

EMISSIONS TRADING SIMULATION

Markets by ChoiceResults by Design

Josh Margolis, CarbonSim simulation expert

Formerly Managing Director at EDF

Why Simulations?

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 roll-out time

Caution - Simulations:

- Provide a simplified model
- May not accurately predict real-life ETS

Public Disclosure Authorized

CP
LC
CARBON PRICING
LEADERSHIP COALITION

Technical Note
April 2020

icap

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.



Public Disclosure Authorized

[World Bank Simulation Report](#)

Key terms

Emissions cap

Emissions trading/cap and trade

Goals

Compliance obligation

Compliance instruments

- Emission 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)

Over-the-counter (OTC) trading market (secondary market)

Compliance vs voluntary market

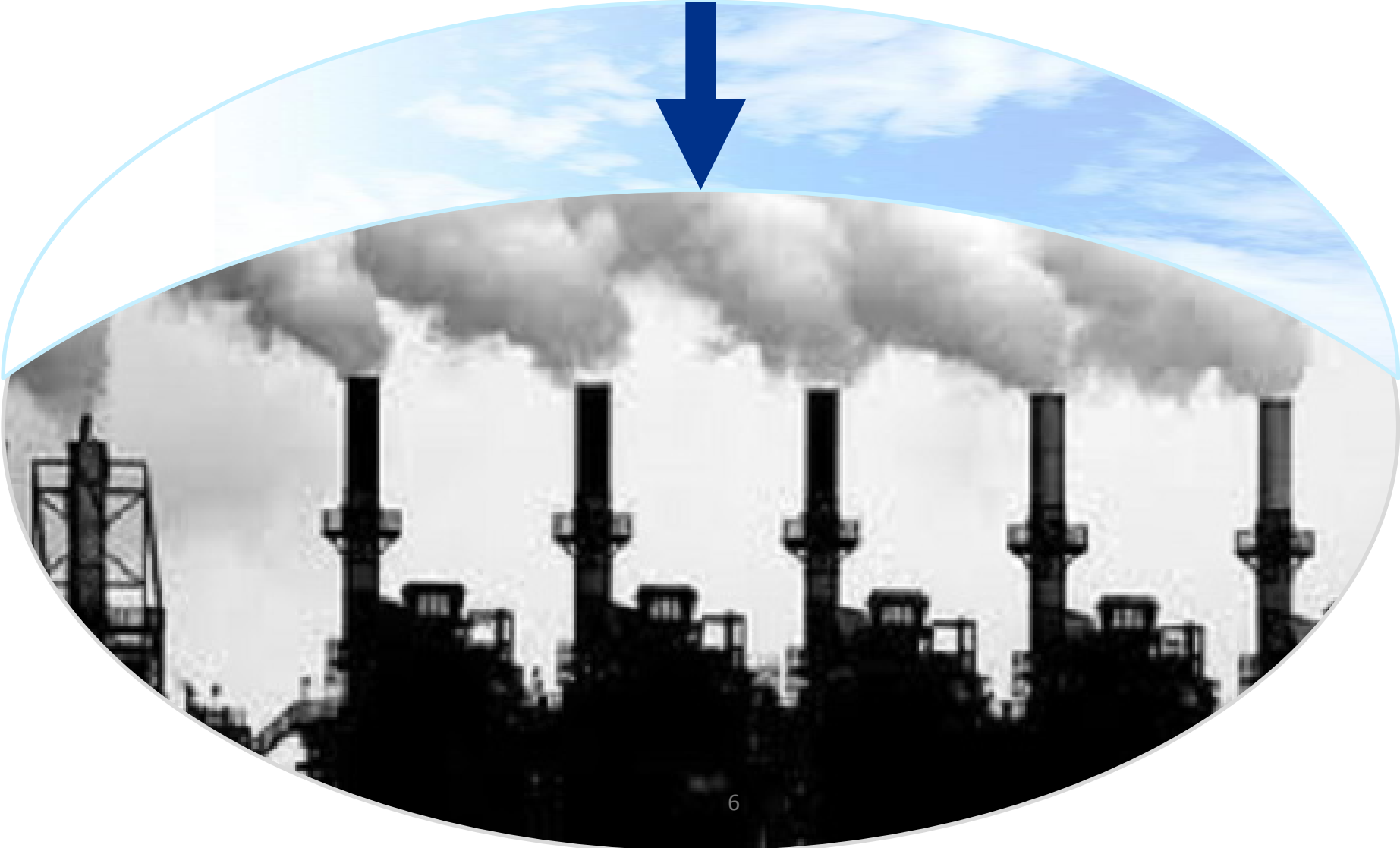
PRIZES



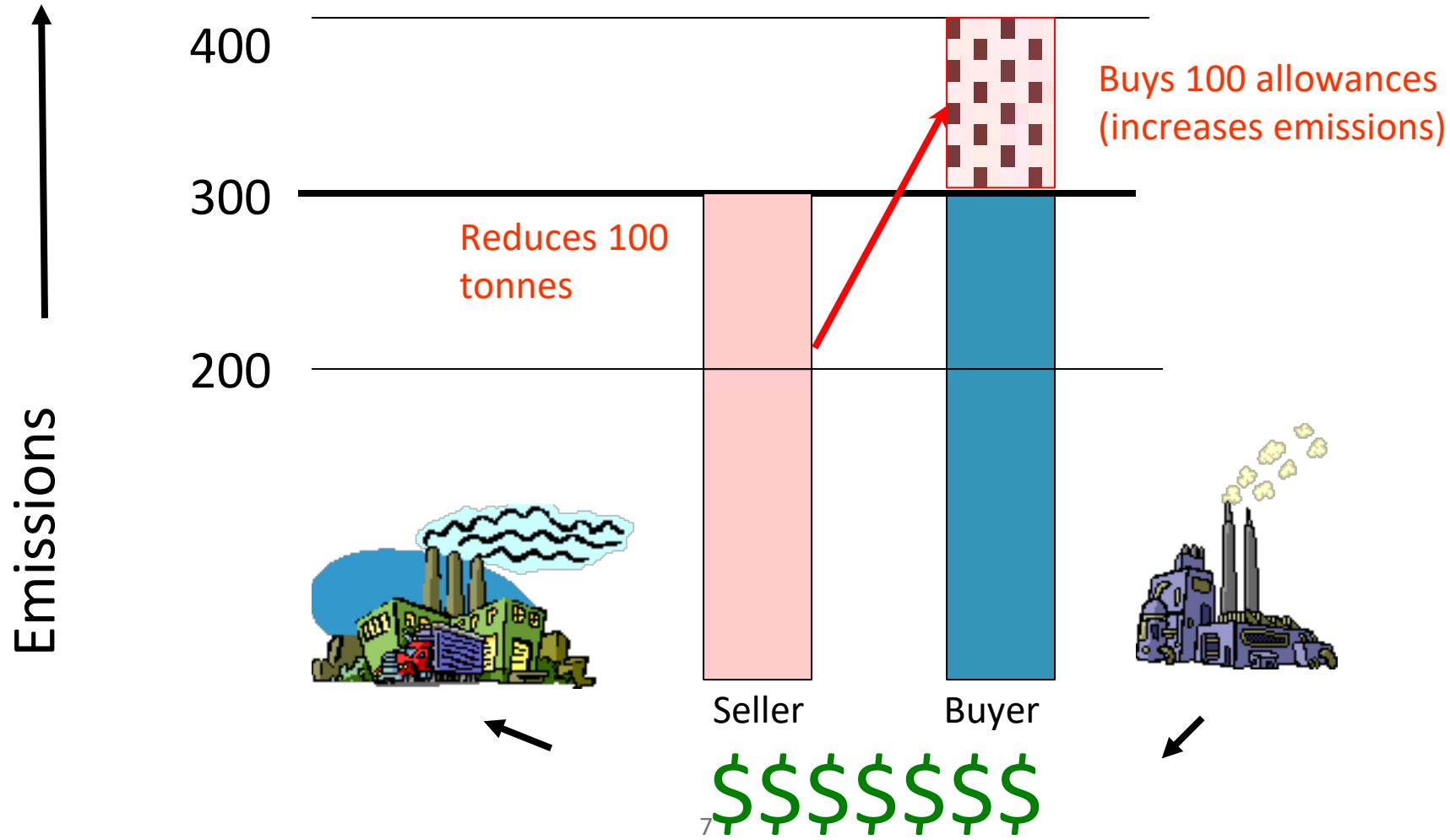


China, Korea, Vietnam, Thailand, Japan, India, US, Dominican Republic, Colombia, Ukraine, Brazil, Mexico, Chile, Europe, Wharton, Lewis & Clark, Duke, Yale, Columbia, UCSB Bren, UC Santa Cruz, Georgia Tech, Northeastern, Newcastle Law, Universidad Jesuita de Guadalajara, Universidad de los Andes, University of Queensland, Vrije Universiteit Amsterdam, University of Western Ontario, Saint Ignatius, Pacific Collegiate School

