

# Regional Greenhouse Gas Initiative (RGGI)

## CO<sub>2</sub> Cap and Trade Program

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Sydney Emissions Allowance Trading Workshop Presentation,  
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## Regional Greenhouse Gas Initiative

- 10 Northeast States (research funded by NY)
- “cap and trade” program for CO<sub>2</sub> starting in 2009
- **All agreed to auction at least 25% of allowances**
- (c.f. *at most* 5% in the EU ETS, now 10%)
- NY, MA, and four other states will auction 100%
- Revenues for strategic energy initiatives, “public benefit”
- RGGI: precursor to a US national program?
- As first program to auction substantial fraction of allowances, RGGI will have global impact



## Why Auctions? Avoid Rent Seeking

- “beauty contest” allocations of US spectrum licenses
- Opposition to market allocations
- First crack, 1980s, FCC conducted a lottery
- 320,000 applications for 643 cell phone licenses
- Accounting firms prepared applications, about \$600 each
- Total application costs: about 40% of ex postresale value
- “accountants and lawyers are people too”
- FCC’s switch to auctions has been viewed as a major success in raising revenues with minimal rent seeking



## Experimental Economics Methodology

Auction “experiments” used to test alternative institutions

- > 100 “sessions” lasting 1-2 hours
- > 1,000 participants
- > 10,000 auctions
- > budget of \$30,000 in payments

Human subjects, paid based on earnings, bid in auctions and then earn money in subsequent spot market trading.

RAs: They ran and analyzed experiments on yesterday and the day before! Erica Myers, Anthony Paul, Danny Kahn, Susie Chung (all at RFF); Lindsay Osco, Ina Clark, Courtney Mallow, AJ Bostian, Angela Smith (all at UVA)



## Structure of a Policy Experiment

- Students or relevant professionals (e.g. farmers)
- Read rules and provide financial incentives
- Put them in alternative environments, e.g. different auction formats
- Observe and compare outcomes, e.g. auction revenue, economic efficiency, possible political effects



## Dual Punch

- Experiments provide consultant with the confidence to make recommendations that are relatively free of assumptions
- Experiments provide the policy maker with a clearer view of how the policy might work
- “We think that their experience of playing the roles of bidders within our experimental software had a significant effect on bolstering the confidence of non-economists on the auction team in the workability of the design. By contrast, mathematical equations have very little persuasive power.” Binmore and Klemperer



## 2004 Virginia NOx Auction

- Nitrous oxide (NOx) emission allowances
- 1855 one-ton allowances for each of 2004 and 2005 years, tradable in 19 state area
- (5 percent of state total, the rest are “grandfathered” based on high use)
- Auction decision: driven by budget crisis
- Auction: fast, transparent, and fair (as compared with “leaking” sales to the spot market)



## Experiments

- Bill Shobe worked with George Mason team that included Vernon Smith, shortly after “go ahead” decision made in Dec. 2003
- 8-12 students per group
- Neutral instructions
- Repetition (12 auctions per session)
- Induced unit values for allowances or “permits”
- 4 different value ranges (narrow to wide)
- Earnings = values of permits acquired – prices paid
- All payments made in cash



## Alternative Auctions

- Sealed bid: “pay as bid” one round submission of dollar amounts for given number of 1-ton allowances
- English Clock – prices determined by a clock, starting low. At each price, bidders indicate desired quantities. Bidding stops when the total bid quantity falls to equal the available supply (revenue max at last stage)



## Tight Design Phase

- RPF in May, contract award in early June, software and instructions in mid June, auction on June 24, 2004
- Winning bidder had seen theoretical paper by famous University of Maryland economists on internet recommending a clock auction
- Sequential vs. simultaneous auctioning of 2004 and 2005 vintages
- State opted for sequential auctions on basis of transparency, over the objections of the academic advisors



## Successful Auction Outcome

- Inexpensive to run: \$200,000, yielded high revenue: \$10.5 million
- High prices, 5-7 percent above spot prices
- One bidder with a large share was keeping the auction open and began experimenting with small quantity reductions until it stopped, Bill believes that they would have stopped the clock earlier if they had observed excess demand after each stage of bidding
- Quick implementation: Bill had complete control, since nobody in upper management positions wanted to be associated with a first-of-kind auction with political risks



