

## E: Acquiring information by waiting

### Big picture:

- Many uncertainties resolve over time:  
Can be **worthwhile** to **postpone** decisions
- Especially important for **policy uncertainties**:  
Will policy X be adopted or made more stringent?  
Will policy Y be repealed or not enforced?
- Gain in payoff from waiting and then deciding:  
**"Option value"**

### Example:

Extended version of power plant construction from G07

Two possible plants:

1. Conventional natural gas combined cycle (STD)  
Construction cost: \$490 M
2. Advanced plant with carbon capture and sequestration (CCS)  
Construction cost: \$530 M

Policy uncertainty:

- Carbon tax of \$50 may be announced in year 5
- Would apply starting in year 6

State	Probability
Carbon tax (state CT)	50%
No carbon tax (state NT)	50%

### Previous analysis:

Annual profit of key cases:

Plant	Carbon tax	Profit
STD	<b>no</b>	\$88 M
STD	<b>yes</b>	\$22 M
CCS	n/a	\$62 M

Interest rate 5%, build at 0, plants have 40 year cash flows:

Plant type	Build date	Carbon tax	NPV
STD	0	<b>no</b>	\$1015.5 M
STD	0	<b>yes</b>	\$175.5 M
CCS	0	n/a	\$536.5 M

$$\text{EV of STD} = 0.5 \cdot 1015.5 + 0.5 \cdot 175.5 = \$595.6$$

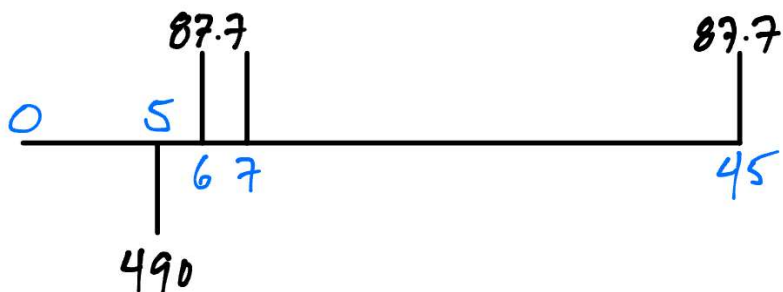
- Conclusion: build the STD plant

### Now add option to wait and build at 5:

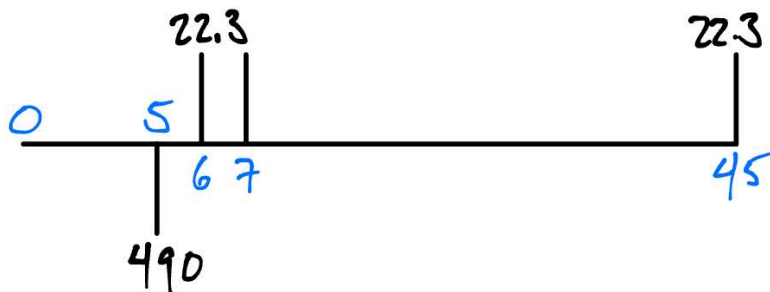
- Interest rate 5%,
- 40 year cash flows delayed 5 years: build at 5, profits in 6-45