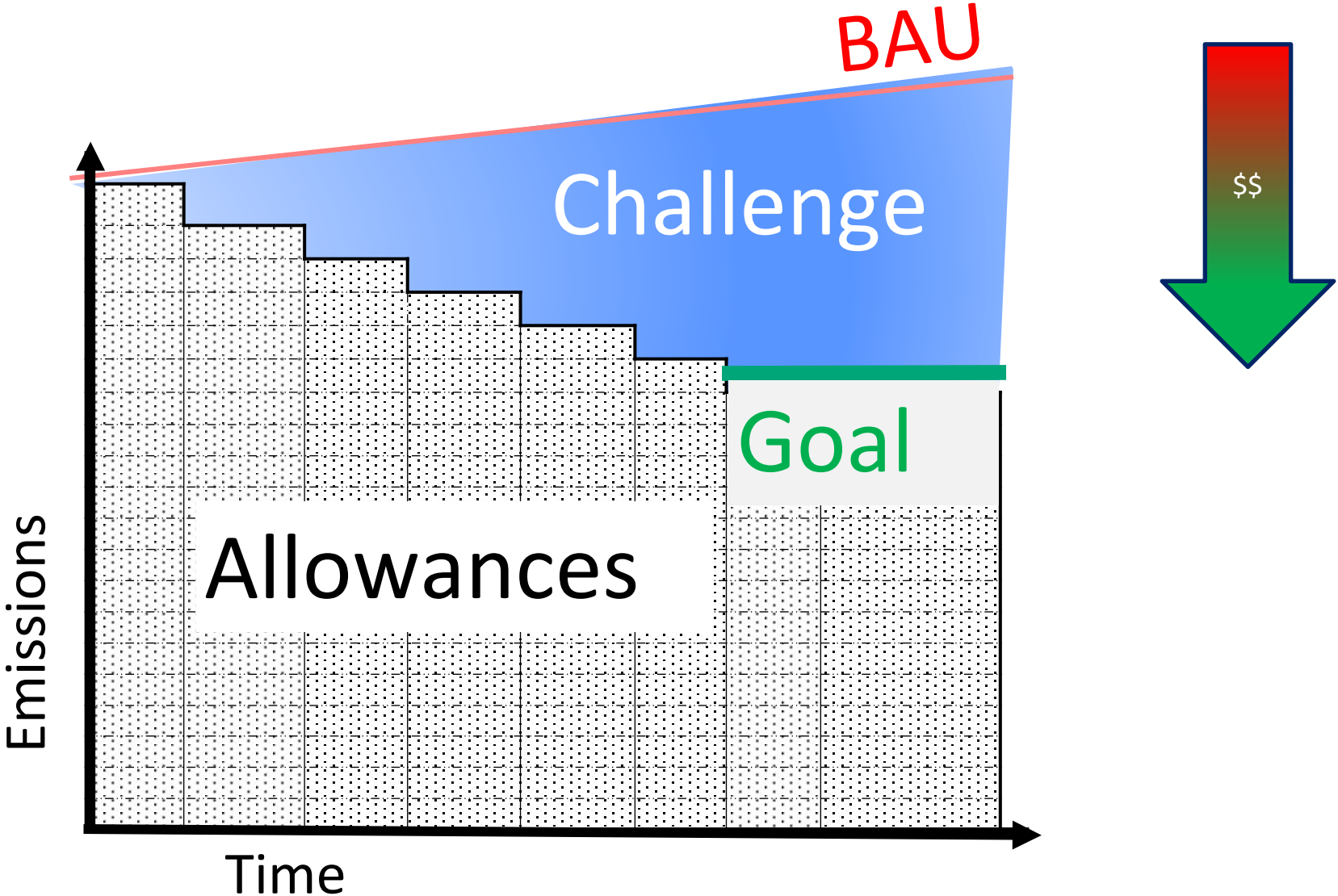
ETS Basics – The Cap



ETS Basics - Trade



Objective



CarbonSim Schedule

YEAR 1, 2, 3, $n = 20$ MINUTES/YR

ABATEMENT

Auction 1
2:15

2:45

Auction 2
2:15

2:45

Auction 3
2:15

2:45

Auction 4
2:15

2:45

EXCHANGE TRADES

OVER THE COUNTER TRADES

DISCUSSION – QUESTIONS – LESSONS LEARNED

OBJECTIVE



Each team will manage a company participating in the emissions trading system. **Objective: Comply at lowest cost.**

