Climate Policy: A CO2 Variant

The commercial board game *CO2* simulates the race to develop clean energy. These rules add accurate models of actual climate policy to the game. Three major policy options are explored: 1) Do Nothing, 2) Carbon Taxes, and 3) Carbon Emission Permits. Options (2) and (3) can also have minor variants involving politics and research funding. Players will learn how these policies work and the way they change the incentives of power companies. The impact of policy on global climate conditions is directly observable.

In this version of the game, players are power companies seeking to earn profits. Profits are modeled as victory points (VPs), and the player with the most VPs at the end of the game wins. Victory points come from power plants, both clean and dirty. Dirty plants are worth 3 VPs each, reflecting the revenue stream that they provide. Clean plants produce at least this much revenue (and this many VPs), but may be worth more depending on their level of technology. Each dollar held at the end of the game is worth 1 VP as well. However: If the CO2 level reaches 500 PPM, no one wins.

# Components

* Game board, with the following modifications
	+ Each research track has two asterisks (\*) in the following spaces:

|  |  |  |
| --- | --- | --- |
| Energy Type | First Asterisk | Second Asterisk |
| Biomass | 3rd space | 6th space |
| Recycling | 4th space | 5th space |
| Cold Fusion | 5th space | 7th space |
| Forestation | 7th space | 10th space |
| Solar | 5th space | 10th space |

* + Power plant spaces on each continent each have a Development Cost number, written in the space from left to right:
		- Africa: First space: 1, second space: 2, third space: 3
		- Asia: 1,1, 2, 2, 3, 3
		- Europe: 1, 1, 2, 2, 3
		- South America: 1, 2, 2, 3
		- North America: 1, 1, 2, 2, 3
		- Oceania: 1, 2, 2, 3
* Coins: five 10s, ten 5s, fifteen 2s, and twenty 1s
* 100 wooden discs, 20 each in five player colors
* 20 wooden pawns, 4 each in five player colors
* 30 Dirty power plants, ten each of coal, oil, and gas
* 25 Clean power plants, 5 each of biomass, recycling, cold fusion, solar, and forestation
	+ Each energy type has two levels of technology, one with fewer white cubes printed on the face of the tile, and another with more. These are “Level 1” and “Level 2” technologies.
* 30 Research project tiles, 6 each of biomass, recycling, cold fusion, solar, and forestation
* 35 Carbon Permits (purple disks)
* 8 Loophole tiles (use the regional agenda tiles)
* 1 Global CO2 pollution marker
* 1 Decade counter
* 1 Round counter
* 1 First Player token
* 6 Event cards
* Things to ignore:
	+ All data on the face of clean power plants, except the number of white cubes listed
	+ All data on research projects, except the energy type
	+ The VP track (VPs are based on money and power plants only)
	+ 18 Summit tiles
	+ Images in the research tracks
	+ Images on the regional agenda tiles
	+ All numbers on the research tracks (asterisks should be marked by hand)
	+ The 3 project spaces and the CEP space by each continent
	+ The summit and regional agenda spaces around the market
	+ White research cubes, UN goal cards, company goal cards, lobby cards, and the large red disc

# Setup

First, players decide on a policy variant. The rules for each variant are interspersed in each section of the rules, but they are also separated out and summarized in one section (8.0).

Players should first choose one of these options:

1. Do Nothing. No attempt is made to control CO2 emissions. No additional funding goes to research.
2. Carbon Taxes. Companies who own CO2 producing plants are taxed depending on how much CO2 they emit.
3. Carbon Emission Permits. Companies are allowed to build CO2 power plants if they own enough permits. Permits can be bought and sold among the players.

Then if Option (2) or (3) is chosen, players may choose one or both of the following:

1. Grants. Funds from permits and taxes are allocated to clean energy research
2. Loopholes. Energy companies can influence policy administration and obtain exceptions for economic hardship, etc.

