CH402 Chemical Engineering Process Design

Class Notes L16

Plant Cost Scaling and Breakeven

L15 lookback: Estimating capital cost for an industrial facility

Method C – percentage method

- Method C.1 – percentage of FCI – Example 6-1.
- Method C.2 – percentage of PEC – Colorful worksheet.
- Need to set the different components of capital investment. *Each of these components has a well-known percentage.*
- Example 6-1 and problem 6-8.
- We also discussed Method 2c – Lang Factors - in Lesson 15.

Methods D – Lang factors

- Not as precise as method C but easy to apply.

Methods E and F – scaling against a known price

- Scaling methods for equipment extended to entire facilities.
- Problems 6-9 and 6-10 and Table 6-11).
- Method F is the same as E but with and exponent of 1.

Methods G – turnover ratio

- Scaling methods for equipment extended to entire facilities (problems 6-9 and 6-10).

FE Ref. Manual pages 257

Objectives for Lesson 16:

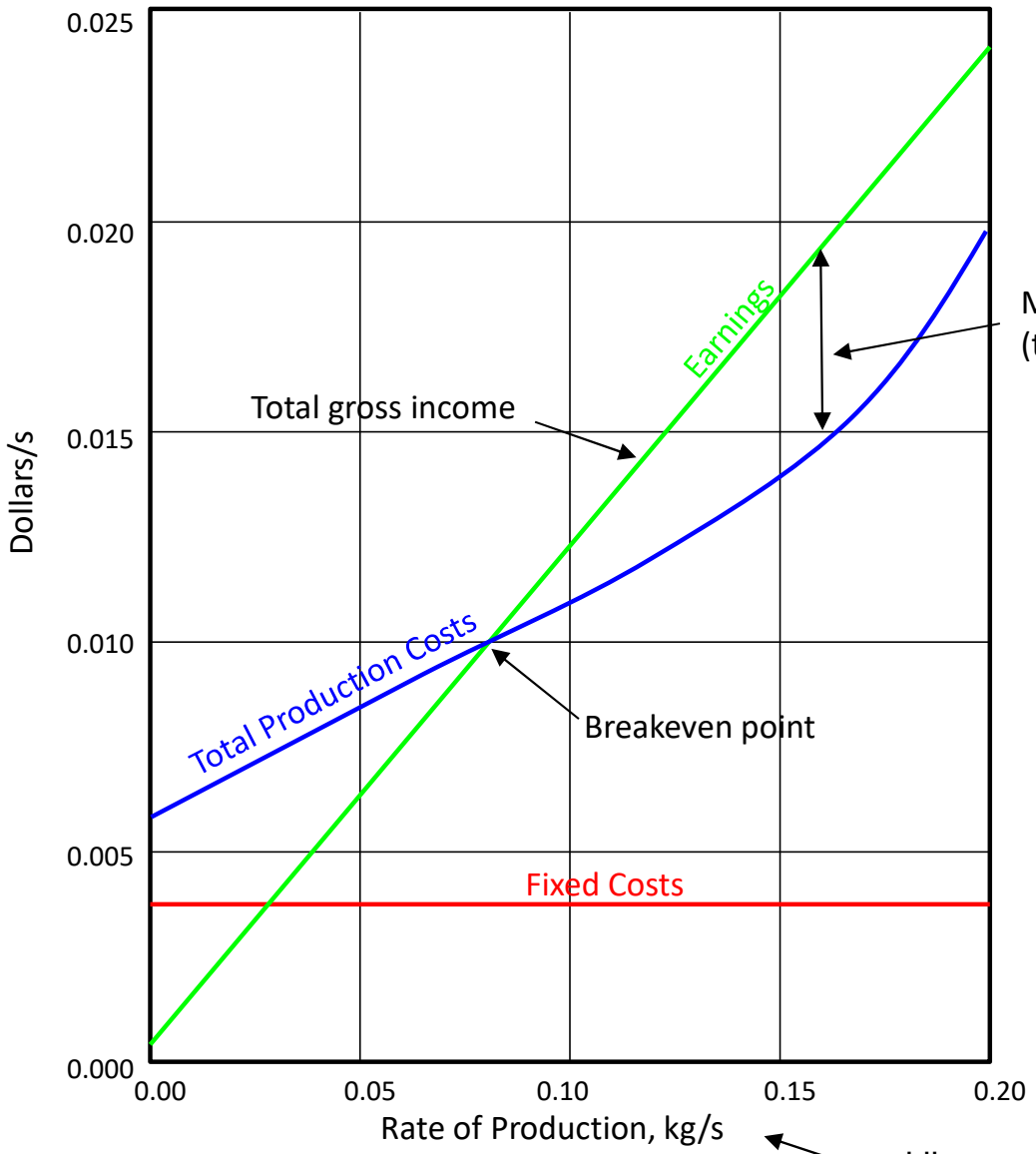
1. Estimate capital costs using scaling factors.
2. Estimate capital costs based on turnover ratio.
3. Determine breakeven point given production data.