Choices

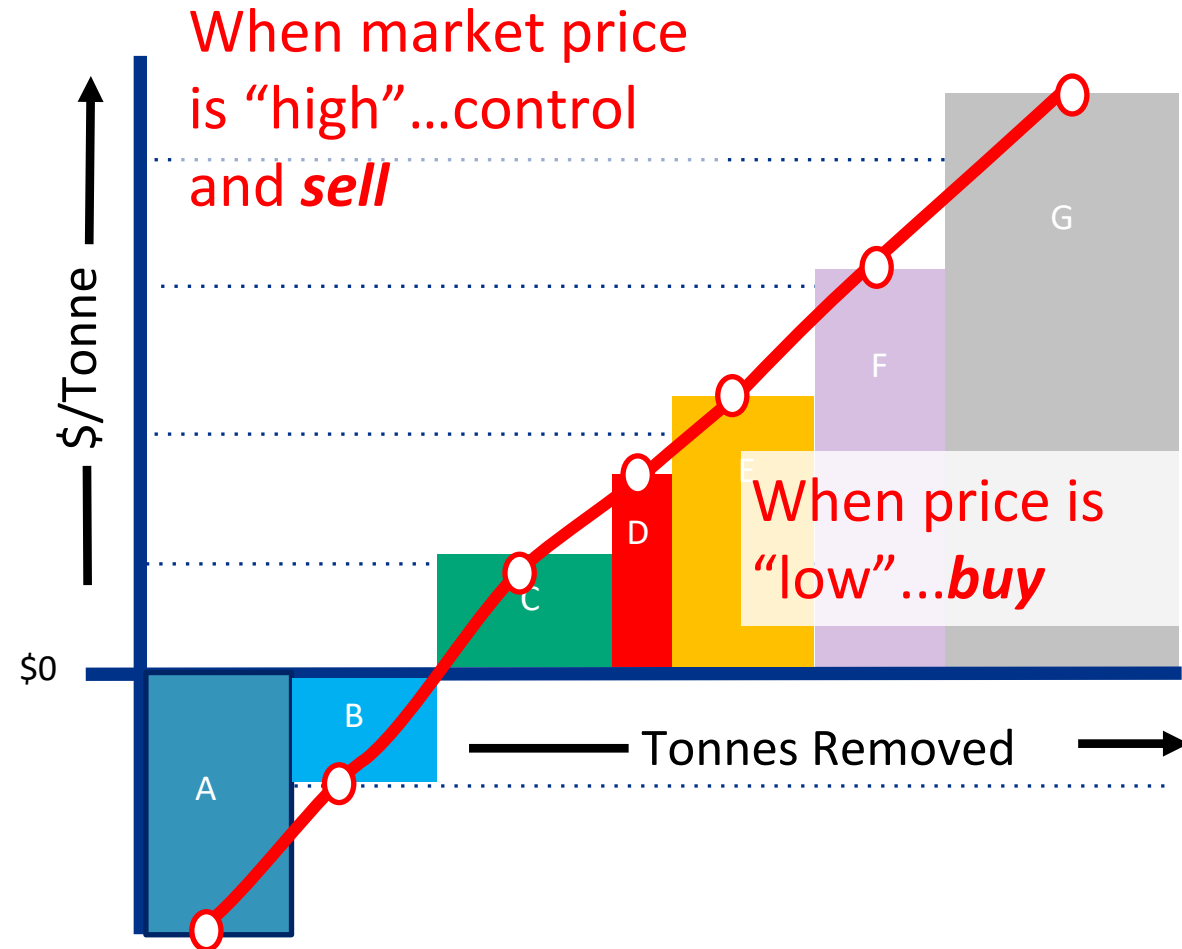




ETS Basics - Control, Buy, or Sell?

- On-site controls
- No need to trade
- Build time
- Irreversible

Marginal Abatement Control Cost Curve



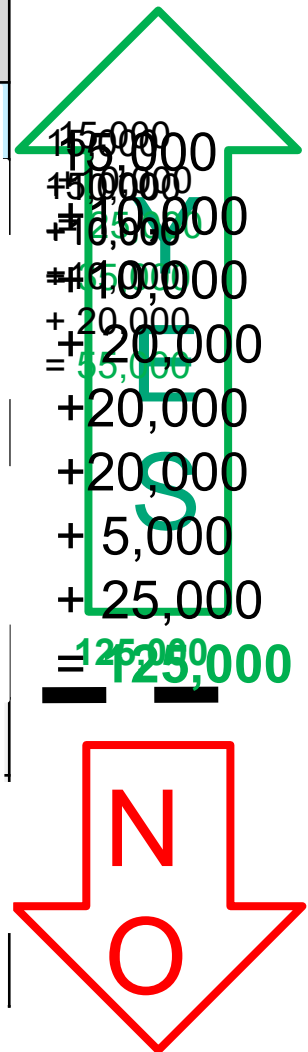


- Sealed bid
- Uniform price
- Price and quantity
- Multiple bids OK
- Winners pay same
- Clearing price = last fill
- Low bids don't trade