Game versions can be identified by these numbers and letters: 2A, 3AB, 3B, etc. New players should try Policy 1 first, then 2A, then 3A. It can be debated which variant is most accurate historically. Most would say Variant 1, but it could be argued that the carbon policy has effectively been Variant 2AB: Public pressure against dirty power (which imposes costs on the companies), but with loopholes, and clean energy development subsidies.

## Common setup for all policy variants

Mix up the dirty power plants and place them in a face-down pile by the board. Do the same with the summits. Sort the clean power plants and put them to one side.

Put all of the research projects in a cup or bag. At random, draw out a number equal to the number of players and place them by the ‘1’ space on the market in the middle of the board. Do this for the ‘2’ space as well, and the ‘3’ space, and so on. Continue up to the market number that corresponds to the number of players. If there are four players, there should be four random projects on 1, four more on 2, four on 3, and four on 4.

Each player takes discs and pawns in his color, and two random dirty power plants. Determine a starting player and give him the First Player token. Players take money from the bank according to turn order: 1, 2, 3, 4, 5 takes $8, $9, $9, $10, $10.

Place the pollution marker at 0, the decade counter at 1970, and the round counter on the number of players. Shuffle the event cards and place them face down in the place indicated on the board.

## Setup for the Do Nothing variant (1)

No additional setup required.

## Setup for the Carbon Taxes variant (2)

No additional setup required.

## Setup for the Carbon Emissions Permits variant (3)

Place 35 purple CEPs on the market. Put 7 on the ‘1’ space, 7 on the ‘2’, and so on, up to space 5.

## Setup for the Grants variant (A)

No additional setup required. Identify an area on the board as the Funding Pool area.

## Additional setup for the Loophole variant (B)

Set the regional agenda tiles (“Loophole tiles”) to one side.

# Sequence of play

The game is played in rounds and decades. It continues until the end of the 5th decade, the 2010s, (2020s with five players). The number of rounds per decade depends on the number of players. The round marker starts on the number of players and is advanced one space per round. The decade ends when the marker reaches the end of the track. Thus with 4 players, there are 3 rounds per decade. With 3 players, there are 4 rounds per decade.

Each round has the following structure:

1. Income. All players take income from their Power Plants
2. Player actions. Beginning with the player with the First Player token, Each player in turn gets one action round, which consists of these phases:
	1. Market phase. Players may visit the market to buy CEPs and Loophole tiles (Variants 3 and B only)
	2. Build phase. Players may build 1 power plant
	3. Development phase: Players may develop dirty energy capacity or clean energy capacity (not both)
3. Research Infrastructure. After each player gets one turn, move research projects down in price. The first player marker advances to the left.
4. Pass the First Player token to the left.

After the required number of rounds for the decade, the decade ends. Perform the Decade Upkeep actions, which include:

1. Event. Draw an Event card, add a dirty power plant
2. Carbon policy. Update the permits market, apply carbon taxes, award research grants, etc.

Continue decades and rounds until the end of the 2010s decade (2020s with 6 players). Do the last Decade Upkeep phase, then do the final Victory Point tally (10.0) and determine the winner.

Note: If at any point the atmospheric CO2 level reaches 500 PPM, the game is over and everyone loses.

# Starting A Round: Income

At the start of each round, give each player $1 for every dirty power plant he owns on the board. In addition, each player receives $1 *per white cube* printed on the clean plants he owns.

## Continent control bonus income

If you own more power plants on a continent than any other player, you control the continent and receive a $1 bonus each Income phase.

## Debt

Once per game, a player may borrow. Take $5 from the bank. Make a note that you are in debt. At the end of the game, subtract 6 VP from your total.

# During a Round: Player Actions

After incomes are given out, each player in turn gets to take actions. These are all optional but must be performed in this order.

## Market phase (Variants 3 and B only)

The player may buy Permits and Loopholes, if the corresponding variants are in effect. Permits are used in Variant 3. Loopholes are part of Variant B.

To purchase a good, pay the price on which it sits and put the good in your stock.