FEE Manual, page 230

Break-Even Analysis – ICP

PTW Figure 6-3; equation: gross earnings – variable costs – fixed costs

apply this equation



dollars per second

Maximum net earnings
(typo p. 231 ~~gross~~)

kilograms per second

In this figure, total production costs are the sum of fixed and variable costs.

In ICP, the are separate (normal way).

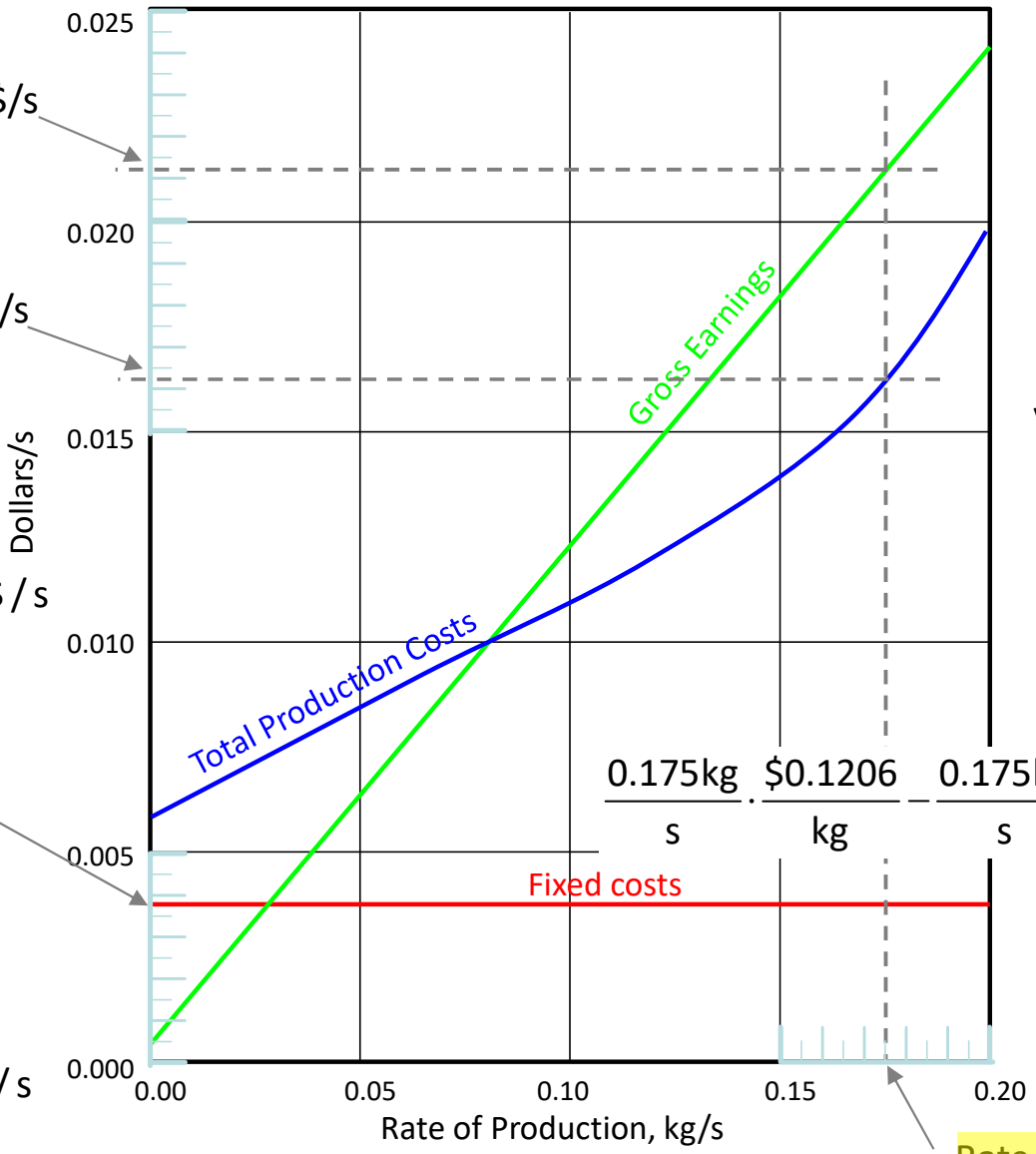
Breakeven point is at the indicated point if total product costs include fixed costs.