125,000 for Auction			
Bids	Price (\$/ton)	Quantity (tons)	Aggregate Demand

Rank Bids by Unit Price – Highest to Lowest

Sold 125,000 ~ \$45



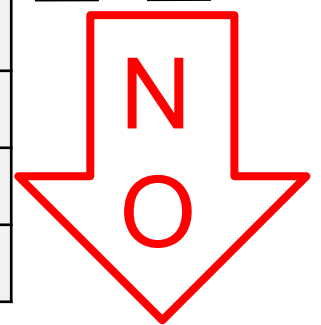


- Sealed bid
- Uniform price
- Price and quantity
- Multiple bids OK
- Winners pay same
- Clearing price = last fill
- Low bids don't trade

125,000 for Auction			
Bids	Price (\$/ton)	Quantity (tons)	Aggregate Demand
E	60	15,000	15,000
A	59	10,000	25,000
B	58	10,000	35,000
D	55	20,000	55,000
E	50	20,000	75,000
A	49	20,000	95,000
C	47	5,000	100,000
E	45	25,000	125,000
D	39	10,000	135,000
B	37	25,000	160,000
A	35	40,000	200,000
C	30	20,000	220,000

Sold
125,000
~ \$45

15,000
+ 10,000
+ 10,000
+ 20,000
+ 20,000
+ 20,000
+ 5,000
+ 25,000
= 125,000





Last Trade

- Multiple buyers, sellers
- Inside bid & offer
- Market depth
- Recent trades
- Anytime*
- Market, limit, stop loss, partial fill orders

Exchange					
Current Market			Last 10 Trades		
	Tonnes	Price/ton	Time	Price/ton	Tons
SELLING	30,000	48.90	14.42.10	45.12	10,000
	60,000	48.00	14.41.00	45.12	10,000
	10,000	46.10	14.38.22	45.40	20,000
	5,000	45.25	14.38.01	46.00	15,000
	25,000	45.10	14.37.45	46.25	20,000
BUYING	15,000	45.00	14.36.22	47.00	5,000
	35,000	43.90	14.35.33	47.25	25,000
	15,000	42.10	14.32.52	48.00	10,000
	5,000	42.00	14.10.05	48.10	25,000
	42,000	41.75	14.01.34	48.00	40,000

Inside Market



Market Order	Purchase or sell specific quantity at the then current market price.
Limit Order	Set a minimum sell price or a maximum buy price . Order will only be cleared if the limit price is reached.
Stop Loss Order	Order will be cleared once the market price reaches the specified level. Sellers (Buyers) can protect their position if the market falls (rises) beyond the order price.
Partial Fill Order	Order can be filled if less than the entire volume can be sold/bought.
Immediate or Cancel	(‘Fill or Kill’): An order to buy or sell a specified number of units that is immediate filled. If the order cannot be immediately filled, it is automatically cancelled (killed).



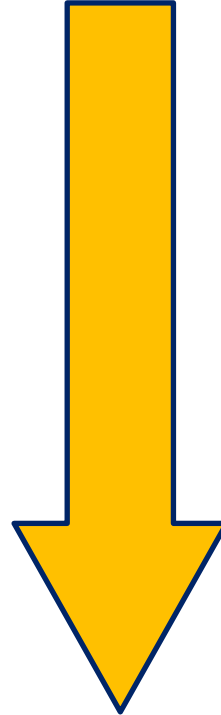
- Single buyer, seller
- Product, price, volume
- Anytime*

CarbonSim Schedule

Virtual Year #		Real Time*
Day 1	Training	60 mins
	Year 1	20 mins
	Year 2	20 mins
	Year 3	20 mins
Day 2	Year 1	30 mins
	Year 2	20 mins
	Year 3	20 mins
	Year n & survey	20 mins
Wrap up and award ceremony		