#### Restrictions. A player may not buy more than 4 CEPs per turn. A player may not buy more than 1 Loophole tile per turn.

#### Where to pay. Money from market purchases goes into the bank, unless Variant 3A is in effect. In that case, the money from Permit purchases goes into the Funding Pool for grants. Money from Loophole purchases always goes into the bank.

## Build phase

You may build one plant per turn.

To build a CO2 burning plant (“dirty power”), choose a continent. You must build in the left-most open space. A number in the space indicates location cost. These start at $1 on the left and rise to $3 on the right. Pay the location cost to the bank, take a dirty plant from your stock and put it in the space with one of your colored disks to indicate ownership.

If you have advanced sufficiently on a clean energy research track (see Research and Clean Energy 8.0), you may instead build a clean power plant. The location cost on the left-most open space must be paid, as above. In addition, clean energy plants have an extra build cost on top of the location cost:

* Biomass, Recycling: $1 build cost
* Cold Fusion: $3 build cost
* Forestation, Solar: $5 build cost

*Example:* To build a Recycling plant on the ‘2’ space in Africa would cost $3. Pay the $3, take a Recycling plant from the stock, and place it on the board.

Unlike dirty power plants, you may not buy clean power plants and hold them for a future turn. Clean power plants must be placed immediately in the build phase in which they were purchased.

### Check continent control

If you build a plant and have more plants on a continent than any other company, you control the continent. Place a disc of your color on the continent control spot.

### Add pollution

If your plant adds CO2 to the atmosphere, move the CO2 marker up by the number of PPMs on the plant.

### Upgrades and Demolition

If there are no spaces in a continent, you may select the space farthest to the right and build there. All the other plants shift to the left. The left-most plant is demolished. Demolished plants go back in the pool and can be selected and built again. If the demolished plant added CO2 to the atmosphere, lower the CO2 level by the amount on the plant.

**Note:** A player may voluntarily demolish a plant during his turn at no cost. Simply place it back in the pool and slide all other plants to the left to close up any space.

### Loopholes (Variant B)

If you own a Loophole tile, you may place it on a plant when it is built. This plant is exempt from carbon policy.

## Development phase

The player chooses one: Dirty energy development or clean energy development. You cannot do both.

### Dirty energy development

Pay $1 to the bank. Select three dirty energy plants at random from the face-down pool and add them to your stock. You cannot have more than 3 dirty plants in your stock. If you have more than 3, choose plants and place them in the pool, face-down, until you are down to 3 again.

### Clean energy development

You may fund your research projects through the market circle in the center of the board. Select the project you want, pay the price it is next to, and return it to the cup or bag in which projects are being held. The money goes into the bank.

When you fund a research project, move your Scientist (wooden pawn) up one space on the associated Research track. If it is your first purchase of a line of research, put your scientist on the first space. When your pawn reaches the first ‘4’ space on a track, you may build the first level of technology in that energy source. To build the second level of technology, your pawn must reach the end of the track. See Research and Clean Energy (8.0).

#### Research limit. You may fund no more than **two** research projects in a given turn

#### Knowledge transfer. If you fund a research project and you are two or more spaces behind the leader on that research track, you may give $1 to the leader and move ahead two spaces instead of just one. The $1 payment is taken from the amount you are spending on research. Instead of putting it in the bank, give it to the leader.

# Ending a Round: Research Infrastructure and First Player

Once all players have performed their actions in a round, end the round by conducting a Research Infrastructure step that reflects the long-run benefits of investments in clean energy research. If research has been done on a clean energy type, the resulting infrastructure lowers the costs of future research in that area. To show the effects of Research Infrastructure, do steps 6.1 and 6.2 below:

## Reduce costs

First check the research projects of each energy type. Starting at $2, if there are no projects of a given type at $1, move all the $2 projects of that type down to $1. Then if there are no projects of that type at $2, move all the $3 projects of this type down to $2, and so on. Move each project down $1 in price, unless there is already a project of that type at the lower price. Do this separately for each energy type.