## 2001 Irrigation Reduction Auction

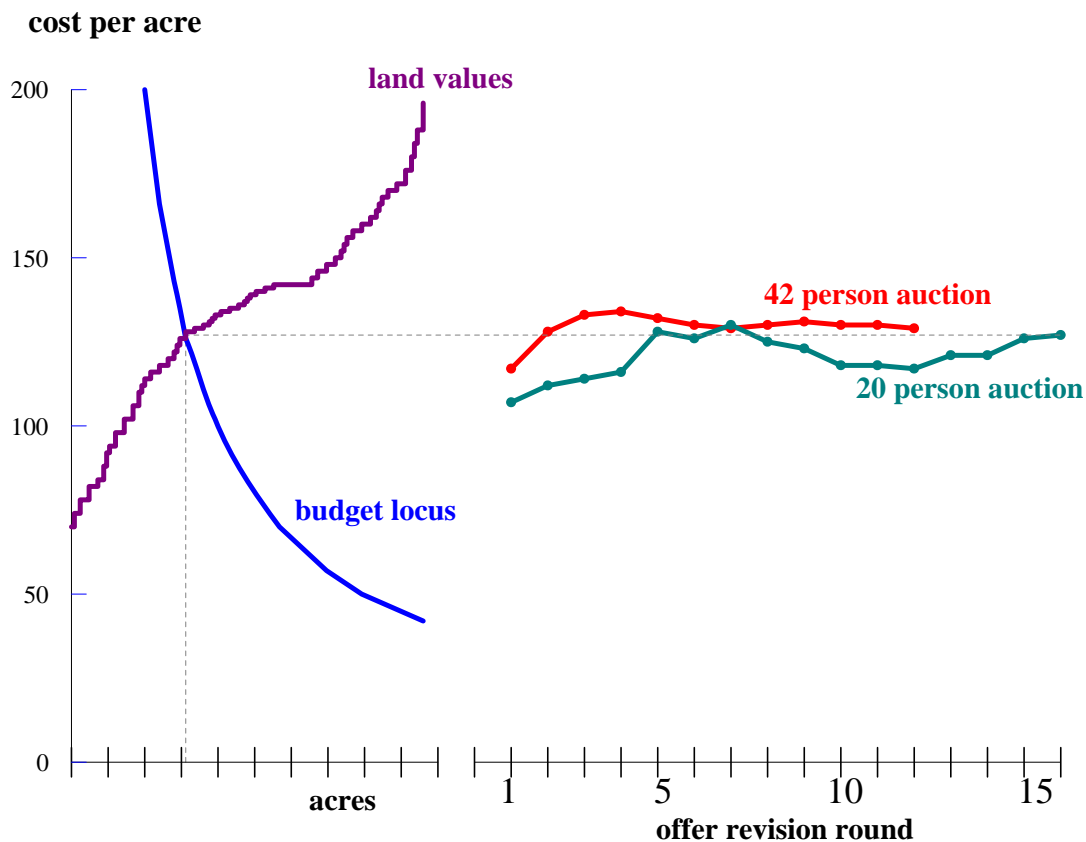
- 2000 drought, severe effects on environment and possibly on Atlanta drinking water, “Dry 2k Crisis”
- 10 million in tobacco settlement money was set aside to run an “auction-like process” to pay farmers not to irrigate
- Irrigation permits for 50-300 acre circular irrigation arrays in Flynt River valley, issued for free, not traded
- Auction decision: driven by budget windfall, tobacco settlement
- Auction: fast, transparent, fair, and voluntary (as compared with forced reductions)





# Experiments

- at Ga. State beginning just as law was passed
- 8-80 subjects per group, students and farmers
- Rich instructions (“acres”, “permits”, etc.)
- No repetition (1 auction), long instructions
- Induced opportunity cost of irrigated land
- Multi-round “pay as bid” auction to deter collusion and allow learning during the auction
- Fixed budget used to purchase reductions from low bidders – uniform price ruled out to avoid appearance of “wasted” payments above bids

