

CH402 Chemical Engineering Process Design

Class Notes L16

Plant Cost Scaling and Breakeven

L15 lookback: Estimating capital cost for an industrial facility

Method 1 – scaling against a known price

- Method 1a – scaling equipment
- Method 1b – scaling entire facilities (problems 6-9 and 6-10)

Method 2 – percentage method

- Method 2a – percentage of FCI – Example 6-1
- Method 2b – percentage of PEC – Colorful worksheet
- Need to differentiate between capital investment and purchased equipment cost.
- Need to understand the different components of capital investment.
- *Key - Each of these components has a well-known percentage of the total FCI.*
- To illustrate, we examined example 6-1 and problem 6-8.
- We also discussed Method 2c – Lang Factors - in Lesson 15.

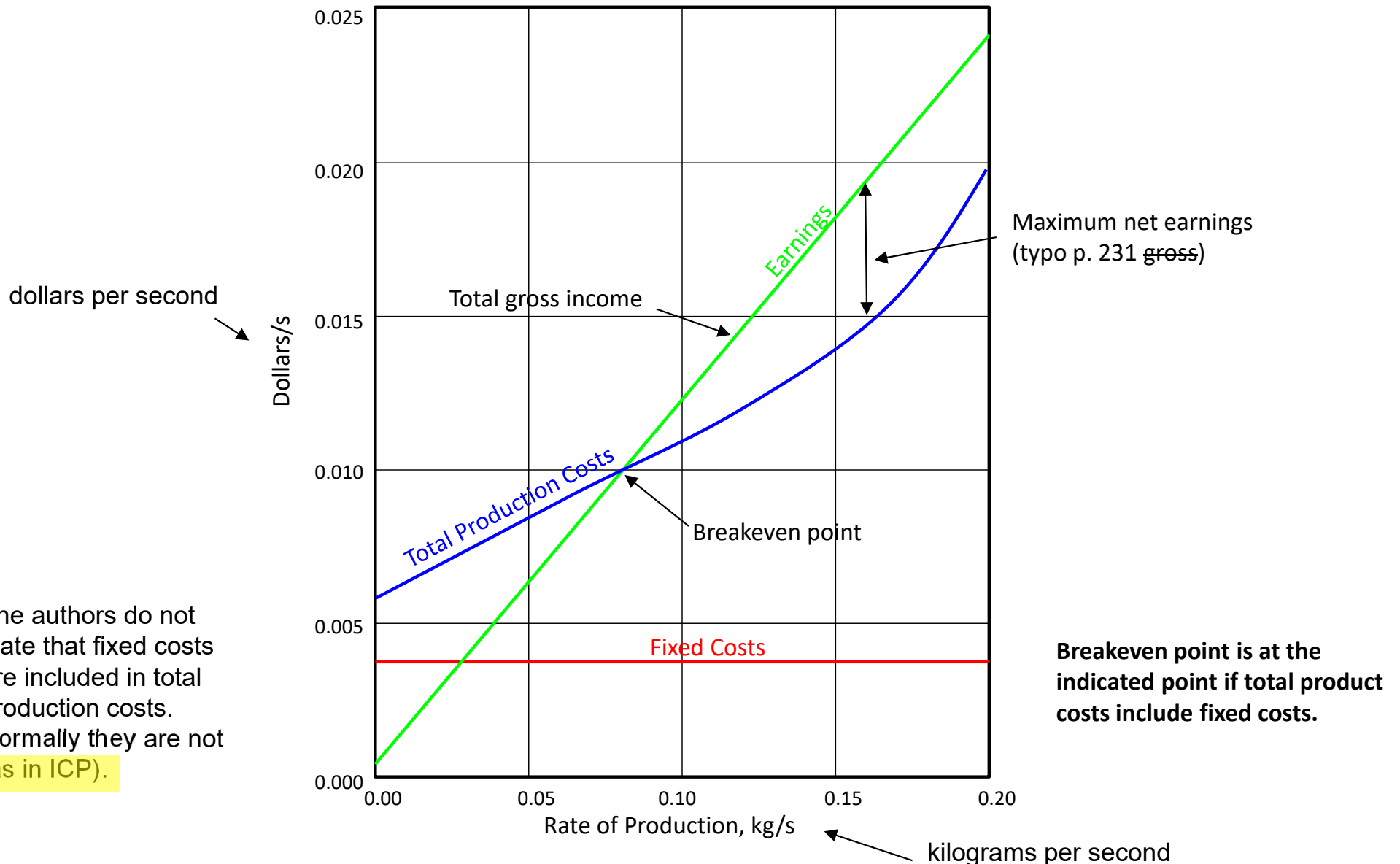
Objectives for Lesson 16:

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

Break-Even Analysis – ICP

PTW Figure 6-3; FEE p. 231; equation: gross earnings – variable costs – fixed costs

apply this equation



Break-Even Analysis – Ex1

Figure 6-3; FEE p. 231; equation: gross earnings – variable costs – fixed costs

apply this equation

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

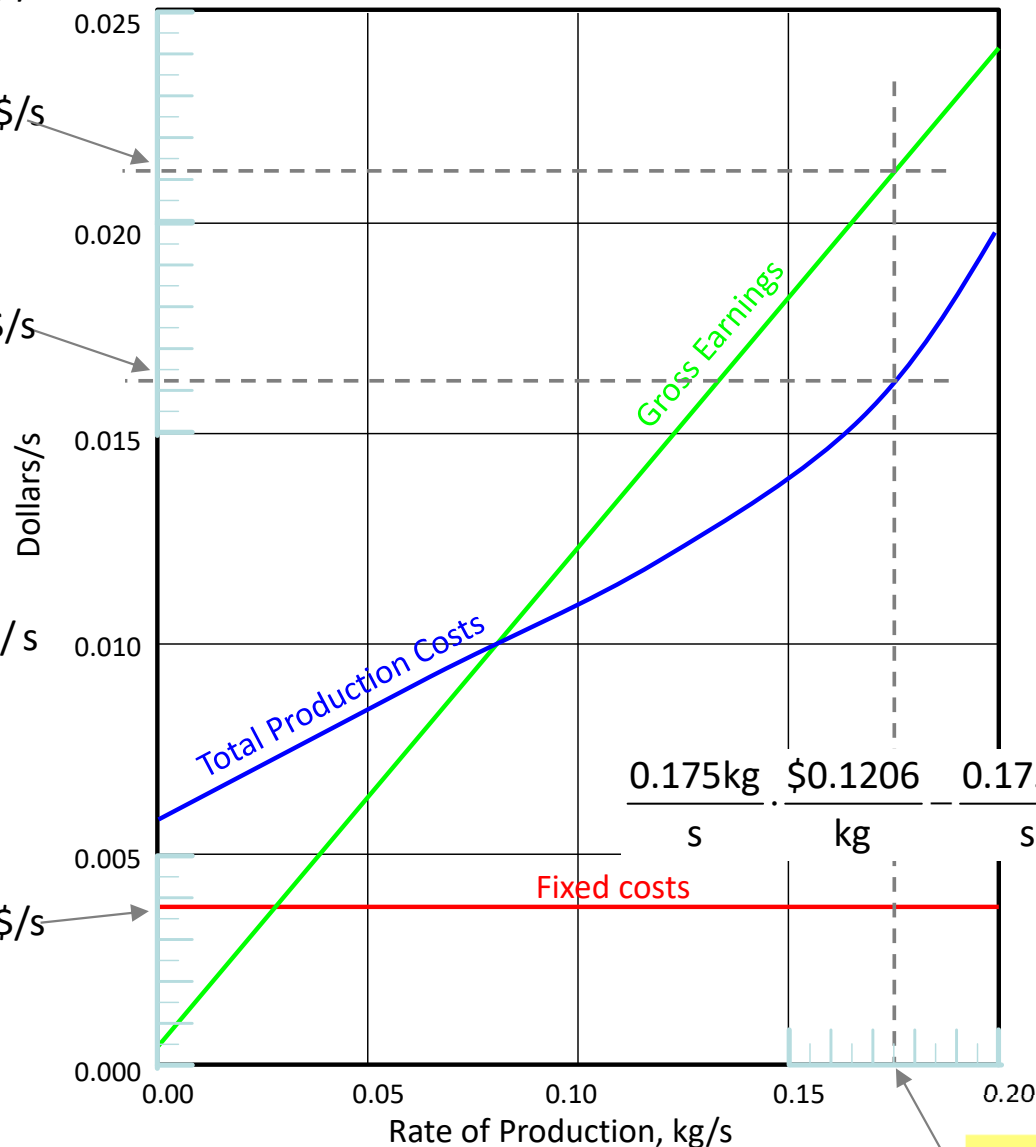
$$\text{Gross Earnings} = 0.0211 \$ / s$$

$$\text{Total Prod. Cost} = 0.0162 \$ / s$$

Variable Costs =

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

$$\text{Fixed Costs} = 0.0038 \$ / s$$



market price x, \$/kg:

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

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

variable production cost y, \$/kg:

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

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

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

Operating at a profit

Rate of production = 0.175 kg/s

Break-Even Analysis – Ex2

Figure 6-3; FEE p. 231; equation: $\underbrace{\text{gross earnings} - \text{variable costs}}_{\text{apply this equation}} - \text{fixed costs}$

apply this equation

Variable Costs =

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

market price x , \$/kg:

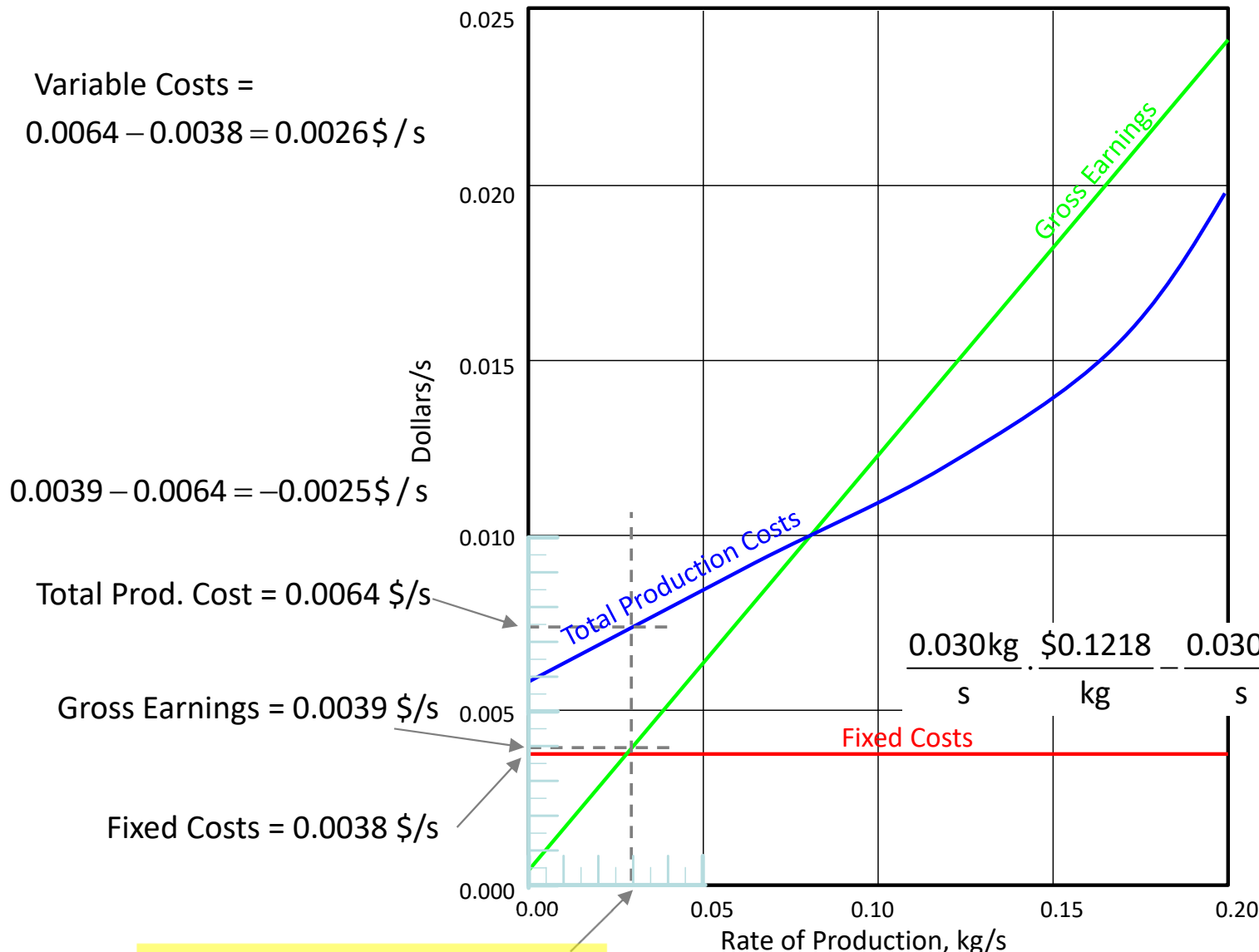
$$\frac{0.030 \text{ kg}}{s} \cdot x = \frac{\$0.0039}{s}$$

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

variable production cost y , \$/kg:

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

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



Operating at loss

Rate of production = 0.030 kg/s

Break-Even Analysis – Ex3

Figure 6-3; FEE p. 231; equation: $\text{gross earnings} - \text{variable costs} - \text{fixed costs}$

apply this equation

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

market price x , \$/kg:

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

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

variable production cost y , \$/kg:

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

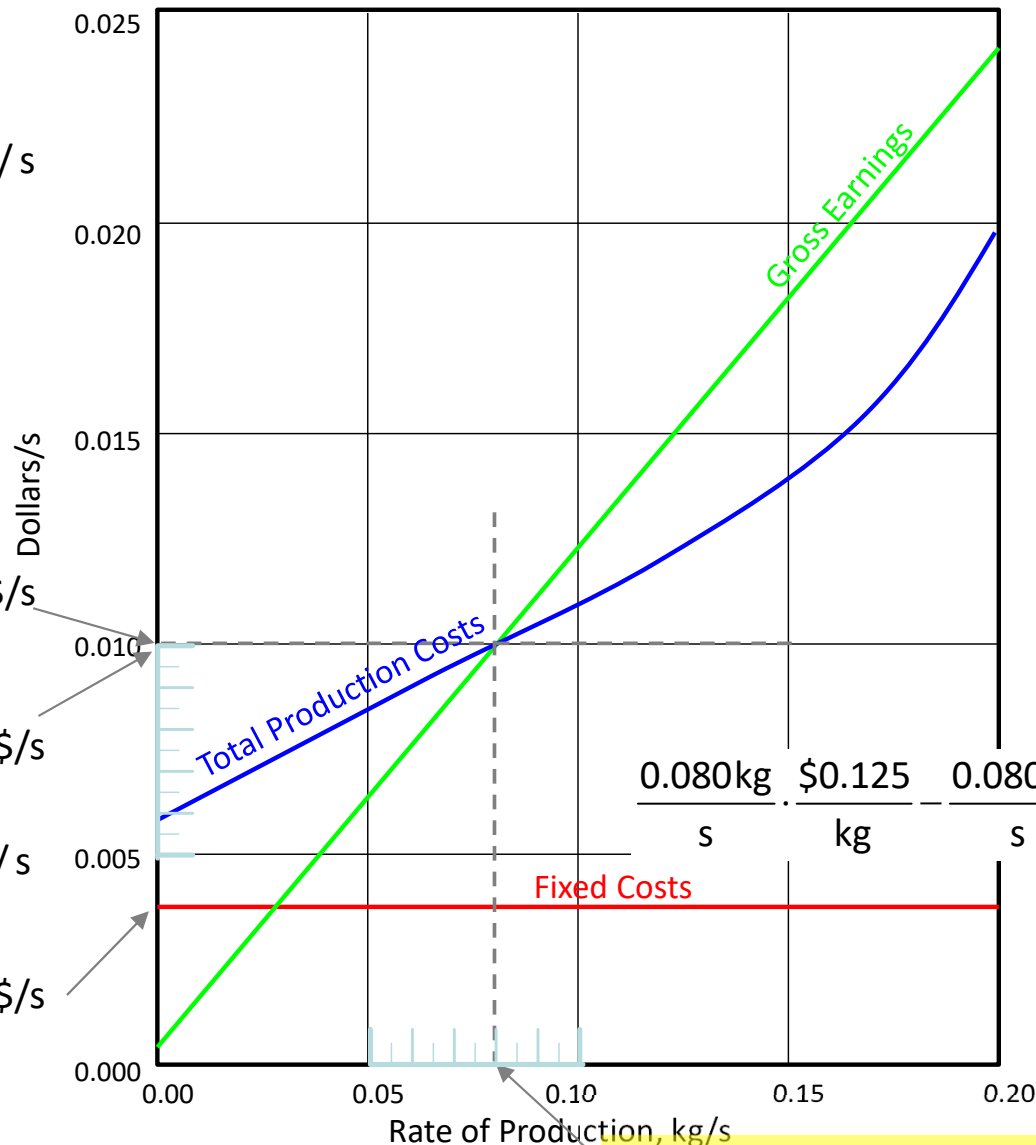
$$y = \frac{\$0.0775}{\text{kg}}$$

Total Prod. Cost = $0.0100 \$ / s$

Gross Earnings = $0.0100 \$ / s$

$0.0100 - 0.0100 = 0.0000 \$ / s$

Fixed Costs = $0.0038 \$ / s$



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

"Break-even"

Rate of production = 0.080 kg/s

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?