Each and Every Year

Abatement



Auction

Auction 1

Interim

Auction 2

Interim

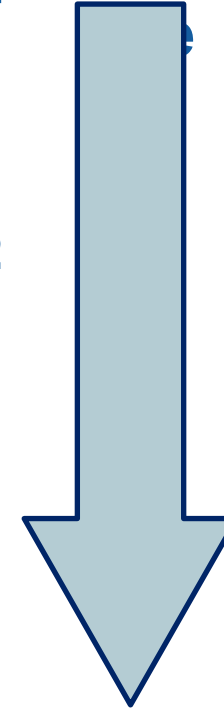
Auction 3

Interim

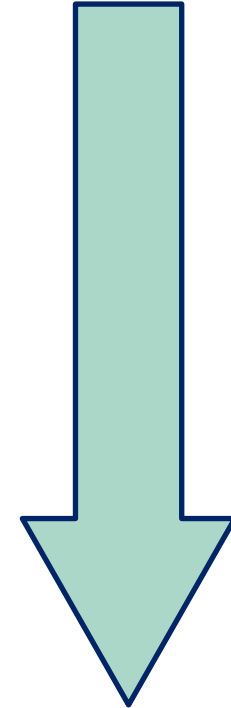
Auction 4

Interim

Exchange



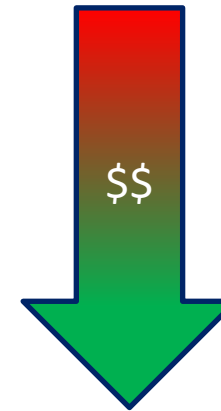
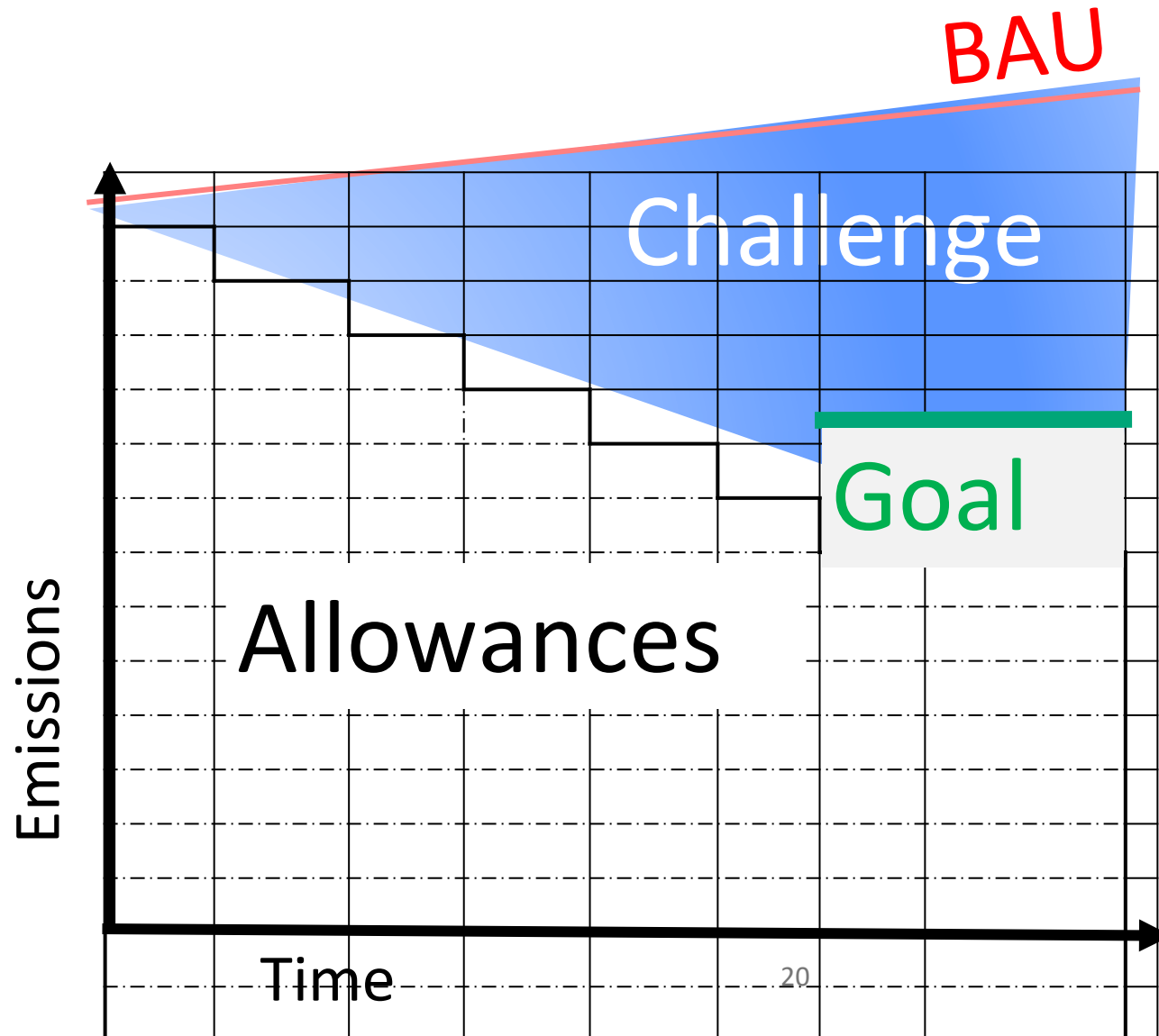
OTC



ETS parameters

Cap	355,850,000
Duration	5-6 years (20 – 30 mins)
Enterprises	242 (~36 humans and 206 AI bots)
Reduction target	15-18% (3%/year)
Share of free allowances	90%
Economic/emissions growth	2 – 6%/year
Banking limit	100% compliance obligation
Maximum offset use	10% compliance obligation
Auction <ul style="list-style-type: none">- Schedule- Duration- Price floor / ceiling- Vintages	4 per year 45% of the year \$100 / \$300 Current + future years
Penalty (per missing EA)	\$300 + 1 Allowance
Exchange volatility management	10%