FEE Manual, page 230

Break-Even Analysis – Ex1

PTW Figure 6-3; equation: gross earnings – variable costs – fixed costs

apply this equation



Gross Earnings = 0.0211 $/s

Total Prod. Cost = 0.0162 $/s

Net Earnings =

$0.0211 - 0.0162 = 0.0049\ \$/s$

Fixed Costs = 0.0038 $/s

Variable Costs =

$0.0162 - 0.0038 = 0.0124\ \$/s$

product market price x, $/kg:

$$\frac{0.175\text{kg}}{\text{s}} \cdot x = \frac{\$0.0211}{\text{s}}$$

$$x = \frac{\$0.1206}{\text{kg}}$$

variable production cost y, $/kg:

$$\frac{0.175\text{kg}}{\text{s}} \cdot y = \frac{\$0.0124}{\text{s}}$$

$$y = \frac{\$0.0709}{\text{kg}}$$

$$\frac{0.175\text{kg}}{\text{s}} \cdot \frac{\$0.1206}{\text{kg}} - \frac{0.175\text{kg}}{\text{s}} \cdot \frac{\$0.0709}{\text{kg}} - \frac{\$0.0038}{\text{s}} = \frac{\$0.0049}{\text{s}}$$

Operating at a profit

Rate of production = 0.175 kg/s

FEE Manual, page 230

