Chapter Twenty-Two

Firm Supply

Firm Supply

- **How does a firm decide how much product to supply? This depends upon the firm's**
  - **technology**
  - **market environment**
  - **goals**
  - **competitors' behaviors**

Market Environments

- Are there many other firms, or just a few?
- Do other firms' decisions affect our firm's payoffs?
- Is trading anonymous, in a market? Or are trades arranged with separate buyers by middlemen?

Market Environments

- **Monopoly**: Just one seller that determines the quantity supplied and the market-clearing price.
- **Oligopoly**: A few firms, the decisions of each influencing the payoffs of the others.

Market Environments

- **Dominant Firm**: Many firms, but one much larger than the rest. The large firm's decisions affect the payoffs of each small firm. Decisions by any one small firm do not noticeably affect the payoffs of any other firm.

Market Environments

- **Monopolistic Competition**: Many firms each making a slightly different product. Each firm's output level is small relative to the total.
- **Pure Competition**: Many firms, all making the same product. Each firm's output level is small relative to the total.

Market Environments

- **Later chapters examine monopoly, oligopoly, and the dominant firm.**
- **This chapter explores only pure competition.**

Pure Competition

- **A firm in a perfectly competitive market knows it has no influence over the market price for its product. The firm is a market price-taker.**
- **The firm is free to vary its own price.**