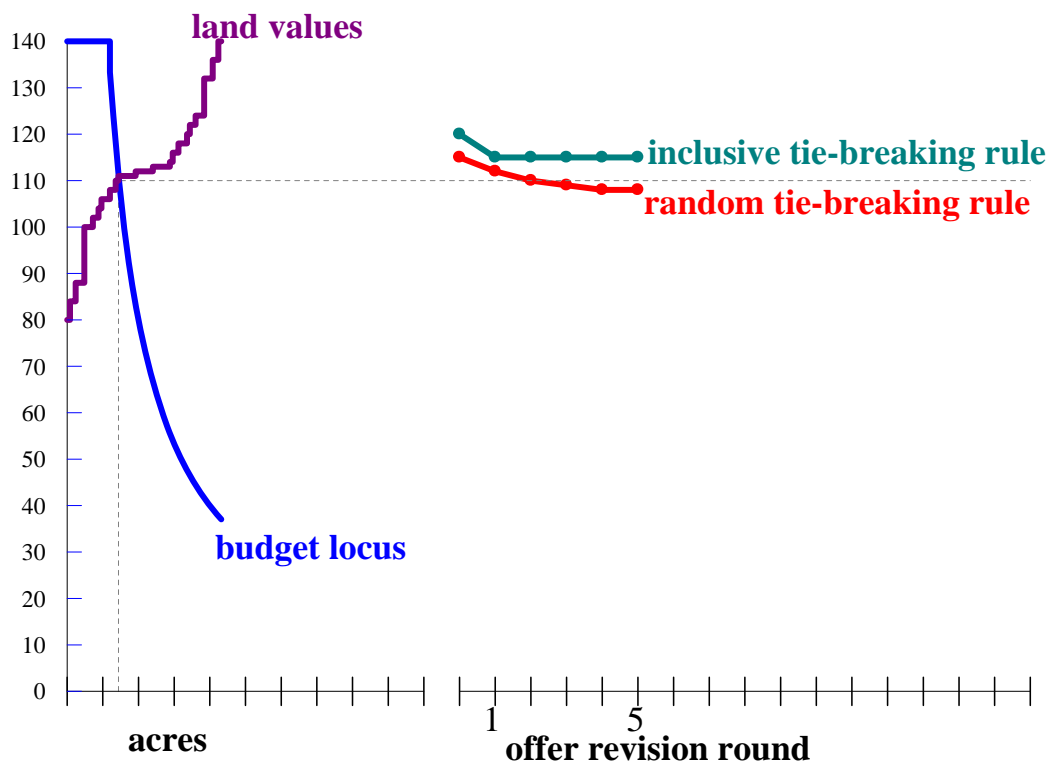


# Experiments Helped Auction Design

- What if there is a tie at the maximum accepted offer?
- At first, our instructions were not specific
- In one session, we bought all permits at this price, even if we had to spend more than our budget to do so
- The result: most offers were eventually revised to this level, and we spent much more than twice the amount budgeted!



cost per acre





## 2001 Auction

- Inexpensive to run (we were free)
- 33,000 acres taken out
- Low price \$135 per acre
- Only one law suit - dismissed



## RGGI Auction Formats

- **Sealed Bid Discriminatory or “Pay as Bid”** – high bids win, pay prices bid which may differ (“discriminatory”)
- **Sealed Bid Uniform Price** – high bids win, all winners pay the same uniform price, i.e. the highest rejected bid
- **English Clock** – multi-round ascending prices, bidders state demand quantities, uniform price
- **Shot Clock** – clock with a final round “shootout” sealed bid
- **Dutch** – descending price, with a Buy Now button
- **Continuous Time Auctions** – show provisionally winning bids, high bids at closing bell become actual winners

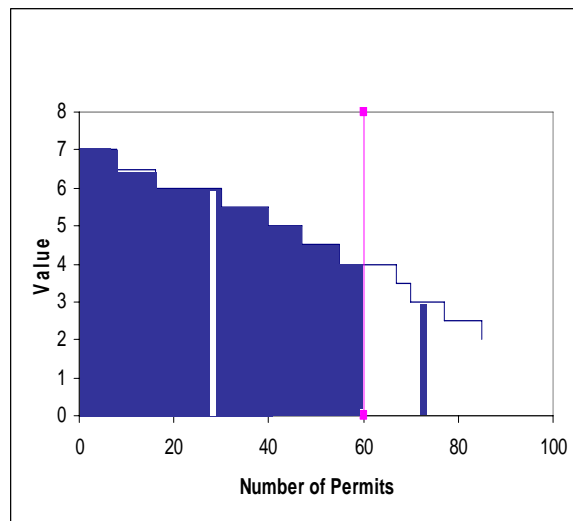
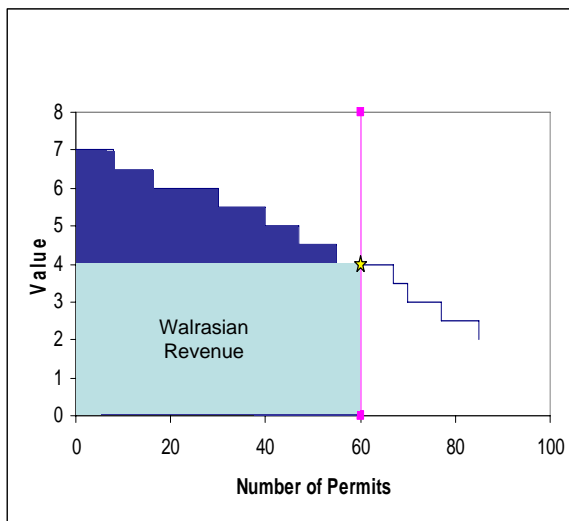


