



Simulating Carbon Markets

KEY MESSAGES

- Carbon market simulations are programs, models, virtual environments, and/or games that allow stakeholders to participate in a fictitious process of designing or participating in an emissions trading system (ETS).
- Simulations can increase carbon pricing literacy and build support for the policy among stakeholders, helping to pave the way for an ETS roll-out. Later, once a government has decided to implement an ETS, simulations can help test design options, engage stakeholders and deepen knowledge on carbon markets.
- However, simulations only provide a simplified model of a carbon market. Care should be taken with the results of any simulation exercise as they may not accurately predict how an ETS would play out in real life.

SUMMARY

An emissions trading system (ETS) is a market-based policy that mandates emissions reductions (through setting a cap) and provides covered entities with the flexibility to select the specific means to achieve the goal. By putting a price on carbon through an ETS, companies are incentivized to pursue the most cost-effective solutions and the overall environmental goal is achieved.

Worldwide, interest in carbon pricing and ETSs as key options for ambitious climate action is increasing and important lessons can be learned from their implementation in different contexts. In countries newly considering an ETS, however, simulations can be a useful tool to assist both policymakers and businesses to prepare for emissions trading.



WHAT IS A CARBON MARKET SIMULATION?

Carbon market simulations are programs, models, virtual environments, and/or games that allow **stakeholders to participate in a simulated process of designing or participating in an ETS**. They are a low-cost and low-risk option of building capacity for both policymakers and regulated companies. The experiential learning processes these tools enable serves to increase ETS literacy, helps build support for ETS as a policy option, and illustrates how policy outcomes are a function of design. Importantly, ETS simulations can provide an opportunity for different stakeholders to build relationships, mutual understanding and trust, all of which are key prerequisites for working together on policy design and implementation. Finally, these tools provide stakeholders with a safe and risk-free opportunity to try out new ideas, make mistakes, and to learn lessons which can serve to speed the adoption of effective ETSs.

Simulations synthesize years of learning into one interactive experience that 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. Highly recommended for advocates, industry practitioners, and policymakers.

*- Dan Dudek, Vice President,
Asia, Environmental Defense Fund*

WHAT SORT OF SIMULATION TOOLS ARE AVAILABLE?

There are a number of simulation tools that are available for use by ETS advocates. These differ based on their users, objectives and the extent to which they are technology-supported or not:

- **Users** – Some simulation tools are primarily focused on a particular user – e.g., regulated industries, ETS

administrators or climate negotiators, while others target multiple ETS stakeholders.

- **Training Objective** – Some tools are intended to provide training in the principles of carbon portfolio management. Others are intended to simulate the challenges associated with the task of negotiating an effective ETS policy that considers the interests of diverse stakeholders.
- **Platform** – Simulation tools may or may not be computer-assisted.

In terms of substance, ETS simulations have either focused on policy design or trading dynamics in a carbon market:

- **Policy design:** Based on fictitious country information, participants are given various stakeholder roles to simulate parts of the ETS design process, such as deciding on the cap.
- **Trading:** Key elements of an ETS are simulated and companies are given fictitious information and economic resources in order to comply with the virtual ETS regulations. All interactions and trades take place in a virtual marketplace.

ETS simulation programs have been developed by:

- Environmental Defense Fund – CarbonSim
- International Carbon Action Partnership - Carbono
- Motu Economic and Public Policy Research in New Zealand – Emissions trading

ETS simulations have taken place in over 20 countries and several states and provinces across six continents.

WHY USE CARBON MARKET SIMULATIONS?

Before the EU started with its ETS, there was little familiarity with the real-life functioning of a carbon market. Simulation exercises turned out to be a most useful capacity building tool that allowed key players in the administration and in the industry to get used to emissions trading. Simulations allowed for the testing of different ETS design options and for developing trading strategies by companies. The interactive nature of the tool helped stakeholder engagement and policy design.

- Jos Delbeke, Professor, European University Institute and former Director General, DG-Clima, European Commission

Depending on their design and participants, simulations can serve several objectives, including:

1. **Learning and capacity building:** At the start of an ETS development process, key stakeholders – including government officials, regulated entities and civil society stakeholders – may have limited practical experience with markets. Significant work may be required to explain how carbon markets work, as well as how they can be designed to meet the needs of business and society. Simulations can be one tool to help build knowledge and expertise on emissions trading.

