STABILIZING CARBON PRICES: An Agent-based Model for the European Union Emissions Trading System

CAP AND TRADE SYSTEM

GOAL → Reduce emissions through market based incentive

CAP

- Government-imposed limit on total industry GHG emissions
- Individual companies receive allowances
- 1 allowance = 1 metric ton of gas
- Allowance distribution varies
- Subject to fee for non-compliance
- Cap is lowered each year

TRADE

- Market for companies to buy and sell allowances
- Carbon price determined by supply and demand forces
- Economic incentive to lower emissions

EU EMISSIONS TRADING SYSTEM (ETS)

41 countries, 11,000 heavy energy-using installations, 45% of European emissions

PHASE 1 (2005-2007)
- Linear reduction factor = 1.74%
- Non-compliance fee = 40 Euros
- Covered CO2 emissions

PHASE 2 (2008-2012)

PHASE 3 (2013-2020)
- More sectors and gases
- Single, EU wide cap

PHASE 4 (2021-2030)
- Increase linear reduction to 2.2%
- Rules to address carbon leakage

FINANCIAL CRISIS CHALLENGE

STAGE A

2009 Financial Crisis

STAGE B

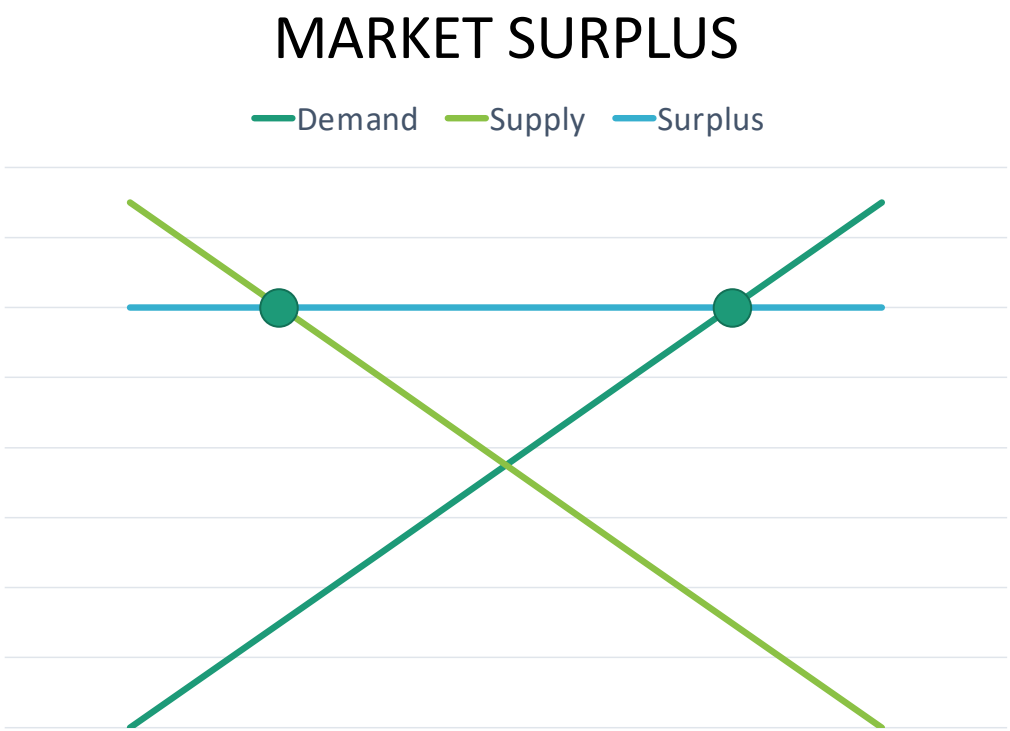
Decreased industrial production

STAGE C

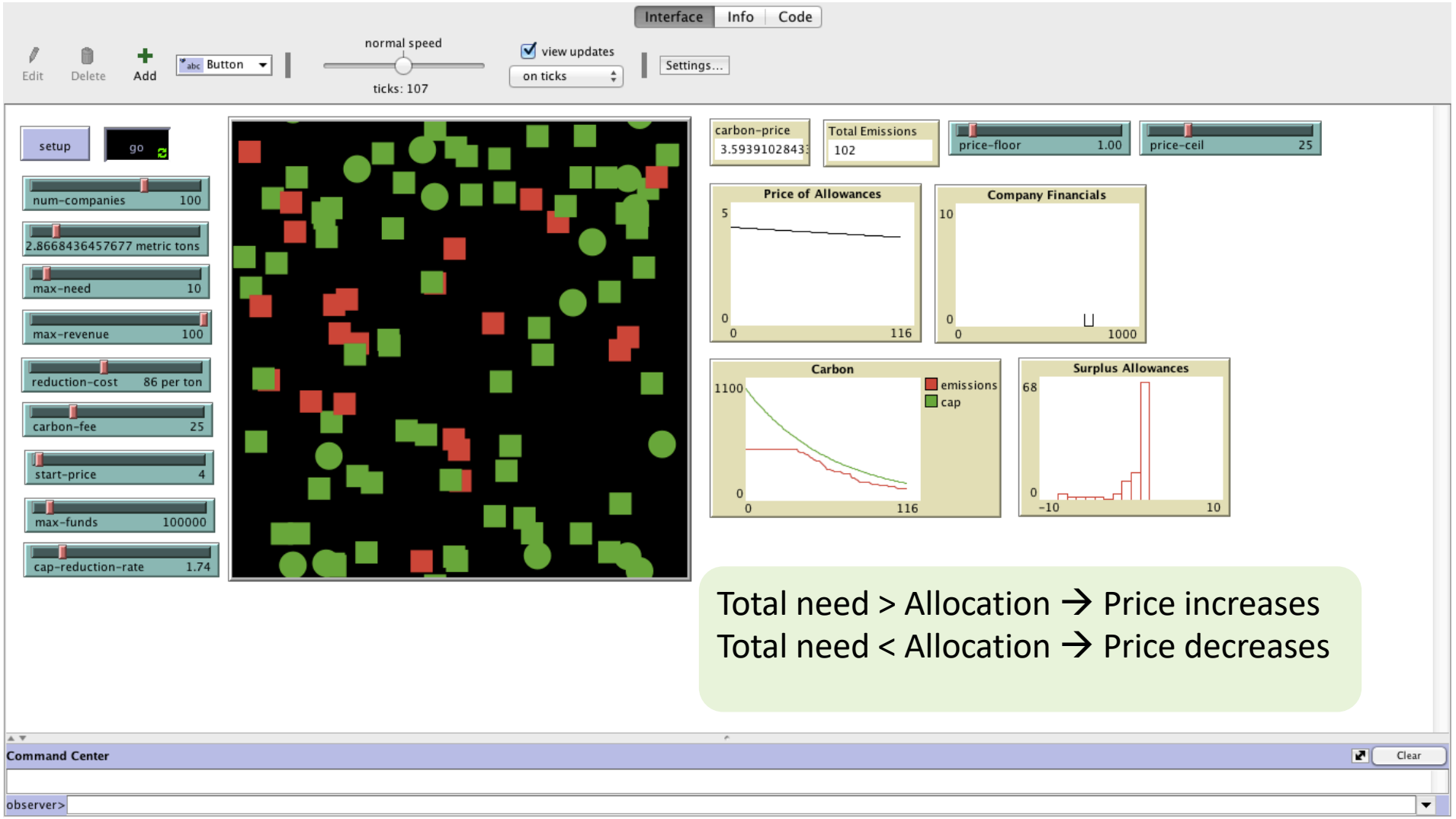
Allowance surplus

STAGE D

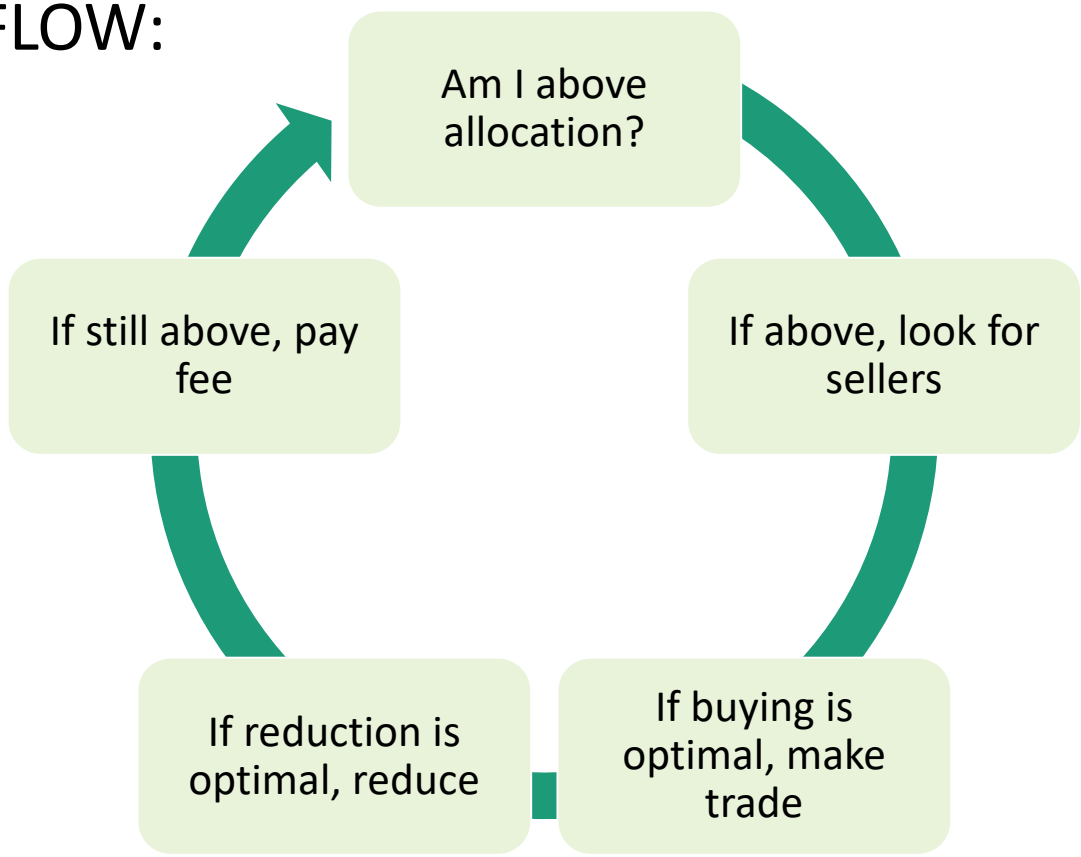
Carbon price collapse



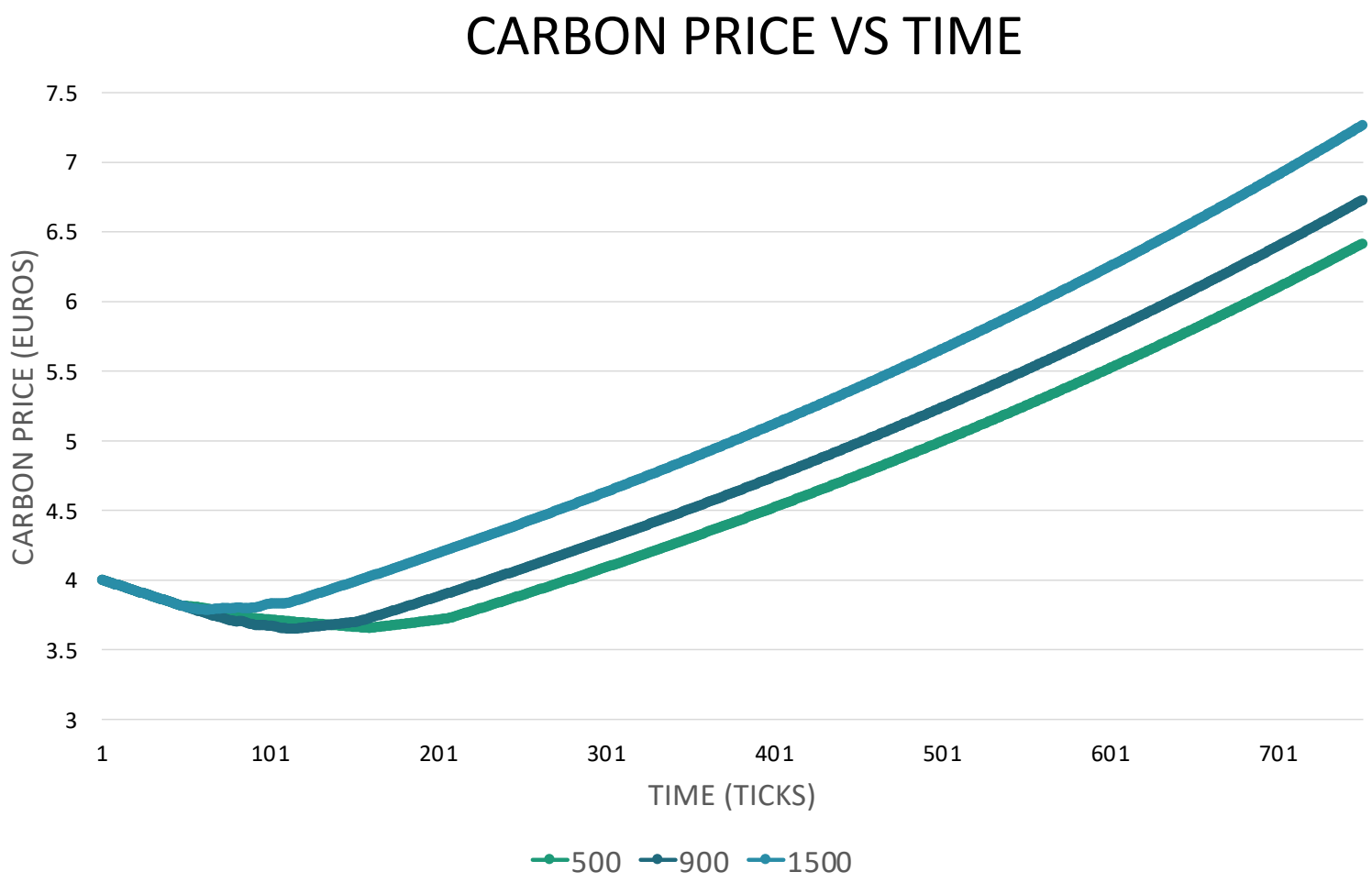
RESEACRH QUESTION: What number of allowances will lead to a stable price of carbon in a cap and trade system?