## Phase One Experiments

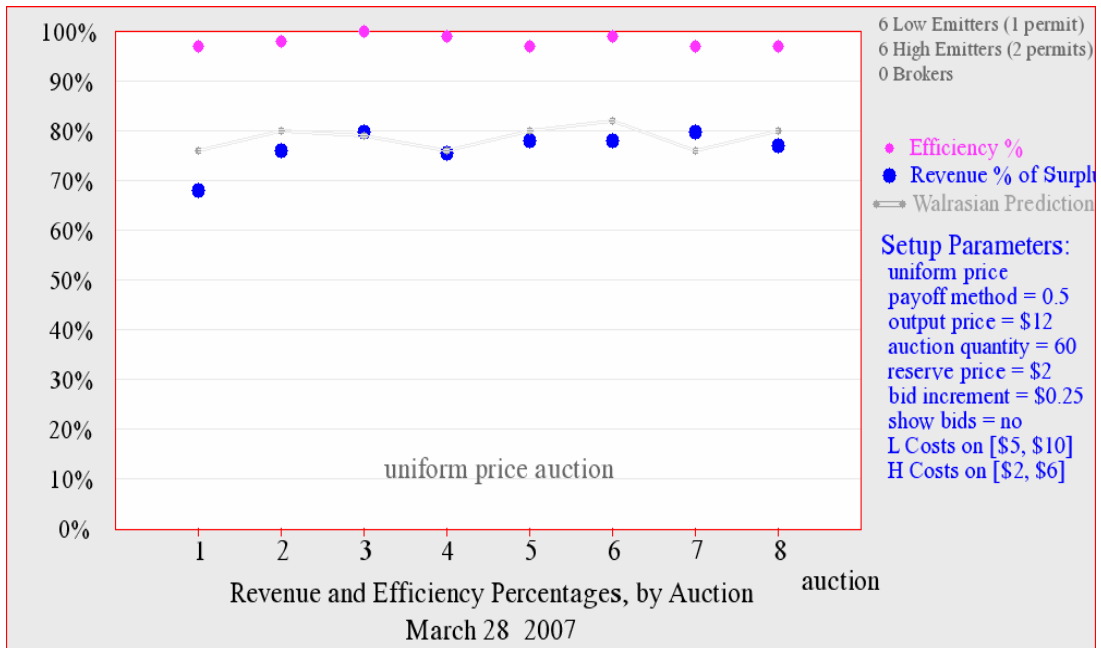
- 12 bidders, 90 “permits” demanded, 60 being sold
- Earnings = sales revenues – costs – permit costs
- Permit value = (price – cost)/permits needed
- **Veconlab**: flexible, web-based, automatic instructions
- U. of Virginia student subjects, earnings about \$30 for sessions lasting 1-2 hours
- Simple setup: no banking, no spot markets, no shifts in costs, no chat room



## Performance Measures: Revenue and Efficiency

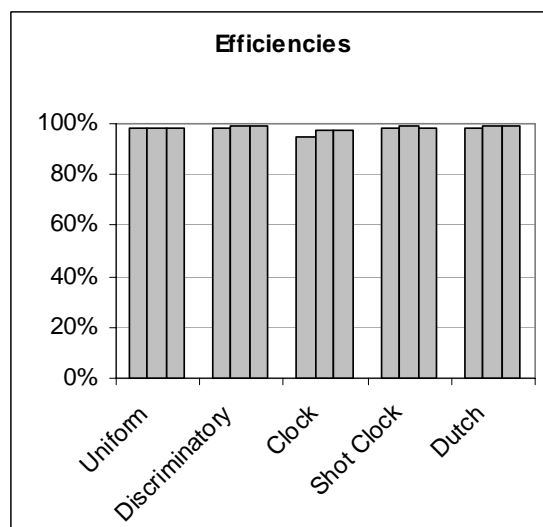
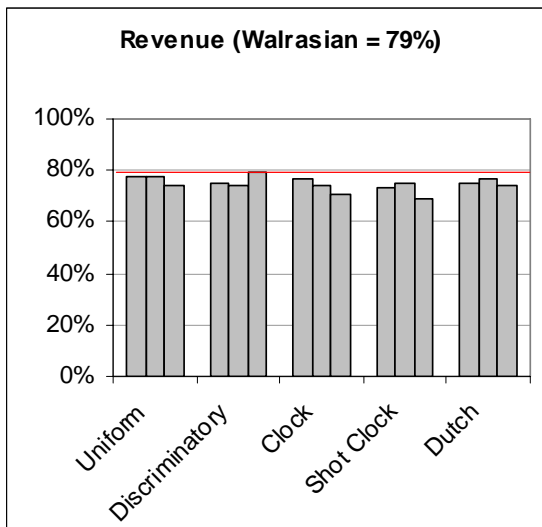