Simulations can help:

- Learning and capacity building
- Design testing
- Engagement and outreach
- Building trust and mutual understanding

While any stakeholder can take part in ETS simulations, past exercises have focused on building

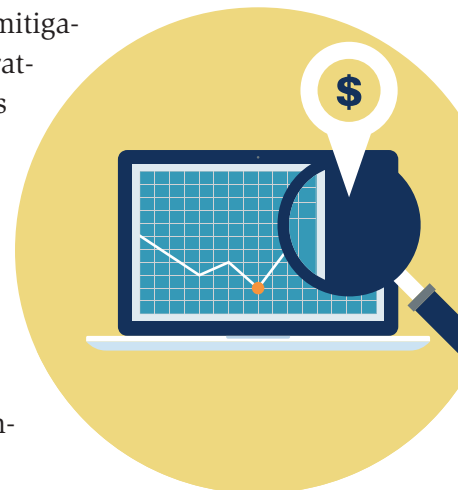
capacity for policymakers, companies and the financial sector:

- By participating in a carbon market simulation, government officials can understand **how an ETS functions and the steps involved in the design process**. Simulations can also give policymakers some exposure to typical **stakeholder concerns** or interests, as well as highlighting **trade-offs** involved in the design process.

The Santiago carbon market exercises were excellent. Participants holding a range of views were able to collaborate and participate in an experiential learning process that demonstrated how emissions markets work and can be designed to serve the interests of diverse stakeholders.

- Juan Pedro Searle Solar, Head of Climate Change Unit in the Ministry of Energy of Chile

- Companies can gain an initial understanding how an ETS would affect them, as well as how to **comply with future regulation**. They can start to learn how to **factor a carbon price into their business strategy**. Simulations may encourage companies to begin thinking about when to invest in emissions reductions, as well as a broader awareness of the need to develop mitigation and trading strategies. Simulations can also flag the **importance of involving other departments**, such as planning, procurement and legal, in developing smart carbon management decisions.



- If the ETS will be open to other actors **in the financial sector**, like traders and investment banks, their involvement in simulations can help familiarize them with the system, as well as potential financial products and the role they can play in the carbon market.
- 2. Engagement and outreach:** Carbon markets can initially come across as a complex economic instrument and there may also be some misconceptions about an ETS. Giving stakeholders a hands-on experience with emissions trading can **help build support** for a carbon market both within the government and amongst the private sector. An online simulation tool can also make the “ETS experience” more easily accessible.
 - 3. Building trust and mutual understanding:** ETS design and implementation require coordination and collaboration across government departments and different stakeholder groups. Simulations can be a powerful tool for **bringing together representatives** from different institutions to **interact in a safe and relaxed setting**. Going through a fictitious policy design process may help with clarifying the arguments underlying certain positions and with **building a common understanding** of key policy options, their benefits and draw backs. The personal relationships and trust created through this experience may be beneficial in the next steps of the process.
 - 4. Design testing:** ETSs can be designed in different ways to fit different jurisdictional contexts and socio-economic circumstances. Simulations can help test out the **effects of different design decisions**, including allocation and offset decisions, to better address key policy priorities, amplify co-benefits and minimize the risk of any undesired outcomes. By testing these options at an early stage, stakeholders can **understand some of the potential impacts** of the program and the trade-offs involved

in its design. If conducted at an early stage, they may also help inform policymakers’ decisions on appropriate design features.

Simulations can be run by governments to meet these objectives but can also be organized by the private sector either to advocate for an ETS or in anticipation of one. What kind of simulation tool is used will depend on the audience, objectives and resources of the government and/or companies. Simulations can run over the course of a day or last several weeks or months. When designing or choosing a simulation, it is important to be clear which of the above objectives should be prioritized as this has implications for the set-up and selection of participants.

WHAT ARE THE LIMITATIONS OF SIMULATIONS?

