good	Great session :)	Exciting experiential learning session
	Well done	Wonderful event	Excellent engaging and a crisp session
	Very good	Wonderful event	Nicely explained and informative session
	It's good	engaging for sure	Absolutely amazing session. Very informative Thanks
	Great work	Very informative	Well-designed session and overall glad to have participated
	Insightful	Very nice session	
Immediate impacts/outcomes	Interesting and excited for the future		
	Innovative things can change the carbon market		
	It was a great session and very knowledgeable one. From zero to something I have learnt		
	Excellent session. Thanks for organizing it has improved my understanding on carbon trading		
	Nice simulation exercise. At our company we would want to assist and support the ETS infrastructure in India given our experience		
	Very enriching. Hoping India to implement such an ETS soon for transparent price discovery and trading offsets at lowest cost possible.		
Specific likes	It is very useful		
	Great session to understand ETS		
	New learnings for all of us. Thank you		
	Great job organizing the simulation game		
	Crisp program on simulation but more in-depth		
	Very insightful and a hands-on experience, thanks		
	Highly informative because of the hands on approach		
	Good initiative to give stakeholders a flavour of ETS		
	Very well conducted simulations. Great learning experience.		
	Great experience and practical understanding of trading systems		
	Learned the difference between allowance market and offset market		
	It provides insightful and hands on experience of cap and trade system		

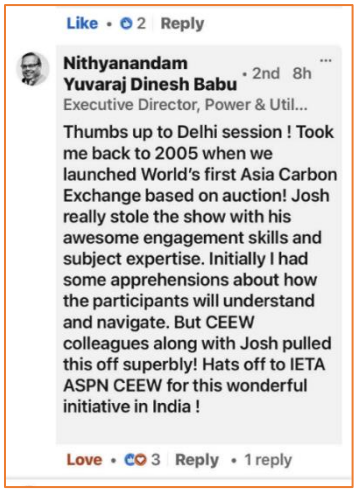
Table 3. When Asked to Provide a Short Word or Phrase about the Session Participants Offered a Number of Responses	
Specific likes	It was really insightful and the operational flavour brought in with the stimulation
	As someone with basic knowledge, I found this to be a good introduction into the issue.
	The simulation was interesting. It gave a sneak peak to how an auction market functions.
	It was a great experience to de-mystify the complicated concepts. Thank you for organizing
	It was extremely well designed and engaging. The presentations were succinct and informative
	Informative and interactive session to get perspective of ETS and how it works for carbon market
	Excellent team and tremendous efforts went in hosting the event. Truly appreciate the learning experience
	This session was an eye opener and a vision to what might come in the future. A real life learning experience
	Learnt a lot from this wonderful conference. Loved the classroom combined with practical experiential learning exposure
	This was very useful session and helped me understand different markets, as well as carbon portfolio management strategy. This session will be very useful to market participants and service providers
Willing to join similar events in the future/Would recommend this to others	Very informative with request to organize more
	Very informative session, looking forward for more such sessions on various development
	Informative session got good knowledge of basics of ETS, looking forward for more insightful sessions
	This was an exciting stimulation program. It was very insightful and would love to explore more in this arena
	I have attended multiple trainings in the past but the simulation training was amazing and something which I will take back
Suggestions	Can be more elaborative
	Great learning. Simulation helped but how it will be used was not clear
	There should be sessions on Carbon Emissions and ways to calculate and control it
	It was a very useful & insightful session. It might be better to have an advance training session as well

Figure 25 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. The information provided in Figures 23, 24, and 25 and Table 3 convey the very positive reaction of the participants.

Figure 25. Word cloud that correlates the frequency of words used by participants to describe the session.

Finally, an article published by Ahmedabad University (https://lnkd.in/gnx-fVa8) and communications between the author of this report and participants augment the conclusion that the sessions were positively received. Figures 26–28 provide examples.





Figures 26–28: Unsolicited participant communications with Josh Margolis regarding the session.

Nicely explained and informative session.

PROJECT OUTCOMES, LESSONS LEARNED, AND NEXT STEPS

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

PROJECT OUTCOMES

As the result of this effort, approximately 215 ETS stakeholders were trained. A total of three simulations were run – one each in New Delhi, Mumbai, and Ahmedabad.