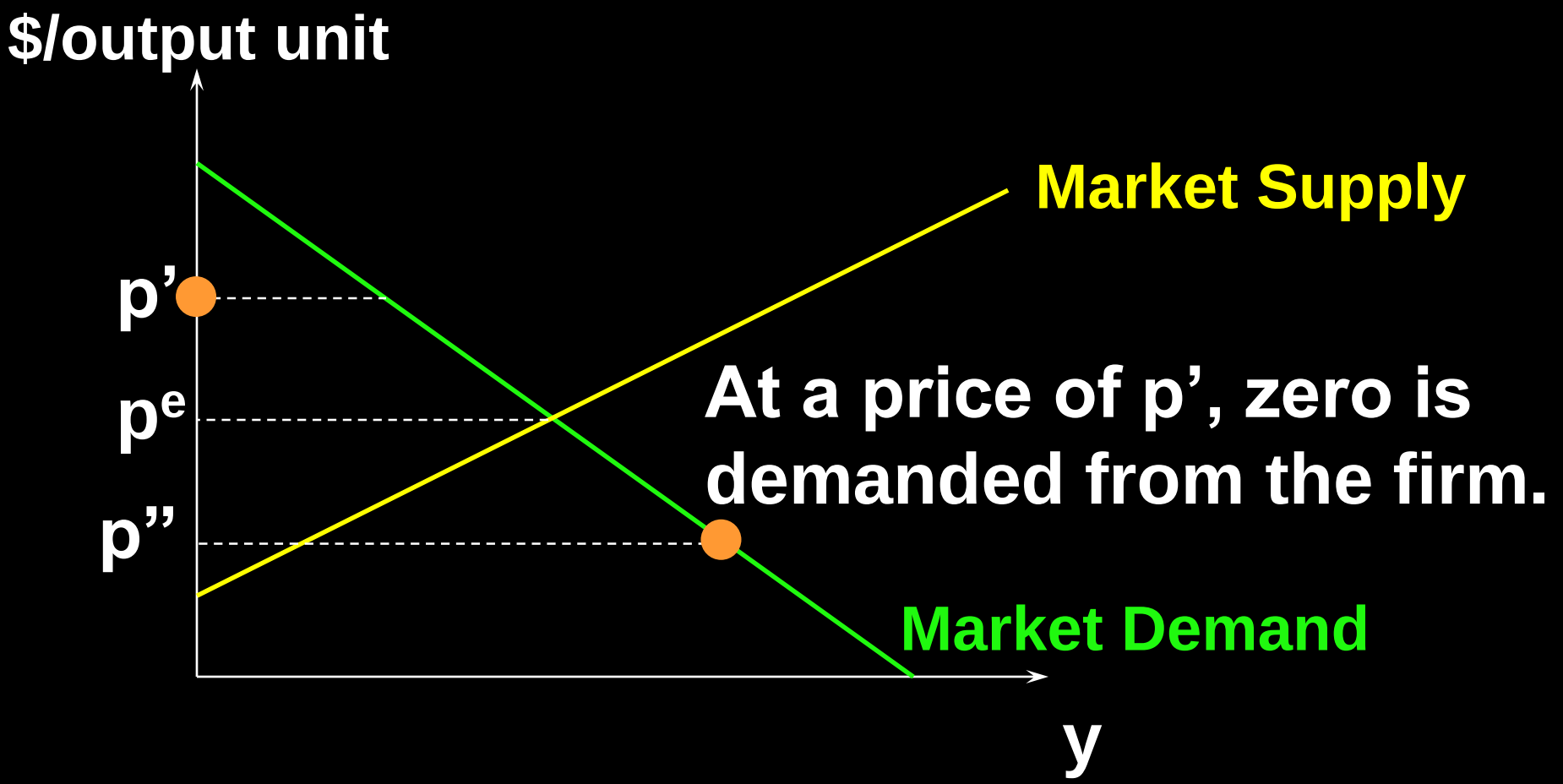
Pure Competition

- **If the firm sets its own price above the market price then the quantity demanded from the firm is zero.**
- **If the firm sets its own price below the market price then the quantity demanded from the firm is the entire market quantity-demanded.**