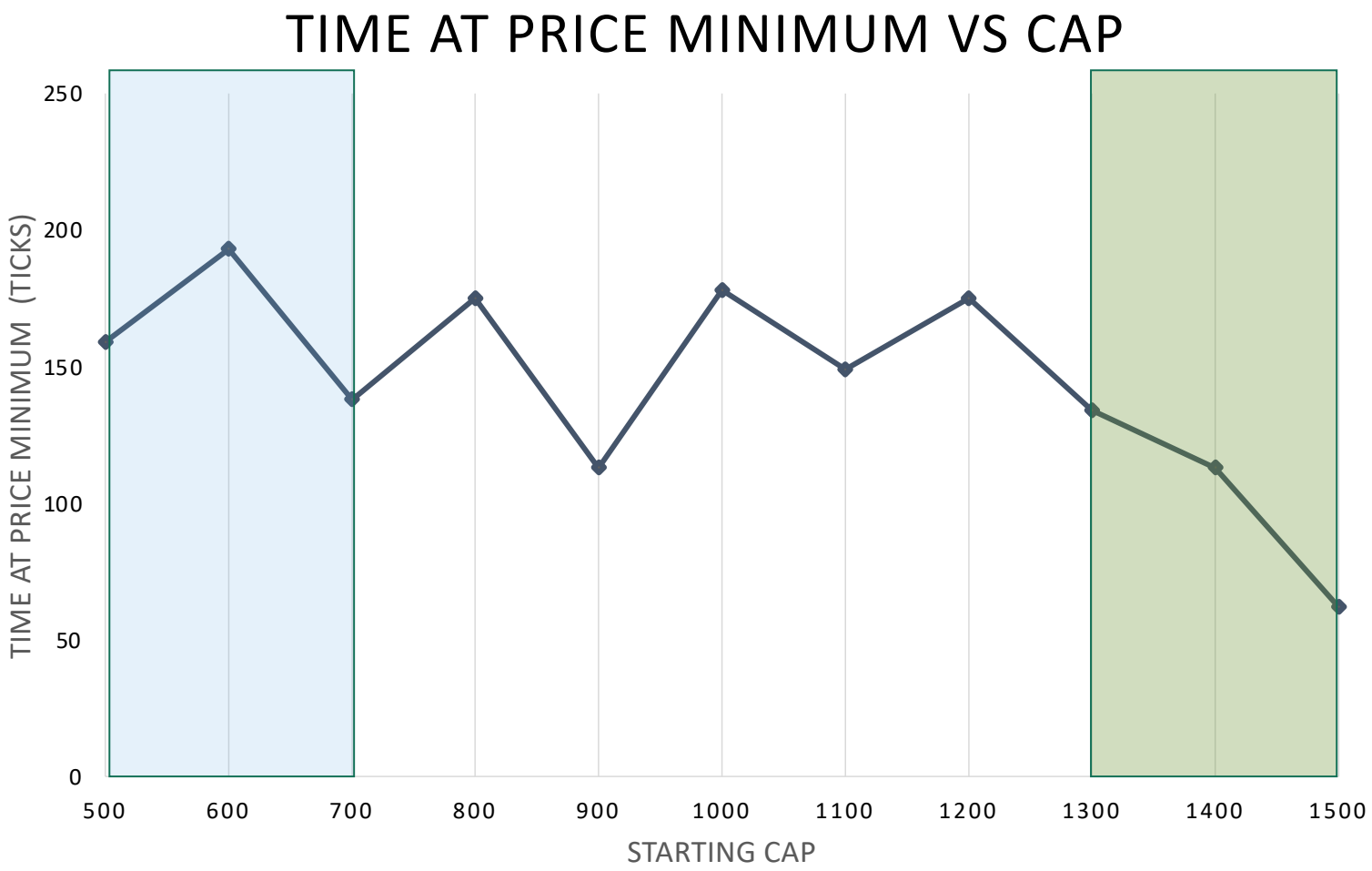

Interface
Info
Code
Edit
Delete
Add
Button
normal speed
ticks: 107
view updates
on ticks
Settings...
setup
go
num-companies 100
2.8668436457677 metric tons
max-need 10
max-revenue 100
reduction-cost 86 per ton
carbon-fee 25
start-price 4
max-funds 100000
cap-reduction-rate 1.74
carbon-price
3.59391028433
Total Emissions
102
price-floor 1.00
price-ceil 25
Price of Allowances
5
0
0
116
Company Financials
10
0
0
1000
Carbon
1100
0
0
116
emissions
cap
Surplus Allowances
68
0
-10
10
Total need > Allocation → Price increases
Total need < Allocation → Price decreases
Command Center
Clear
observer>