Experiences provided through the simulations were augmented by lessons and discussions that were delivered through lectures and question-and-answer sessions prior to, throughout, and following the simulations.

Information gained through participant surveys shown in Figures 18 to 24 and Tables 1–3 suggests that the training significantly improved participants' ETS literacy and was appreciated. It also brought together – and stimulated discussions among – representatives from five key sectors, the following in particular:

- **Government officials** who will contribute to the development and administration of the ETS.
- **Enterprises** that may be regulated by the ETS.
- **Offset developers** who may provide offsets to be used subject to government- issued/approved protocols/regulations.
- **ETS service providers** who may assist the government, enterprises, offset developers, or other stakeholders in delivering on their obligations associated with the ETS.
- **Civil society members** who have an interest in the rationale design and successful performance of the ETS.

It is reasonable to conclude that such discussions will likely continue when the representatives return to their organizations as well as with one another in subsequent ETS-related venues.

After the completion of the exercises **as many as 99% of participants said that ETS would be useful for India to meet its NDC**, with 73.9% saying it will be "very useful", 11.4% saying it will be "indispensable", and 13.6% saying it will be "somewhat useful".

Further, the post-exercise comments offered by participants, summarized in Figures 25–28, further support the conclusion that the exercises were appreciated, raised ETS literacy, and furthered discussions that may well improve the ability of these stakeholders to support India's introduction of an ETS.

PARTICIPANT LESSONS LEARNED

Participants learned a number of lessons as the result of their participation in the practice and competitive simulations. Participants do well if they:

It was a wonderful experience.

- **Evaluate options and markets before acting**. Participants did better if they 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), the 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 their emissions. Those players who 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 if they can be implemented at a cost lower than that obtained 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.
- **Do not use too many abatements.** While it is possible in the simulation to fully abate/eliminate all emissions, it is also very expensive and makes winning impossible. Generally, players will want to 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 simulation, it is imperative that players monitor and engage in all markets as appropriate.
- **Manage long/short positions.** Participants should pay attention to minimizing costs. While compliance is the #1 goal, doing so at the least possible cost is the #2 goal. One way to minimize costs is to go long (buy more 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.

This was an exciting stimulation program. It was very insightful and would love to explore more in this arena.

- **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 vice versa).
- **Be patient and do not wait until the last minute to enter an** order. Because the software is not financial grade, participants should allow the system plenty of time to respond to commands.
- **Look for market signals before acting**. For example, 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 more selective.** Understand that some bids and offers should be rejected because they are well above or below that which may be considered prudent.
- **Opt for limit orders.** When accessing and using the exchange, 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 – that is, 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 before actually transacting.
- **Look for – and take advantage of – arbitrage opportunities.** Since prices differ in different markets, players may find opportunities to transact at substantially more favorable prices in one market than another.

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

- **ETS design decisions made by the ETS administrator and capacity-building efforts will 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 tended to be set in excess of average exchange prices, prompting most participants to make the economically prudent decision of using other compliance approaches.
    - **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.

Informative session got good knowledge of basics of ETS, looking forward for more insightful sessions.

- **Government revenue generation**, through auctions and fines, which provides elected officials with a means to deliver meaningful benefits to the public and to the ETS entities.
- **ETS duration**, which, because it was finite, prompted players to:
  - Avoid abatements that took longer to implement.
  - 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, serves to improve participant's ETS literacy and their ability to advocate for ETS design features that serve their interests and also provides a riskless opportunity to make and learn from mistakes.**

When reflecting on the lessons learned from this simulation, however, it is important to consider that the exercise is primarily an educational tool to provide realistic insights into how carbon markets work and is not intended to accurately predict how an ETS will play out.