Break-Even Analysis – Ex2

PTW Figure 6-3; equation: gross earnings – variable costs – fixed costs

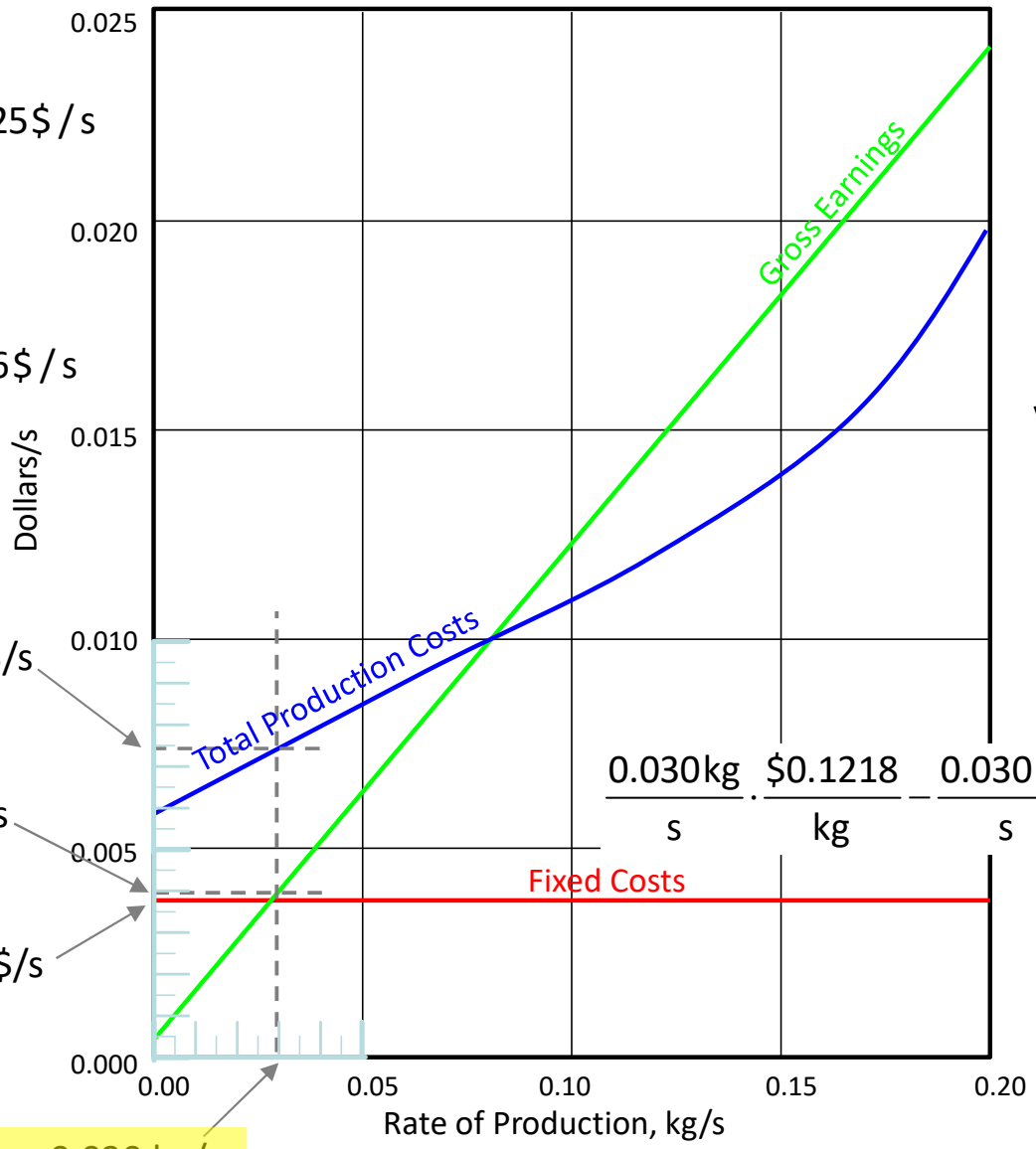
apply this equation

Net Earnings =

$$0.0039 - 0.0064 = -0.0025\ \$/s$$

Variable Costs =

$$0.0064 - 0.0038 = 0.0026\ \$/s$$



Total Prod. Cost = 0.0064 $/s

Gross Earnings = 0.0039 $/s

Fixed Costs = 0.0038 $/s

Rate of production = 0.030 kg/s

product market price x, $/kg:

$$\frac{0.030\text{kg}}{\text{s}} \cdot x = \frac{\$0.0039}{\text{s}}$$

$$x = \frac{\$0.1300}{\text{kg}}$$

variable production cost y, $/kg:

$$\frac{0.030\text{kg}}{\text{s}} \cdot y = \frac{\$0.0026}{\text{s}}$$

$$y = \frac{\$0.0867}{\text{kg}}$$

$$\frac{0.030\text{kg}}{\text{s}} \cdot \frac{\$0.1218}{\text{kg}} - \frac{0.030\text{kg}}{\text{s}} \cdot \frac{\$0.0867}{\text{kg}} - \frac{\$0.0038}{\text{s}} = -\frac{\$0.0025}{\text{s}}$$