There are limitations of simulations (see table 1 for a comparison of simulated vs. real-life carbon trading). Some relate to their design -- others as to how simulations can or should be used.

“It’s important for those of us working on carbon markets to have sense of how they work on trading desks.”

- Jackson Ewing, Senior Fellow, Nicholas Institute for Environmental Policy Solutions at Duke University

Though powerful, ETS simulations have limits as they:

- Are imperfect, simplified models of real life
- Cannot accurately reflect the impact of non-ETS drivers
- Should not be used simultaneously to train participants and predict how an ETS will play out in real life.

Table 1: Differences between simulation and real world ETS participants

Participating in Carbon Trading Simulations vs a Real World ETS

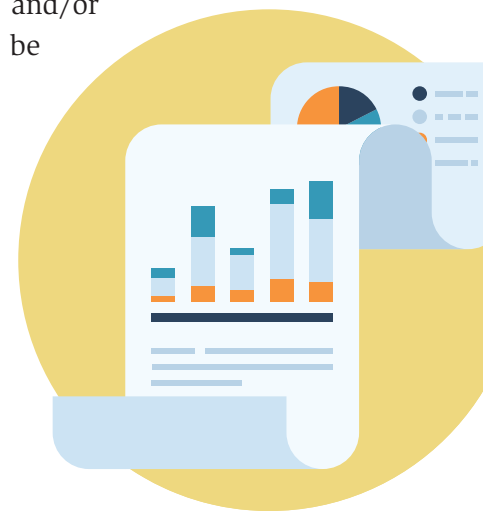
	Simulation	Real World
Prior training	Likely little	Extensive
Oversight	Only within the confines of the game	Extensive – internal auditors and external inspectors
Motivation	To learn and win	Avoid noncompliance Meet corporate climate targets
Consequences	Negligible: <ul style="list-style-type: none"> • High performers may win accolades from peers and possibly a modest prize • Poor performers get to learn from their experiences 	Extensive and consequential: <ul style="list-style-type: none"> • High performers may get to keep their jobs, secure a bonus. • Weak performers may receive/be responsible for: criticism by boss, company fines, job loss(es), company shutdown, jail
Non-carbon drivers	Weak influence, if any	Extensive and consequential

Simulations provide a **simplified model** of an actual ETS. As such, care should be taken with the results of a simulation exercise as this may not accurately predict how an ETS would play out in real life. Without incurring great expense, it will be challenging to use the simulation to accurately replicate real-world conditions.

Simulations **cut down the number of factors participants face** compared to a real world ETS. This not only includes a simplified ETS design, but in real life, other factors - including those associated with electricity dispatch restrictions (and prices), labor costs and alternative fuel availability - will likely play a bigger role than in the simulation. Participants are also free of internal oversight or significant consequences in case they make poor design or compliance choices.

In reality, a carbon portfolio manager’s job will be far more complex than a simulation participant.

For all these reasons, as compared to their real-world counterparts, simulation participants may tend to take outsized 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 to derive policy implications.



HOW CAN SIMULATION TOOLS BE MORE EFFECTIVE?

This carbon market simulation tool provides the private sector with a practical way to understand the component parts and dynamics of a carbon market. It underscores the importance of ETS design and why it is critical to participate in the development phase of a carbon market.

- Carolina Rodriguez Gonzalez,
Environmental Coordinator, LafargeHolcim

There are several opportunities to enhance the impact of carbon market simulations.

Tips on using simulations:

- Run simulations early in the policy process
- Use repeatedly or over a longer period
- Integrate them in the broader engagement process
- Encourage broad participation
- Encourage cross-organizational participation
- Involve independent experts
- Consider and heed lessons learned from previous simulations
- Add information to make the simulation more realistic
- Run simulations in controlled settings
- Collaborate with trade associations

Run simulations early in the policy process. At the very early stages of an ETS development process, policymakers and stakeholders alike can benefit significantly from participating in simulations. Doing so will increase ETS literacy, engage a broader set of stakeholders in policy conversations, and provide participants with an opportunity to gain first-hand knowledge about the mechanics of carbon markets. It can

also help them understand the differences between an ETS and other climate policies like a carbon tax or command and control regulations. This sort of experience may also serve to dispel pre-conceived notions about an ETS and convey the idea that an ETS can be a cost-efficient way to reduce emissions. A clear understanding of emissions trading can also help build support for the policy.