RECOMMENDATIONS AND NEXT STEPS

The following recommendations and potential next steps are offered:

- Overall, given the success and value of this exercise to participants, **roll out the simulations to a wider range of stakeholders and a greater number of cities**. The focus should align with the evolving development of the Indian Carbon Market and the associated needs of its key stakeholders.
- **Extend the duration of the sessions and pair the simulation with more extensive training on ETS topical subject matters.** Prior experience has shown that participants get more benefit from the exercise if combined with an equivalent amount of ETS-related lecture-based instruction. The hands-on experiential learning that is delivered via the simulation is reinforced through traditional classroom-style lectures on topics such as ETS design, Monitoring, Reporting and verification (MRV), benchmarking, offset protocols, enforcement, market monitoring, and so on. Expanding the training in this fashion may serve multiple purposes including drawing in additional participants, better informing the policy discussions regarding different ETS parameters, as well as identifying key ETS elements that merit further consideration before/as an ETS program is launched.
- **Consider expanding engagement of those sectors that are most likely to criticize and/or pushback on ETS implementation (such as the highest polluting sectors).** Experience has shown that this sort of exercise can serve to address and ameliorate concerns; turn doubters into supporters; and, as a result, improve the quality of the ETS and reduce its rollout time.
- **Consider trainings that are tailored to different levels of complexity and previous knowledge of participants.** In this project, simulation participants had very different levels of understanding of an ETS and its associated components. Those who knew the most kept pushing to move faster and to cover more complex issues, while a large percentage of the participants still needed basic training on understanding concepts and terminology before going into more advanced topics. To better tailor a

Great job organizing the simulation game.

training to align with participants' interests and needs, consideration could be taken into grouping participants on their level of ETS knowledge.

- **Broaden the type and number of stakeholders involved in simulations.** Though successful, this simulation largely involves entities that are likely to be regulated by an ETS and/or service provider. A case can be made to involve additional kinds of participants:
    - Involving those from **different departments** – for example, 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 more participants who may be expected **to write the rules for and/or administer an ETS** will provide such individuals with sensitivity that they may not otherwise have and may, in turn, provide them with insights that result in better policymaking.
    - For similar reasons, efforts could be made to **engage more civil society members** who may be expected to participate in the policy development process and/or provide ongoing programmatic reviews. Their participation in simulations will help them understand how design affects outcomes, the cost-effectiveness benefits of an ETS in reducing greenhouse gas emissions, the opportunity for raising significant revenue for multiple beneficial purposes, why it is in society's interests to provide industry with certainty and investment incentives, and so on.
- **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 and 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 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 were limited to three virtual years. Savvy participants, as a result, elected to only implement abatements with 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, 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

It was a great experience to de-mystify the complicated concepts. Thank you for organizing.

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.** Facilitators of these exercises should be mindful of attempting to deduce the impact of differing policy designs from simulations that involve untrained stakeholders. 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 the real world, fiscally imprudent behavior. As such, researchers should be extremely cautious when using simulation results as a predictor for what may actually 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 simulations 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**, potentially further tailored to the Indian context. Those of primary interest may be associated with the following:
    - Alternative approaches to treating offsets.
    - The impact of the co-benefits of emissions trading.
    - Consideration of other climate, energy, or fiscal policies.
    - International carbon markets.
    - Inclusion in the simulation of risk-hedging instruments like futures contracts.

New learnings for all of us. Thank you.

APPENDIX A – PARTICIPANT RESPONSES TO EXIT SURVEY REQUEST

"Offer a word or short phrase to describe your feelings about this session."

	NEW DELHI –February 15, 2023 (80 participants and 27 responses)
1	Exciting
2	Realistic and motivating
3	Knowledgeable; excellent session
4	Interesting and excited for the future
5	Excited
6	I have attended multiple trainings in the past but the simulation training was amazing and something which I will take back
7	Good initiative to give stakeholders a flavour of ETS
8	Excellent session. Thanks for organizing it has improved my understanding on carbon trading
9	As someone with basic knowledge, I found this to be a good introduction into the issue.
10	This session was an eye opener and a vision to what might come in the future. A real life learning experience
11	Quite Interesting
12	Session is good
13	Very good
14	Interesting and informative
15	Insightful
16	Fun and informative
17	Nice simulation exercise. At our company we would want to assist and support the ETS infrastructure in India given our experience
18	Great learning. Simulation helped but how it will be used was not clear
19	Interactive
20	Engaging for sure
21	Informative and interactive session to get perspective of ETS and how it works for carbon market
22	Very insightful and a hands-on experience, thanks!!
23	Well done
24	Very informative with request to organise more
25	Very useful