# Revenue and Efficiency: A Series of Uniform Price Auctions



## Results by Session

High Efficiencies for all Formats  
Revenues at Near-Walrasian Levels



## Phase One Results

- All auction formats are highly efficient and perform well in competitive environments.
- We strongly support the RGGI decision to require a *minimum* of 25% allocations by auction, and the decisions of individual states to rely exclusively on auctions as compared with inefficient “grandfathered” allocations.

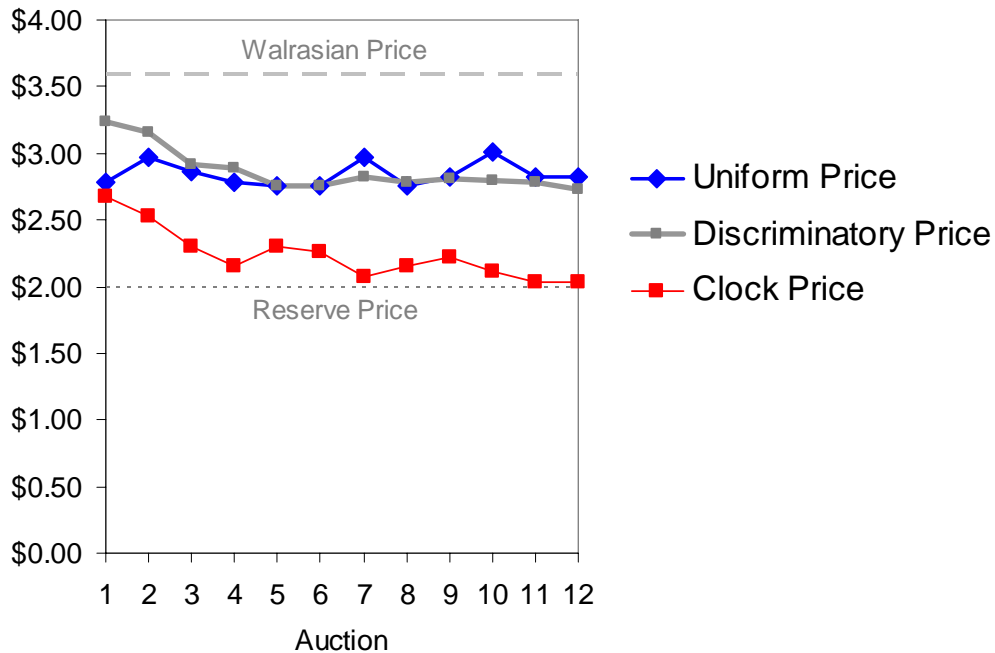


## Phase Two Experiments

- Stress tests in a richer environment: spot markets, compliance penalties, partial grandfathering, loose caps, etc.
- Explicit collusion (chat room, with spot markets and banking)
- Price discovery: unanticipated demand shift, without spot markets