Pure Competition

- **So what is the demand curve faced by the individual firm?**

Pure Competition

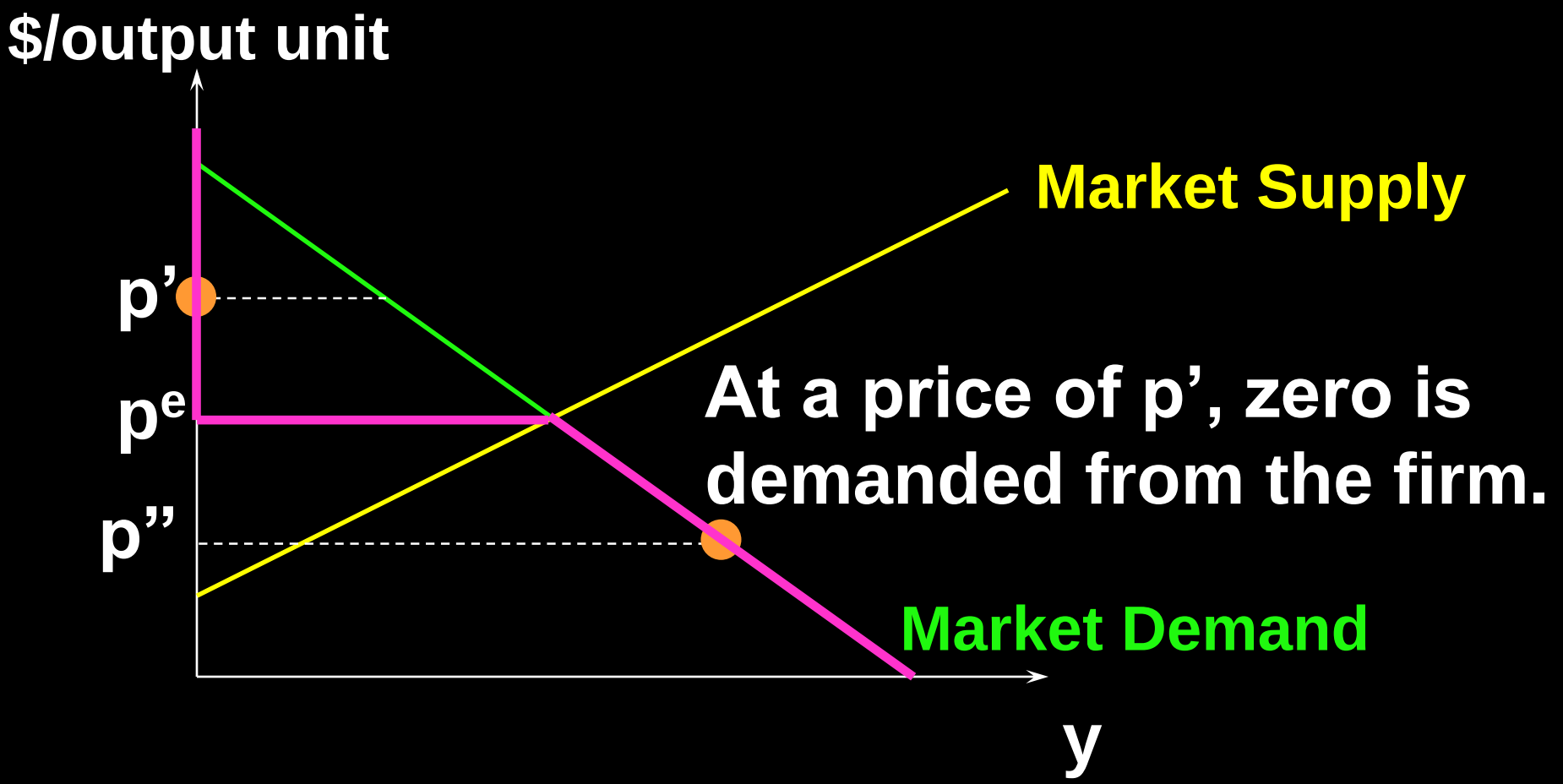


At a price of p'' the firm faces the entire market demand.

Pure Competition

- **So the demand curve faced by the individual firm is ...**

Pure Competition

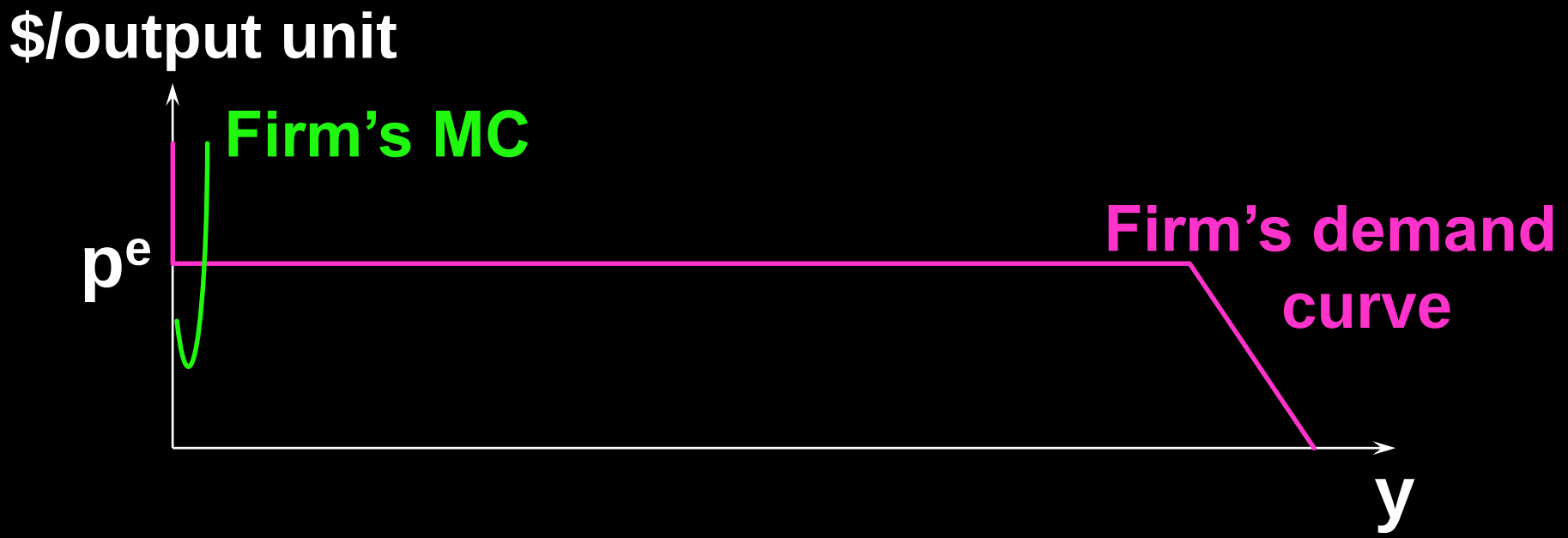


At a price of p'' the firm faces the entire market demand.

Smallness

- **What does it mean to say that an individual firm is “small relative to the industry”?**

Smallness



The individual firm's technology causes it always to supply only a small part of the total quantity demanded at the market price.