26	Excellent team and tremendous efforts went in hosting the event. Truly appreciate the learning experience
27	It was extremely well designed and engaging. The presentations were succinct and informative.
	MUMBAI –February 17, 2023 (70 participants and 27 responses)
1	Great session :)
2	The simulation was interesting. It gave a sneak peek to how an auction market functions.
3	Enlightening
4	This was very useful session and helped me understand different markets, as well as carbon portfolio management strategy. This session will be very useful to market participants and service providers.
5	There should be sessions on Carbon Emissions and ways to calculate and control it
6	Great session to understand ETS
7	Well designed session and overall glad to have participated
8	Good
9	It was really insightful and the operational flavour brought in with the stimulation
10	Very nice session
11	Absolutely amazing session. Very informative. Thanks
12	Its a wonderful session
13	Good knowledgeable sessions
14	Crisp program on simulation but more in-depth
15	Highly informative because of the hands on approach
16	Wonderful event
17	Very well conducted simulations. Great learning experience.
18	Great session
19	Great learning
20	It is very useful
21	Excellent
22	Exciting
23	Exciting experiential learning session
24	Great exposure
25	Excellent
26	New learnings for all of us. Thank you
27	Great
	AHMEDABAD –February 21, 2023 (65 participants and 31 responses)
1	Very good

2	Good workshop
3	Good Insight
4	Very enriching. Hoping India to implement such an ETS soon for transparent price discovery and trading offsets at lowest cost possible.
5	Very informative
6	It's Good
7	Learned the difference between allowance market and offset market.
8	Innovative things can change the carbon market
9	It was a wonderful experience.
10	Great job organising the simulation game.
11	Informative session got good knowledge of basics of ETS, looking forward for more insightful sessions
12	Nicely explained and informative session.
13	Excellent engaging and a crisp session
14	Excellent
15	Great experience and practical understanding of trading systems
16	Engaging and informative
17	Great work
18	This was an exciting stimulation program. It was very insightful and would love to explore more in this arena.
19	Insightful. Thank you!
20	Very informative session, looking forward for more such sessions on various development.
21	It was a great session and very knowledgeable one. From zero to something I have learnt.
22	Excellent.
23	Learnt a lot form this wonderful conference. Loved the classroom combined with practical experiential learning exposure
24	Thank you
25	It provides insightful and hands on experience of cap and trade system
26	It was awesome with much learning
27	It was a very useful & insightful session. It might be better to have an advance training session as well.
28	Can be more elloborative
29	It was great
30	Very good
31	It was a great experience to de-mystify the complicated concepts. Thank you for organising.

APPENDIX B – SIMULATION TOOL DESCRIPTION

CarbonSim is an artificial Intelligence–enhanced, multilingual, multiuser, experiential learning 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 do so at the lowest possible cost. In the simulated carbon market, virtual companies from different industrial sectors manage carbon portfolios for which they can reduce emissions using abatements (including efficiency improvements, process changes, fuel switches, or emissions controls) that are relevant to their particular sectors. Players can also participate in government-sponsored allowance auctions, exchanges, or OTC markets. Two products can be traded – government-issued allowances and private sector–created offsets. Both abatements and market-related options have different capital requirements and financial returns.

Each simulation exercise can be run for a prescribed amount of time (typically from 2.5 to 3 hours in these exercises) and consists of a cap-and-trade/CarbonSim 101 tutorial followed by three virtual years (each of which ran from 15 minutes to an hour in these exercise) and a lessons-learned/practical implications discussion. As the simulation progresses, participants:

- Come to see how they are performing – individually, in comparison to their colleagues, and as part of a system.
- Gain a better understanding of the unique characteristics, risks, and opportunities that are the hallmarks of carbon markets. They will come to understand that environmental and economic outcomes are a function of design choices.

In support of this project, some customizations were made to CarbonSim. Most notably, Indian-sounding company names were included. A selection of screen shots from the version used by participants are provided in Figures B1 through B9.