## Auctions with "Chat": More Collusion in Clock Auctions



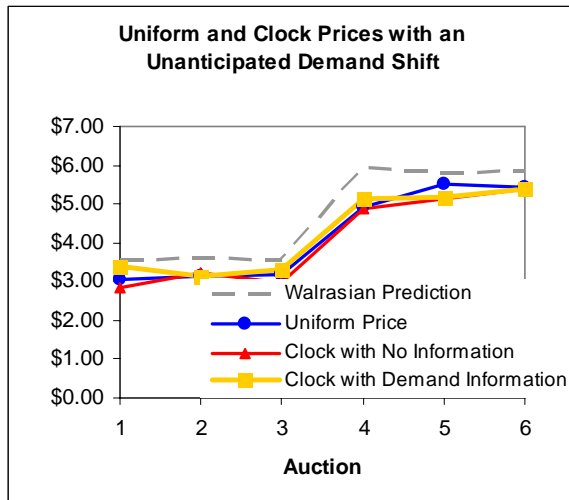
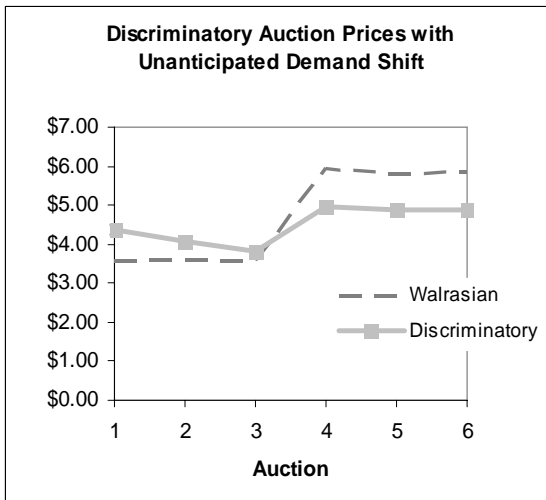
## Collusion Effects in the Clock Auctions:

High **Spot** Prices, Low **Clock** Prices  
Relevance to RGGI? Market Monitoring



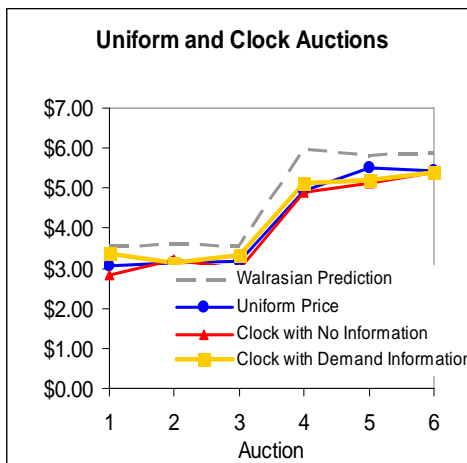
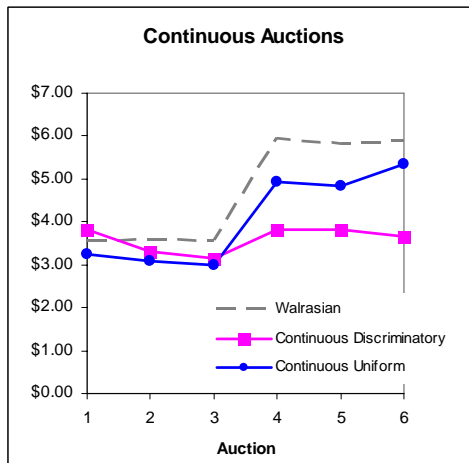
# Unanticipated Demand Shift

Discriminatory Auction (left) Tracks Worse than Clock and Uniform Price Auctions (right)



# Are All Auctions Equally Good?

Continuous Discriminatory (magenta left) Tracks Worse than Clock and Uniform Price Auctions (right) due to sniping and narrow bid range



## Recommendations for RGGI: Auction Format

### **Uniform Price Auction (Proxy Bidding)**

- simple sealed bid implementation, transparent,
- familiar from electricity wholesale markets,
- performs well
  - better price discovery than discriminatory,
  - more resistant to explicit collusion than the clock
- provides “lock-in” for needed allowances



## Recommendations for RGGI: Reserve Price

- Announced reserve price at each auction, no allowances sold below the reserve price
- Unsold allowances rolled into contingency reserve or sold in next auction
- Reserve price should not be too high, to allow market forces to provide correct price signals





## Recommendations for RGGI: Implementation

- Auction open to all financially qualified bidders
- Financial pre-qualifications: bids are binding contracts
- Single bidder's purchases limited to 33% of total volume
- Joint and uniform auction for allowances from all states
- Separate auctions for allowances from different years
- Quarterly auctions
- Auction parts of future vintages in advance



## Recommendations for RGGI: Information, Monitoring and Evaluation

- Announce clearing price, identity of winners and, (only if necessary) quantity they won
- Do not announce *any* bids, nor the identity of losing bidders
- Require disclosure of party benefiting from allowance purchases but do not make this public
- Coordinate with existing efforts by federal and state agencies
- Ongoing evaluation of auction performance



# Bringing Experiments into the Classroom: Veconlab software