Objective



~~To Win~~ .. *Do Well*

- Comply
- Manage (reduce) cost of control
- Abate early
- Participate in all markets – throughout the sim
- Try posting two-way markets
- Manage ‘long’ / ‘short’ positions
- Orders good ‘til cancelled
- Wandering fingers - enter once – be patient
- Choices (and inaction) have consequences

Registration

1. 2-3 people per group/company
2. Close all programs on the computer
3. Connect to WiFi
4. Use a browser
5. Open the page:  sim3.carbonsim.org
6. Select language
7. Select: Register (not log in)
8. Enter personal information:
 - Account name: [first names of student]
 - Password: [optional]
9. Enter PIN = ****

Player Registration sim3.carbonsim.org



~~Login~~

Email Address

Password

Login

[Forgot your password?](#)

[Back](#)

Register

Access Pin

1

Player Name

2
Josh & Can

Email Address

3

Password

4

Company Name

5

- Công ty xăng dầu Petrolimex 2
- Công ty xi măng Bim Sơn - C
- Nhà máy điện Đồng Nai- For
- Nhà máy điện Hải Phòng
- Nhà máy điện Khánh Hòa
- Nhà máy điện khí Cà Ná
- Nhà máy điện khí Dung Quất



CarbonSim

Cheat Sheet

WHAT IT IS

CarbonSim is a fun, artificial intelligence-enhanced, multi-lingual, multi-user, software application that uses riskless experiential learning to teach the principles of emissions trading systems (ETSs) and bring markets to life.

WHO IT'S FOR

- Policymakers use **CarbonSim** to see how choices they make affect the environmental and economic performance of an ETS.
- Companies use **CarbonSim** to learn how to develop and implement carbon portfolio management strategies.

HOW IT WORKS

Participants manage virtual companies with a surplus of carbon emissions and a shortage of emission rights. Players start *long* emissions and *short* emission rights.

WHAT'S THE GOAL

As the carbon portfolio manager, by the end of each year players must reduce emissions and/or secure sufficient emission rights. The goal -- comply at the lowest possible cost.

STRATEGIES

To do well you must spend the least money to eliminate the shortfall and comply each year. Here are some tips: abate early, participate in all markets, compare prices, make smart investments and consider Allowances and Offsets as revenue streams.

ABATEMENTS

Before going to the Market, consider implementing technologies that reduce your emissions. Best are those that can be implemented in a short time, are within your budget, and which have a low marginal cost of control.

MARKET

Depending on the cost, it may be prudent to resolve your emissions rights shortfall through Auctions, the Exchange, and the Over-the-Counter, or OTC Market. Similarly, you can use the market to sell surplus Allowances and Offsets.

KEY TERMS

CAP AND TRADE

The cap limits system-wide and facility specific emissions. Facilities that emit less than allowed can sell/trade surplus Allowances and Offsets. If you are short you can reduce emissions via Abatements or purchase allowances and Offsets through the Market.

ALLOWANCE

A license issued by the government, to emit one ton of CO₂. Issued in vintages which correspond to the years of the game. Year 1 Allowances can be used in Year 1 or banked for use in Year 2. Future year Allowances can be transacted, but cannot be used in prior years.

OFFSETS

The holder of an Offset can emit one ton of CO₂. Unlike an Allowance, an Offset results from an emission reduction from a source that is not covered by the ETS. Offsets do not have vintages and can be used in any year. The ETS likely will limit the number of Offsets that can be used.

AUCTION MARKET

A means by which you can buy Allowances in government-sponsored sealed-bid, single-round auctions where all winning bids pay the same price. Auctioned Allowances are included in the Cap. There may be multiple Auctions each year and multiple vintages offered for sale in each Auction.

EXCHANGE MARKET

Much like the stock market, the Exchange Market is the most efficient place to buy and sell Allowances and Offsets. Unlike the OTC Market, orders are matched against all others that are then active on the Exchange. You can transact using market, limit, and stop loss orders.

OVER-THE-COUNTER MARKET

A Market where you can transact Allowances and Offsets through customized trades with other participants. The OTC Market is the least efficient of the three markets. The OTC and Exchange Markets make up the secondary market -- whereas the Auction is the primary market.

Google drive:

[https://drive.google.com/drive/folders/1NuBTupLJdwbw3vm9Hxlb-qdSo6wj7KX?usp=share link](https://drive.google.com/drive/folders/1NuBTupLJdwbw3vm9Hxlb-qdSo6wj7KX?usp=share_link)

Let the Games Begin!



Each team will manage a company participating in the emissions trading system.