Use repeatedly or over a longer period. Multiple simulations or simulations that run for longer periods encourage participants to get comfortable with emissions trading. They can try out different strategies in a continual learning process.

Integrate simulations in a broader engagement process. Policymakers may want to deliberately integrate simulations as an element of their stakeholder outreach and discussions. As simulation participants understand and engage more with the ETS, holding simulations in tandem with stakeholder discussions can improve the quality and level of the latter.

Encourage broad participation. In a simulation, different stakeholders – e.g., regulated industries, politicians, and NGOs -- can find themselves as teammates. And simulations can be structured to allow participants to assume roles other than those that they hold in real life -- e.g., regulators can assume the role of companies. This serves to lessen barriers that might normally divide stakeholders, build understanding for opposing viewpoints, and, in turn, contribute to richer and more meaningful discussions.

An ETS simulation can change people's attitude from "ETS is a burden for business" to "Business can make a profit from this system if they make a right decision, mitigate first and sell later".

- Sumon Sumetchoengprachya, Director,
Carbon Business Office, Thailand
Greenhouse Gas Management
Organization

Encourage cross-organizational participation. For regulated companies, given an ETS will affect many departments – from legal to procurement, production and trading – efforts should be made to include representatives from all relevant departments. By involving all relevant parties at an early stage, this ensures companies are better prepared for the realities of emissions trading.

Involve independent experts. Involving external experts, such as representatives from universities or research institutes, in the design and running of a simulation lets policymakers and businesses leverage existing expertise, particularly when it involves technical topics. Given their independence from the policy development process, it can help build trust in and legitimize the simulation exercise.

Consider and heed lessons learned from existing ETSs and previous simulations. Where relevant, incorporating best practices and lessons learned from ETSs that are already in operation can help create a more effective simulation experience. Equally, before developing new tools, consider using or building upon the exercises and tools that have been run and developed previously. These have already generated significant lessons that organizers of future exercises can build on.

Add information to make simulations more realistic. Adding design features or inputting data that reflects the latest information and/or local environment can help make simulations more realistic and accessible.

Depending on the design of the ETS and objectives of the simulation, such additional information could include:

- The impact of the co-benefits of emissions trading;
- Other climate, energy or fiscal policies;
- A comparison with a carbon tax;
- International markets like aviation or linking to other regions;
- Risk-hedging instruments like future trades; and
- Broader participation than just regulated companies to allow for more liquidity and speculation in the market.

Run simulations in controlled settings. If conducted in a controlled fashion, simulations can yield results that will also be useful for policymakers. Knowing how participants react when faced with different market designs and circumstances can help policymakers promote or guard against certain behavior. While some efforts have been made in this area^{1,2} a greater investment could yield more useful results.

Collaborate with professional trade associations. Industrial emitters which are (or could be) subject to an ETS may be more inclined to participate in simulations if they are invited to do so by their respective trade associations.

1. University of Virginia – PEAR Project Team. “Investigation of the Effects of Emission Market Design on the Market-Based Compliance Mechanism of the California Cap on Greenhouse Gas Emissions”. February 12, 2013.

2. See MexiCO2 and EDF. “Ejercicio de Simulación del Mercado de Carbono en México Reporte de resultados de la tercera simulación”.

MORE INFORMATION

Context: The Carbon Pricing Leadership Coalition (CPLC) is a voluntary partnership of governments, businesses, and civil society organizations working together to identify and address the key challenges to the successful use of carbon pricing to combat climate change. This Briefing Note was prepared in collaboration with the International Carbon Action Partnership (ICAP). It was authored by Josh Margolis Environmental Defense Fund (EDF), and Constanze Haug (ICAP). The Authors are grateful to Marissa Santikarn, Marcos Castro, Tom Erb and Angela Churie Kallhauge for their input and guidance.

References: This Briefing Note is a synthesis of ideas and literature derived from the key references listed here.

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