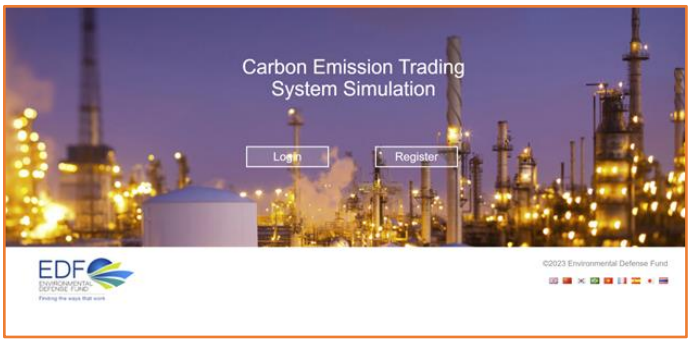


Figure B1. CarbonSim splash screen

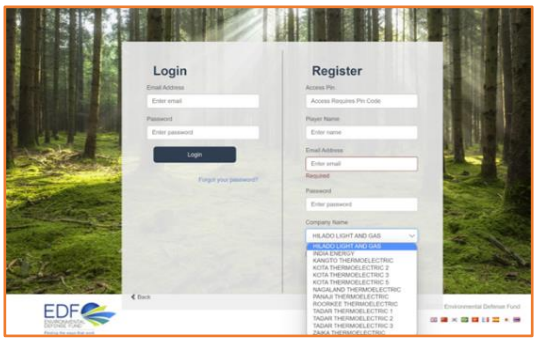


Figure B2. CarbonSim login/registration screen

Figure B3. CarbonSim player dashboard

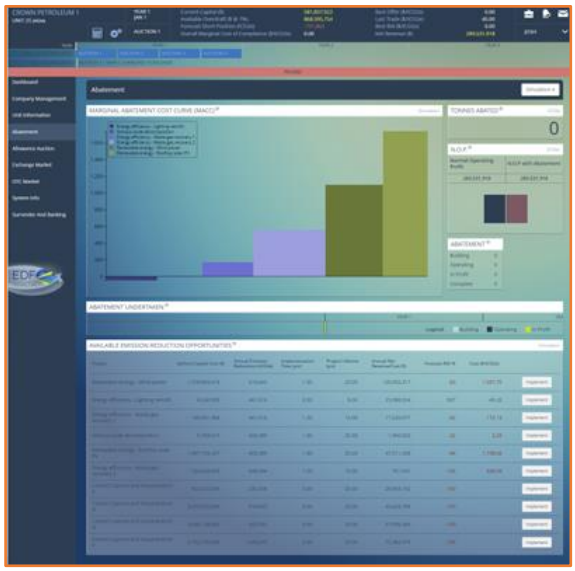


Figure B4. CarbonSim abatement screen

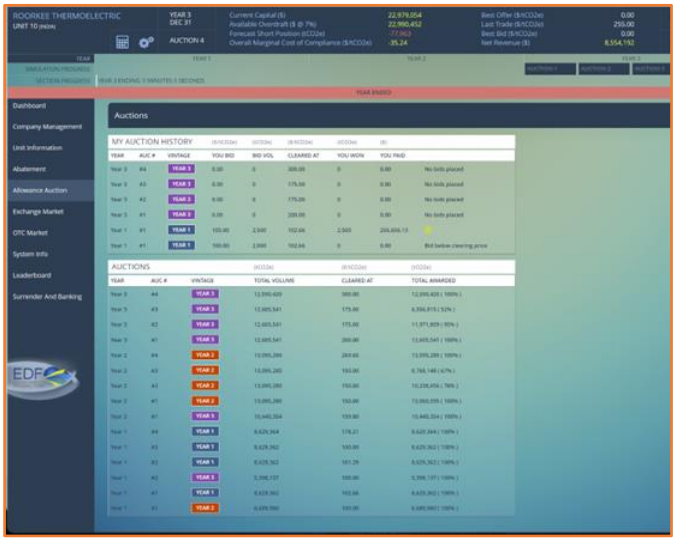


Figure B5. CarbonSim auction screen

Figure B6. CarbonSim exchange screen

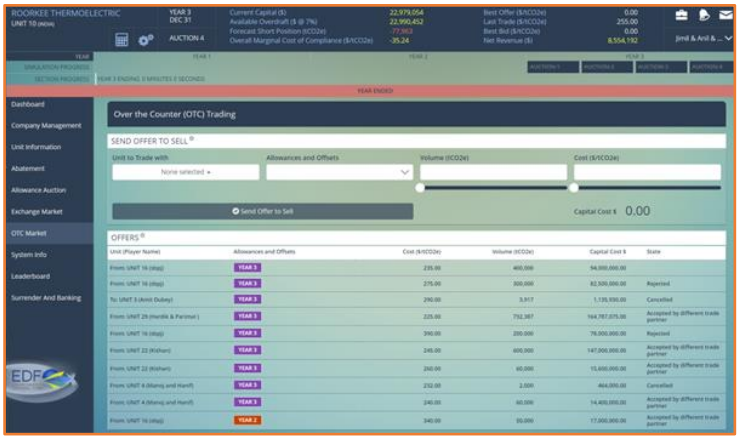


Figure B7. CarbonSim OTC screen

End of Year System Report

Choose System: India

System Totals	This Year	To Date
Forecast Emissions for all Economic Sectors	382,789,801 tCO2e	1,107,684,460 tCO2e
Allowances Sold by Government	43,724,585 tCO2e	145,933,185 tCO2e
Allowances Surrendered to Government	279,595,599 tCO2e	917,685,219 tCO2e
Auction Revenue Collected by Government	$9,540,743,400.00	$24,919,836,811.50
Average Allowance Sale Price	$218.20/tCO2e	$170.76/tCO2e
Offsets Surrendered to Government	5,037,934 tCO2e	19,218,346 tCO2e
Average Offsets Sale Price (This system)	$202.27/tCO2e	$126.79/tCO2e
Average Offsets Sale Price (Other systems)	$0.00/tCO2e	$0.00/tCO2e
Abatement Undertaken	61,798,258 tCO2e	121,228,234 tCO2e
Emission Reduced	66,836,192 tCO2e	140,446,580 tCO2e
Forecast emissions less abatement undertaken	315,953,609 tCO2e	967,237,880 tCO2e
Number of Compliance Penalties applied	145 unit(s)	250 unit(s)
Value of Govt. Penalties Applied	$7,485,548,700.00	$10,401,972,600.00