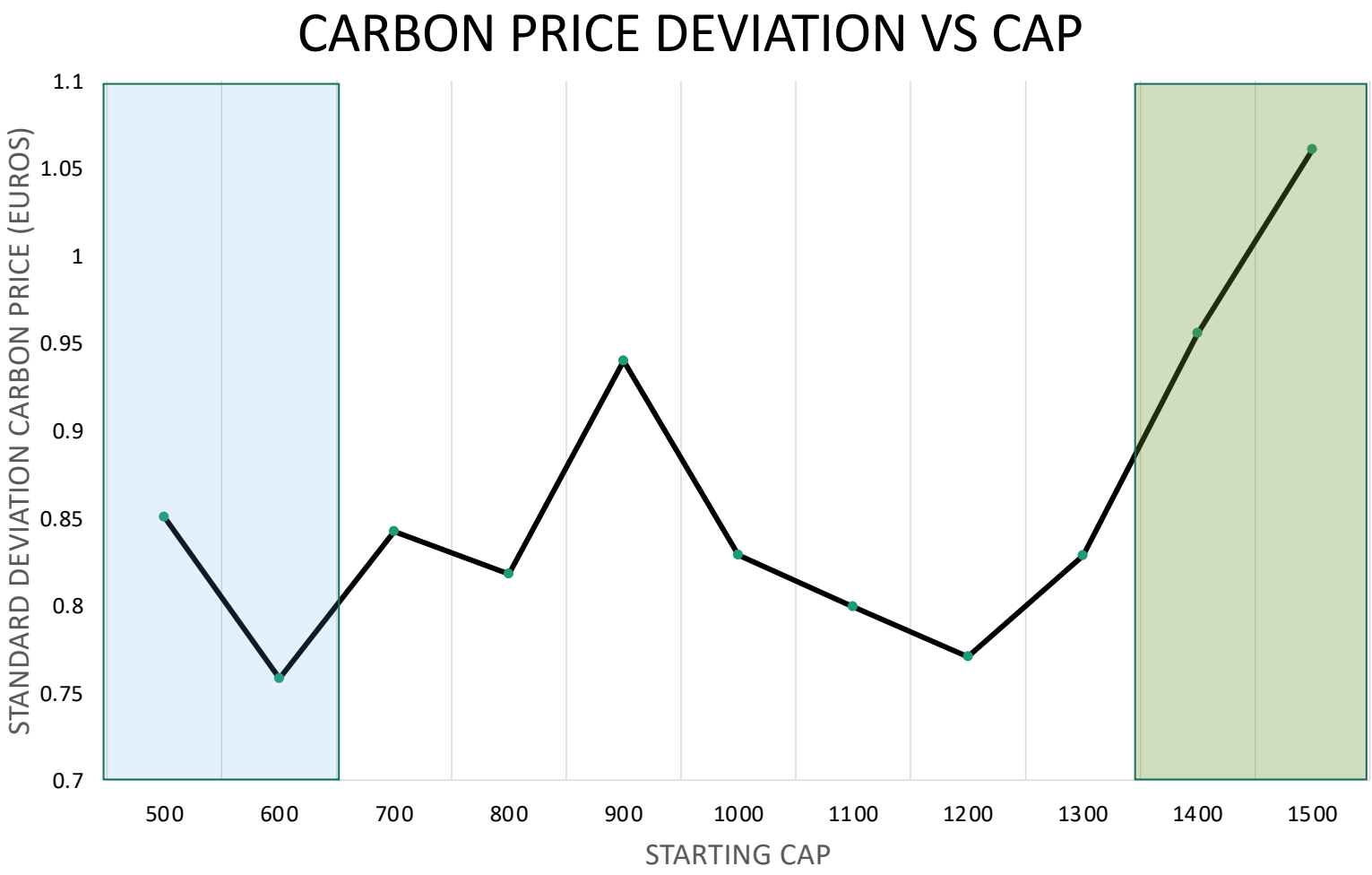
MODEL FLOW: AGENT



Choose one option above


CARBON PRICE VS TIME
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
CARBON PRICE (EUROS)
1
101
201
301
401
501
601
701
TIME (TICKS)
500
900
1500


TIME AT PRICE MINIMUM VS CAP
TIME AT PRICE MINIMUM (TICKS)
250
200
150
100
50
0
500
600
700
800
900
1000
1100
1200
1300
1400
1500
STARTING CAP


CARBON PRICE DEVIATION VS CAP
STANDARD DEVIATION CARBON PRICE (EUROS)
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
500
600
700
800
900
1000
1100
1200
1300
1400
1500
STARTING CAP

DISCUSSION AND CONCLUSION

LIMITATIONS

- Model does not include
  - Auctioned allowances
  - International credits
  - Bankruptcy and limited funds
- Units are scaled down

FUTURE RESEARCH

- Strategies to reduce cap
  - Linear reduction factor
  - Allowance reserve bank
- Strategies to prevent price surge