Operating at loss

FEE Manual, page 230

Break-Even Analysis – Ex3

PTW Figure 6-3; equation: gross earnings – variable costs – fixed costs

apply this equation

Net Earnings =

$$0.0100 - 0.0100 = 0.0000\ \$/s$$

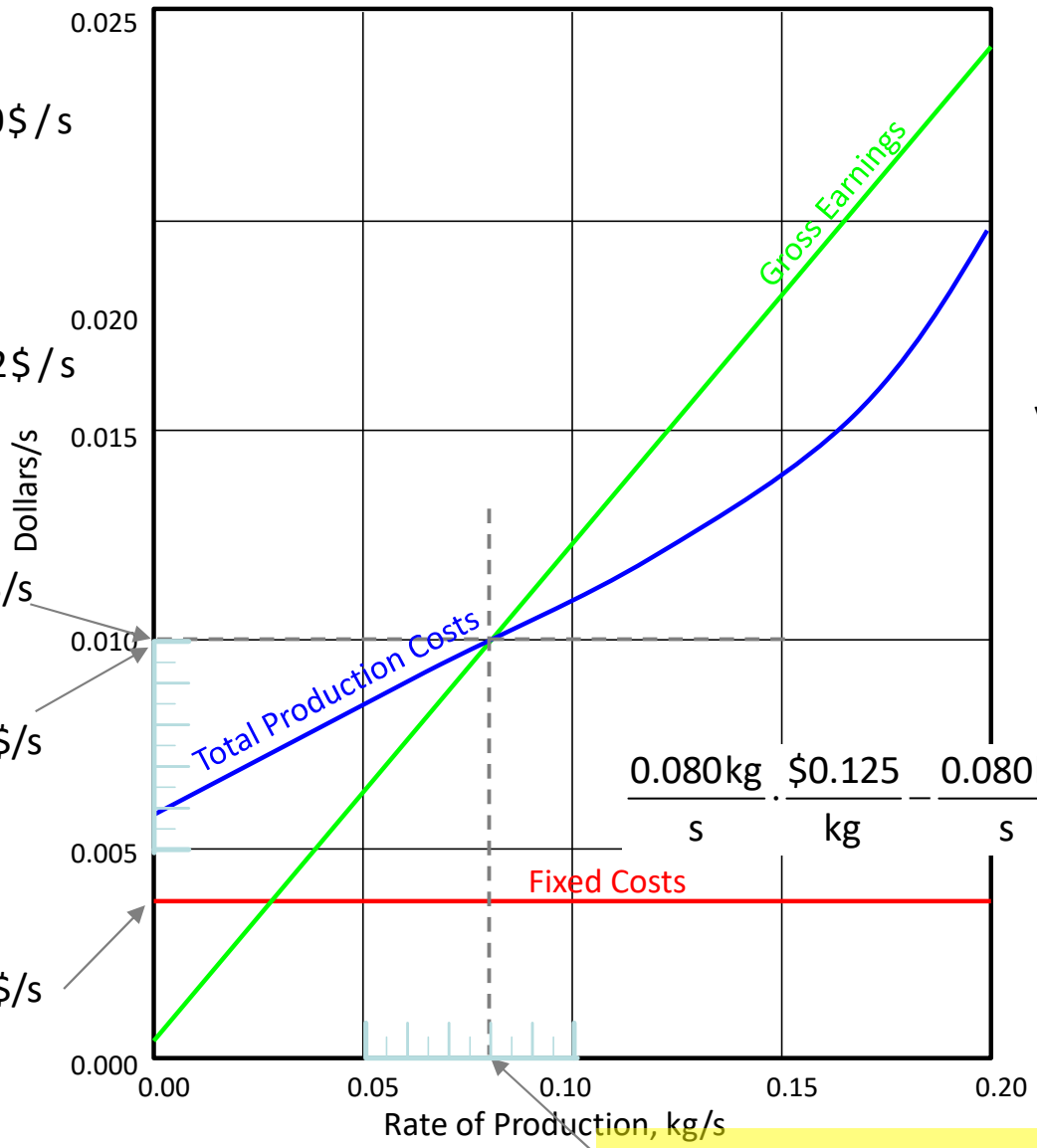
Variable Costs =

$$0.0100 - 0.0038 = 0.0062\ \$/s$$

Total Prod. Cost = 0.0100 $/s

Gross Earnings = 0.0100 $/s

Fixed Costs = 0.0038 $/s



product market price x, $/kg:

$$\frac{0.080\text{kg}}{\text{s}} \cdot x = \frac{\$0.0100}{\text{s}}$$

$$x = \frac{\$0.1250}{\text{kg}}$$

variable production cost y, $/kg:

$$\frac{0.080\text{kg}}{\text{s}} \cdot y = \frac{\$0.0062}{\text{s}}$$

$$y = \frac{\$0.0775}{\text{kg}}$$

$$\frac{0.080\text{kg}}{\text{s}} \cdot \frac{\$0.125}{\text{kg}} - \frac{0.080\text{kg}}{\text{s}} \cdot \frac{\$0.0062}{\text{kg}} - \frac{\$0.0038}{\text{s}} = \frac{\$0.0000}{\text{s}}$$

“Breakeven”

Proceed to ICP1

Uses an equation from lesson 19:

PTW equation 8-1a, page 323

$$ROI = \frac{N_P}{TCI}$$

N_P = Net annual profit
TCI = Total capital investment

Questions?