Plant type Carbon tax Cash flow

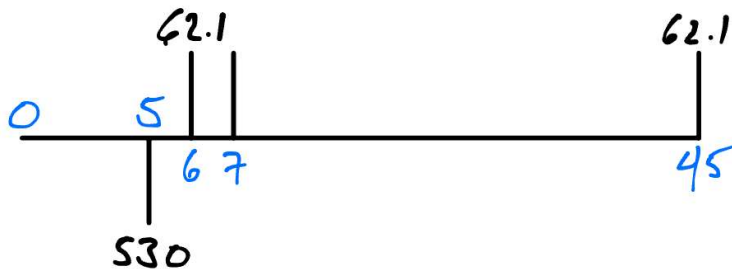
STD no



STD yes



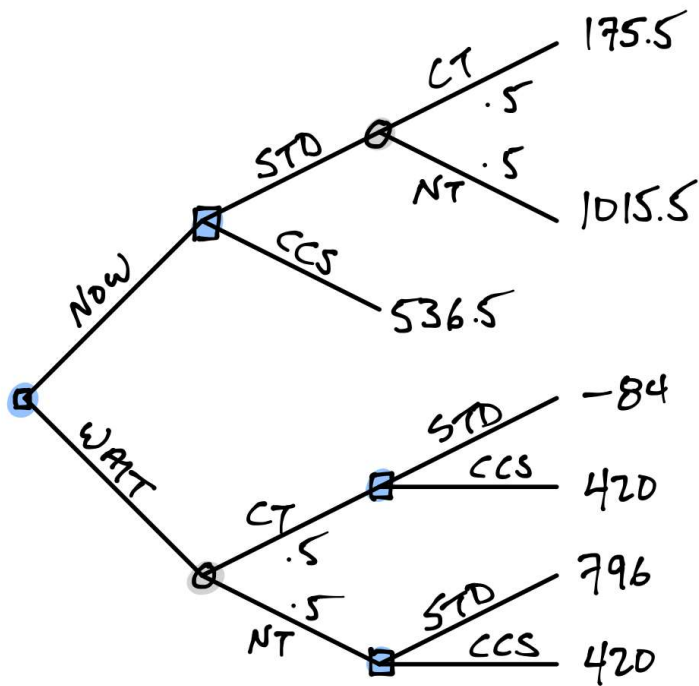
CCS n/a



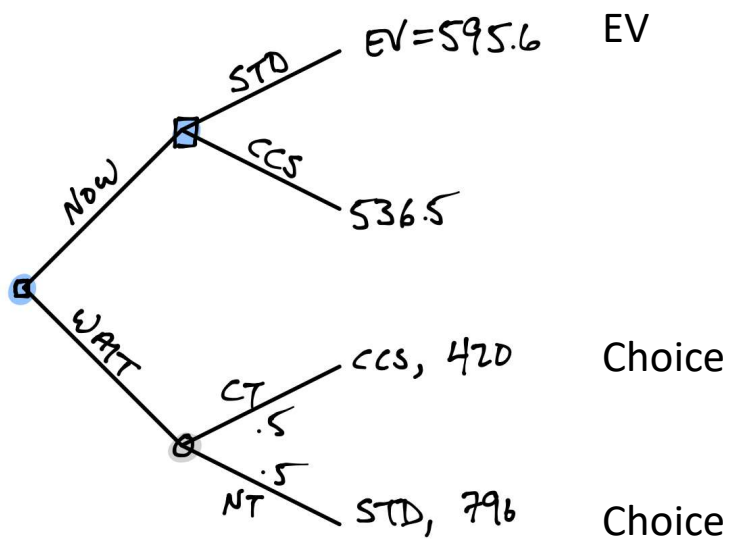
NPVs as of year 0 (initial decision date):

Plant type	Carbon tax	$NPV_0$ build at 5	$NPV_0$ build at 0
STD	no	\$796 M	\$1015.5 M
STD	yes	\$-84 M	\$175.5 M
CCS	n/a	\$420 M	\$536.5 M

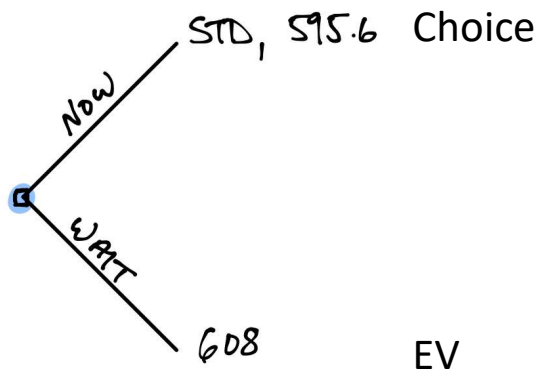
Decision tree:



Simplifying the right-most nodes:



Simplifying again:



Best choice is now to wait:  
 Expected payoff is \$12 M higher

Keeping the option to choose the type of plant open is valuable:  
 Gain is due to "option value"

### Calculating the option value:

Need to separate two effects:

- **Benefit** from acting **after** information is known
- **Cost** in **foregone** profits while waiting

### Step 1: find action and payoff if had to build at 0

- Build STD plant at 0
- NPV = \$595.6

### Step 2: find payoff if wait to 5 and take **same action**

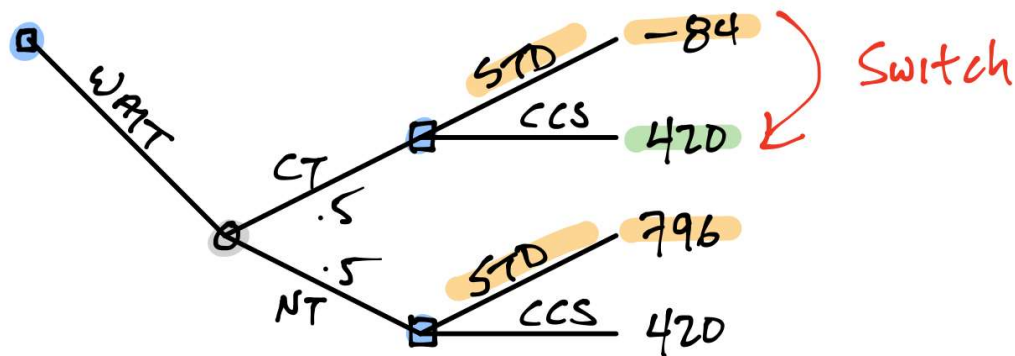
- Build STD plant at 5
- NPV =  $0.5(\$-84) + 0.5(\$796) = \$356$

Loss due to waiting alone (pure impact of postponing STD):

- $\$595.6 - \$356 = \$239.6$

Conclusion: would not want to wait if couldn't change plant type

Step 3: impact of waiting, which preserves the **option to switch to CCS**



How valuable is that?

Gain from switching:  $\$420 - (-\$84) = \$504$

Chance of switching: 50%

EV of the option:  $0.5 * (\$504) = \$252$

- Option value (WTP) is \$252 M
- Switching is known as "exercising the option"

Overall accounting at time 0:

Loss due to delay:  $-\$239.6$  M

Value of the option:  $+\$252$  M

Net gain from postponing:     \$12 M

Gain from option exceeds loss due to waiting

Exercise on GC