* *Example:* Solar has one project at $2, none at $3, and three at $4. Move the $2 project to $1, and the three $4 projects to $3.
* *Example:* Recycling has one project at $1, three at $2, none at $3, and one at $4. The three $2 projects cannot move to $1 because there is already a Recycling project at $1. The $4 project moves to $3.
* *Example:* Forestation has one project at each price level. None move.

## New research

Second, add new research projects at the highest price ($5 for five players, $4 for four, etc.). The number added equals the number of players. Draw randomly from the research project cup.

## Pass First Player token

Pass the First Player token to the left. Then if this was the last round in the decade, proceed to decade upkeep. Otherwise, continue with the next round.

# Decade Upkeep

After the Research Infrastructure step of the last round in a decade, perform the following decade upkeep actions. Then move to the first round of the next decade.

## Event

Shuffle the Event deck and draw one card at random. Draw a random plant from the dirty pool and place it in the left-most open spot on that continent. This represents the general increase in CO2 emissions from sources other than power (transportation, residential, etc.)

## Carbon Policy

Depending on the variant, carbon policy effects are implemented here.

### Carbon taxes (Variant 2)

Each company must pay $1 per 20 PPMs emitted by all power plants they control. Fractions are rounded up. *Example:* The tax on 70 PPM is $4.

#### Noncompliance. If a company cannot, or does not want to, pay the tax for all his plants, the company is noncompliant and must demolish plants until taxes are paid on all plants owned. Alternatively, a company may sell plants to other players (who must then pay the tax due). The players may agree on any price.

#### Loopholes. Plants plant with loophole tiles (Variant B) do not contribute to carbon tax liability.

#### Grants. If Grants are in effect (Variant A), all carbon tax monies go into the Funding Pool. Otherwise the money goes in the bank.

### Carbon Emission Permits (Variant 3)

Each company must have one Carbon Emission Permit (CEP) for each 10 PPM of carbon his plants emit. Coal requires 4 CEPs, oil 3, and gas 2. A company without enough permits is noncompliant and must buy permits from other players, sell plants to them, or demolish plants until the company is compliant. The players may agree on any prices for these transactions.

#### Loopholes. A plant with a loophole tile on it (Variant B) is exempt from carbon permit requirements.

#### CEP demand adjustment. After compliance has been resolved, move all CEPs on the market down $1 in price.

### Grants (Variant A)

Reveal one Summit tile at random. A subsidy of $3 each is given to the research leaders in the indicated energy sources. The $3 grant goes to the leader in that energy type, as indicated on the research track. If there is a tie for leadership, the companies divide the $3 grant for that track, rounding down.

All funding is taken from the Funding Pool. If the pool contains insufficient funds, give a $3 grant to the leftmost energy type first, then proceed to the right until funding is exhausted. (With Kyoto, go across the top first, then the bottom.)

# Research and Clean Energy

In order to build a clean energy plant, a company must have advanced sufficiently on the research track for that energy type.

## Advancing research

You advance research by funding research projects during the development phase of your turn. Select a project, pay the price, and advance your scientist pawn one space on the associated track. Return the project to the stock of hidden research projects.

### Research limits

You have only 4 scientists and can do research in only 4 energy types. You cannot fund more than 2 projects per turn.

### Knowledge transfer

If you are two or more spaces behind the leader in a track, when you fund a research project you may pay the leader $1 and move ahead two spaces. The $1 comes out of the money you are paying for the research; simply give $1 of your spend to the leader instead of the bank. The leader cannot refuse this payment. Knowledge ‘leaks out.’

## Unlocking technology and building plants

Each energy type has two levels of technology. The lower level has fewer white cubes. Each white cube provides $1 in income per round, and 3VPs at game end.

