



TSC 220

ENERGY

LECTURE 4

Payments in Xcel

=PMT(rate,number of payment,amount)

Example

\$20,000 car loan

5% annual interest

60 months

Example

=PMT(rate,number of payment,amount)

=PMT(0.05/12,60,20000)

= \$377.42

Another Example

\$1 billion plant

40 year life

7% interest

$$= \text{PMT}(0.07, 40, 1e9)$$

$$= \$75,009,138/\text{yr}$$

500 MW needed

4 choices

Pulverized coal plant

Natural gas combined-cycle
plant

Wind

Solar PV

You
are
the
CEO

CO₂ = \$25/ton

7% interest

You
are
the
CEO

What do you build?

PRB Coal

Plant	\$2500/kW
O&M	\$0.003/kWh
Plant life	40 years
Carbon	0.937 ton/MWh
Fuel cost	\$1.25/MBtu
Capacity Factor	90%
Conversion Efficiency	39%

Capacity
Factor

90%

8760 hr/yr

= 0.90 x 8760 hr/yr

= 7884 hr/yr

Plant Cost

\$2500/kW-hr

40 year life

7% interest

$$= \text{PMT}(0.07, 40, 2500)$$

$$= \$188/\text{kW}/\text{yr}$$

$$= \$0.024/\text{kW}\text{-hr}$$

O&M Cost

\$0.003/kW-hr

Fuel Cost

\$1.25/MBtu

39% efficiency

= \$0.011/kW-hr

Carbon Cost

0.937 t/MW-hr

\$25/ton

= \$0.023/kW-hr

PRB Coal

total cost

Plant \$0.024/kW-hr

O&M \$0.003/kW-hr

Fuel \$0.011/kW-hr

Carbon \$0.023/kW-hr

Total = \$0.061/kW-hr

Combined Cycle - Natural Gas

Plant	\$600/kW
O&M	\$0.005/kWh
Plant life	30 years
Carbon	0.437 ton/MWh
Fuel	\$6.00/MBtu
Capacity Factor	60%
Conversion Efficiency	51%

Capacity
Factor

60%

8760 hr/yr

= 0.60 x 8760 hr/yr

= 5256 hr/yr

Plant Cost

\$600/kW-hr

30 year life

7% interest

$$= \text{PMT}(0.07, 30, 600)$$

$$= \$48/\text{kW}$$

$$= \$0.009/\text{kW-hr}$$

O&M Cost

\$0.005/kW-hr

Fuel Cost

\$6/MBtu

51% efficiency

= \$0.04/kW-hr

Carbon Cost

0.437 t/MW-hr

\$25/ton

= 0.011/kW-hr

Natural Gas

total cost

Plant \$0.009/kW-hr

O&M \$0.005/kW-hr

Fuel \$0.040/kW-hr

Carbon \$0.011/kW-hr

Total = \$0.065/kW-hr

Wind

Plant	\$1000/kW
O&M	\$0.07/kWh
Plant life	20 years
Carbon	---
Fuel	---
Capacity Factor	30%

Capacity
Factor

30%

8760 hr/yr

= 0.30 x 8760 hr/yr

= 2628 hr/yr

Plant Cost

\$1000/kW

20 year life

7% interest

$$= \text{PMT}(0.07, 20, 1000)$$

$$= \$94/\text{kW}/\text{yr}$$

$$= \$0.036/\text{kW}\text{-hr}$$

O&M Cost

\$0.07/kW-hr

Fuel Cost

Carbon Cost

Wind

total cost

Plant \$0.036/kW-hr

O&M \$0.07/kW-hr

Fuel ---

Carbon ---

Total = \$0.106/kW-hr

PV Solar

Plant	\$7500/kW
O&M	\$0.07/kWh
Plant life	25 years
Carbon	---
Fuel	---
Capacity Factor	15%

Capacity
Factor

15%

8760 hr/yr

= 0.15 x 8760 hr/yr

= 1314 hr/yr

Plant Cost

\$7500/kW

25 year life

7% interest

$$= \text{PMT}(0.07, 25, 7500)$$

$$= \$644/\text{kW}/\text{yr}$$

$$= \$0.49/\text{kW}\text{-hr}$$

O&M Cost

\$0.07/kW-hr

Fuel Cost

Carbon Cost

PV Solar

total cost

Plant \$0.490/kW-hr

O&M \$0.070/kW-hr

Fuel ---

Carbon ---

Total = \$0.560/kW-hr

PV Solar

	PRB	Nat Gas	Wind	PV
Plant	0.024	0.009	0.036	0.490
O&M	0.003	0.005	0.070	0.070
Fuel	0.011	0.040	---	---
Carbon	0.023	0.011	---	---
Total	0.061	0.065	0.106	0.560