Figure B8. CarbonSim end-of-simulation system report

Leaderboard Year 3

Current Year | Overall

Rank	Company	Unit Name (Player)	Overall Marginal Cost of Compliance ($/tCO2e)	Final Long/Short Position (tCO2e)	System
1	INDIA NATIONAL BANK	India OFFICE (AI)	-$3,316,349,829.59	0	India
2	L&R POWER	UNIT 7 (Prantik Saikat)	-$2.34	0	India
3	BIHAR THERMOELECTRIC 4	UNIT 18 (AI)	$6.86	0	India
4	INDIA CENTURY CEMENT	UNIT 2 (Mayank Sharma)	$12.24	-281,436	India
5	KOTA THERMOELECTRIC 5	UNIT 38 (AI)	$20.48	0	India
6	KOCHI THERMOELECTRIC	UNIT 1 (PoojPris)	$20.52	0	India
7	GUJARAT LIGHT AND GAS	UNIT 34 (Neeraj Patel)	$24.00	0	India
8	CROWN PETROLEUM 2	UNIT 26 (Aman - Tutor)	$24.08	0	India
9	INDIA ENERGY	UNIT 9 (NiranjanGaurav)	$29.52	0	India
10	CROWN PETROLEUM 1	UNIT 25 (JOSH)	$30.66	0	India
11	BIHAR THERMOELECTRIC 3	UNIT 17 (PDV)	$30.96	0	India
12	DIVA THERMOELECTRIC	UNIT 27 (Harvinder Lalji)	$32.08	0	India
13	SP ELECTRIC	UNIT 8 (Sumeet & Supratim)	$32.39	0	India
14	GAYA POWER	UNIT 31 (Vibhav)	$33.28	0	India
15	TADAR THERMOELECTRIC 2	UNIT 12 (AI)	$33.49	-90,970	India
16	ROORKEE THERMOELECTRIC	UNIT 10 (Jimil & Anil & Viral)	$33.62	-77,963	India
17	XTREME LIGHT AND GAS	UNIT 21 (bhimashnkar nikhil)	$35.42	-12,600	India
18	BIHAR THERMOELECTRIC	UNIT 15 (AnirSamSan)	$36.08	0	India

Figure B9. CarbonSim end-of-simulation leaderboard (portion)

For more information about the carbon market developments in Asia, visit:
AsiaSociety.org/ChineseCarbonMarket

ASIA SOCIETY

Navigating Shared Futures