When you reach the first asterisk on a research track, you may build the first technology plant in that energy type. You cannot build the second technology plant in that type until you reach the second asterisk on the track.

|  |  |  |
| --- | --- | --- |
| Energy Type | First Asterisk | Second Asterisk |
| Biomass | 3rd space | 6th space |
| Recycling | 4th space | 5th space |
| Cold Fusion | 5th space | 7th space |
| Forestation | 7th space | 10th space |
| Solar | 5th space | 10th space |

# Policy Variants

This section collects in one place the rules for different variants and their interactions. The “Policy Experiments” sections suggest further variants on these rules that tease out different policy effects.

## Do Nothing (1)

In the Do Nothing variant, there are no carbon taxes, no permits, no loopholes, and no grants. Ignore the purple CEP disks, the Loophole tiles, and the Funding Pool.

## Carbon Taxes (2)

There is no additional setup for this variant. During Decade Upkeep, each company must pay $1 for each 20 PPM his plants emit, rounding up. If he cannot pay or does not want to pay, he must sell plants to other players, who then must pay the tax. Otherwise, the plants must be demolished.

### Grants (A)

If Grants are in effect, the carbon tax money goes into the Funding Pool.

### Loopholes

If Loopholes are in effect, a plant with a loophole tile does not add to your carbon tax burden.

### Policy experiments

Vary the carbon tax amount.

## Carbon Emission Permits (3)

At setup, put 35 Carbon Emission Permits on the market. This will enable 350 PPM of CO2 in the atmosphere. Put 7 permits at each price on the market, from $1 to $5. These CEPs are available for purchase during the Market phase of each player’s turn. A player cannot buy more than 4 per turn. Once purchased from the market, CEPs may be bought and sold among players at any agreed price.

During each decade upkeep step, the remaining CEPs on the market are moved down $1 in price. In addition, each player must show that he has enough permits to cover his CO2 emissions. If he does not, he has to buy permits from other players or sell plants to them. Players who buy plants must have enough permits to cover the emissions of the plants that they buy. If a player cannot come into compliance, he must demolition plants.

### Grants (A)

If Grants are in effect, money spent to buy CEPs from the market goes into the Funding Pool.

### Loopholes

If Loopholes are in effect, a plant with a loophole tile does not require CEPs.

### Policy experiments

Put a different number of CEPs on the market. Give CEPs to players. Introduce CEPs midway through the game.

## Grants (A)

If Grants are in effect, funds from carbon taxes or CEP sales go into a research Funding Pool. During decade upkeep, a Summit tile is chosen at random. Each energy type on the tile will receive $3 in research grant money. The grant goes to the leader in research in that type of energy. If players are tied on the relevant research track, the $3 is split. If two or three are tied, each gets $1. If more than three are tied for the lead, none receive grant funding.

### Policy experiments

In the Do Nothing policy (1), roll a d6 during each decade’s upkeep and give this money as grants. This would reflect the constantly changing commitment of governments to clean energy research. Or, select a fixed amount ($3, $5, $10) and distribute it according to different rules.

## Loopholes (B)

Loopholes reflect the political pressure energy companies can use to evade emission regulations, through arguments involving the need for energy and economic growth (to reduce unemployment, for example). During Setup, set aside the regional agenda tiles. These tiles are called “Loophole tiles” in this variant; the images on them serve no purpose and can be ignored.

During the Market phase, players may purchase these tiles. You may only buy one Loophole per turn. The Loophole price reflects the cost of lobbying, public persuasion campaigns, and bribes. The price depends on the current CO2 level.

* Below 300 PPM, Loophole price = $3
* 300-400 PPM, Loophole price = $5
* Above 400 PPM, Loophole price = $7

The cost rises because the deteriorating atmosphere renders these arguments less plausible. When a company builds a plant, it may place a loophole tile on it. The plant is then exempt from all carbon-related policies.

### Policy experiments

Add more or fewer loophole tiles to the market. Change their price distribution.