What if....?

- Policy scenarios
- Term
- Banking
- Auction price collars
- Penalties
- Limitations
- Linking

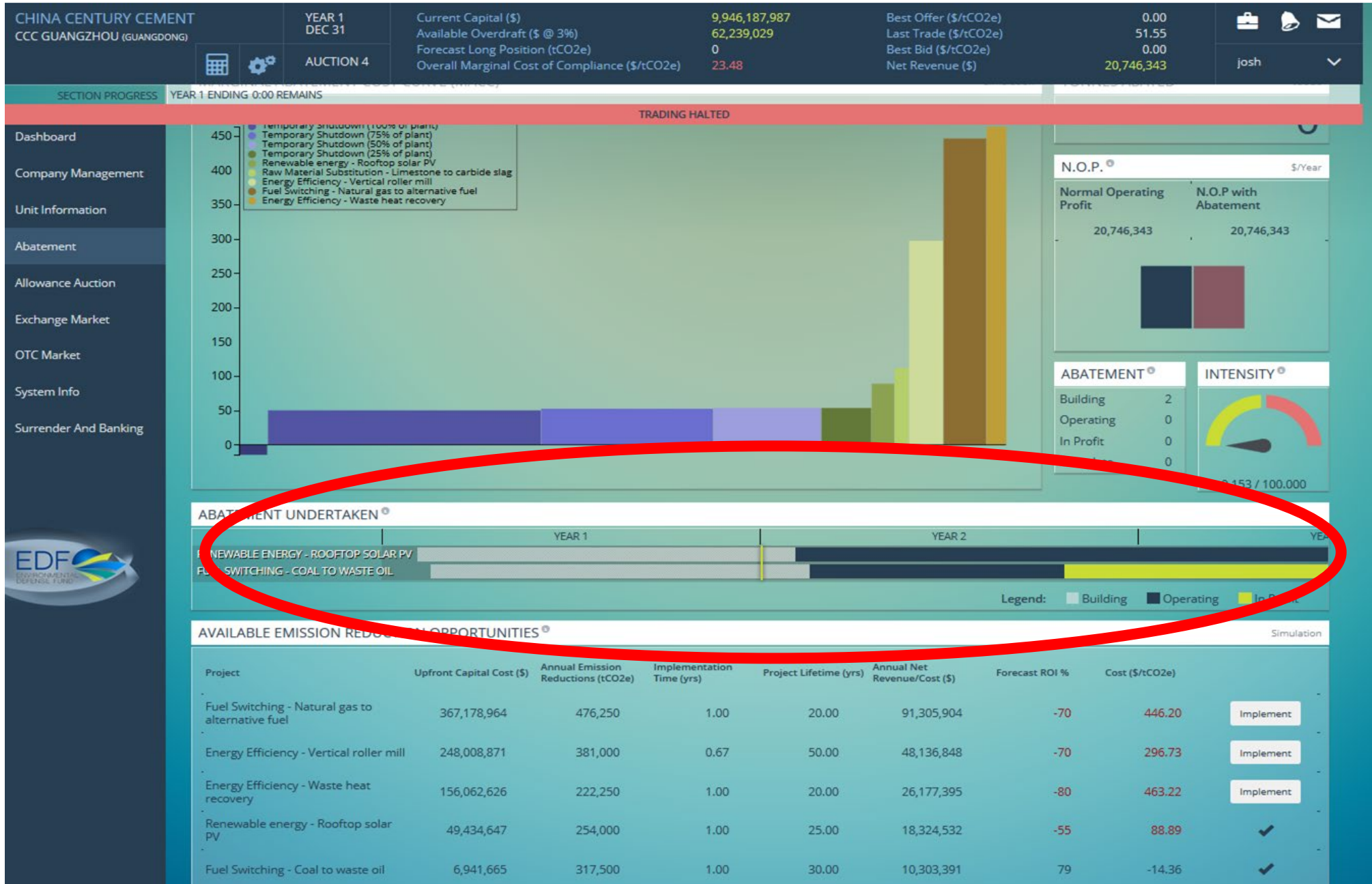
3 Years, 90% free, 3rd Year



10 Year, 90% free, 10th Year



Abatements – 3 year, year 1



3 vs 10 year Sim

		3 Year Term	10 Year Term			
		3 Year Term	10 Year	Delta		Delta
		Year 3	Year 3	vs 3 term	Year 10	vs 3 term
Abatements	106.7 M	449 M	4.2	2.24B	25.7	
Offsets	24.4 M	4.6 M	0.2	10.8M	0.6	
Reductions	57.4 M	454 M	8	2.25B	21.0	

THANK YOU!



Zalo/WhatsApp: +1-415-601-4084



Email: Josh.EnvMkts@gmail.com