# Final Scoring and Victory

Companies in this version of CO2 are like real companies, in that they receive victory points (VPs) not for their clean energy record but for their revenues. At the end of the game, each player receives VPs as follows:

* For each dirty power plant: 3 VPs
* For clean power plants: 3VPs for each white cube printed on the plant
	+ Note: this does not refer to the wooden white cubes. In this variant, there is no connection between the white cubes printed on clean energy tiles and the wooden white cubes that come with the game.
* For each $1 held: 1 VP
* For each CEP held: 2 VPs
* Debt: -6 VPs

# Rules for 2 or 3 players

With 3 players, reduce the size of each continent by one space. With 2, reduce each continent by two spaces.

# Credits

Original CO2 game designed by Vital Lacerda. Published by Giochix.it, 2012. *Climate Policy* variant designed by Edward Castronova, 2015.

CO2 Carbon Policy

PLAYER AID

**Sequence of Play**

Each Decade:

1. Rounds (depends on number of players)

2. Decade Upkeep

Each Round:

1. Start the round: Income

2. Player actions, one turn per player. Each turn:

a. Market Phase

b. Build Phase

c. Development Phase

3. End the round: Research Infrastructure, pass the First Player token

**Victory Points**

Dirty power plants: 3 VPs each

Clean power plants: 3 VPs per printed white cube

Money: 1 VP per $1

CEPs: 2 VP each

Debt: -6 VPs

**500 PPMs: ALL LOSE**

**Build Phase**

One plant per turn. Choose space. Pay location cost and build cost. Place plant with disk.

*Dirty energy*: No build cost. Add PPMs to world total

*Clean energy*: Build cost is 1/1/3/5/5

for Bio, Recycle, Fusion, Forest, Solar

**Income**

$1 per dirty plant

$1 per white cube on clean plants

$1 for continent control (most plants)

Debt: Take $5 (Note -6 VPs)

**Development Phase**

*Dirty*: Pay $1, draw three tiles, discard down to 3

*Clean*: Purchase research projects, advance on research track. Limit 2 projects per turn.

**Research Infrastructure**

Move each project down $1 unless blocked by existing project. Then add more projects in highest price, equal to number of players

**Decade Upkeep**

Draw Event. Place random dirty plant on that continent. Then conduct carbon policies.

**Market Phase**

Pay indicated price, place item in stock.

Limits: 4 CEPs and 1 Loophole

**Research Tracks**

Buy research projects during Development Phase. Advance 1 space.

If behind 2 or more, pay $1 to leader and advance 2 spaces.

First \* allows construction of 1st level plant

Second \* allows construction of 2nd level plant

1

CO2 Carbon Policy

POLICIES

**Variant 1: Do Nothing**

No limits on building. No grant support.

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**Variant 2: Carbon Taxes**

Decade Upkeep: Each player pays $1 per 20PPM. Round up.

**Variant 3: Carbon Emissions Permits**

Place 35 CEPs on market, seven each on $1 through $5.

Decade Upkeep: Players must have 1 CEP per 10 PPM or demolish plants. Then lower CEPs on market by $1.

**Variant A: Grants**

All funds from carbon taxes or CEPs go into Funding Pool

Decade upkeep: Draw Summit tile. Research track leader in each energy type receives $3 from pool.

**Variant B: Loopholes**

Plants with loophole tiles are exempt from carbon regulation. Buy Loopholes during Market phase. Price depends on PPM. Below 300: $3, 300-400: $5, above 400: $7.

**Reminders**

No space left: If a continent is full, new plants on the right push all other plants to the left, demolishing the left-most. Demolished plants go back to the pool.

Free trade: Players may buy freely and sell CEPs, built plants, and loopholes.

Knowledge transfer: If behind 2 or more on a research track, when you buy research pay $1 of the money you spent on research to leader and advance 2 spaces.

Turn limits: No more than 1 plant, 2 research projects, 4 CEPs, one loophole.

Clean energy plant unlocks: The first asterisk unlocks the first level plant for construction. The second asterisk unlocks the second level plant.