The Firm's Short-Run Supply Decision

- Each firm is a profit-maximizer and in a short-run.
- Q: How does each firm choose its output level?
- A: By solving

$$\max_{y \geq 0} \Pi_s(y) = py - c_s(y).$$

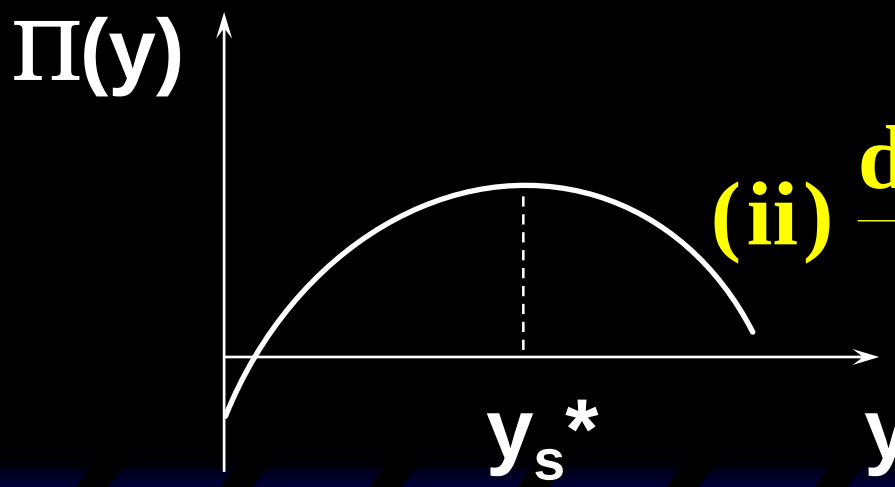
The Firm's Short-Run Supply Decision

$$\max_{y \geq 0} \Pi_s(y) = py - c_s(y).$$

What can the solution y_s^* look like?

(a) $y_s^* > 0$:

$$\text{(i)}\ \frac{d\Pi_s(y)}{dy} = p - MC_s(y) = 0$$



$$\text{(ii)}\ \frac{d^2\Pi_s(y)}{dy^2} < 0 \text{ at } y = y_s^*.$$

The Firm's Short-Run Supply Decision

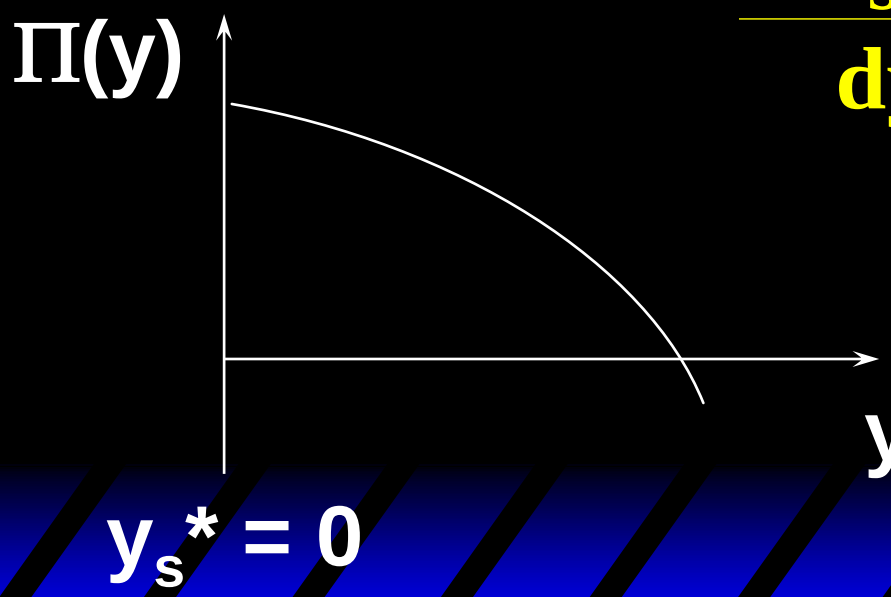
$$\max_{y \geq 0} \Pi_s(y) = py - c_s(y).$$

What can the solution y* look like?

(b) $y_s^* = 0$:

$$\frac{d\Pi_s(y)}{dy} = p - MC_s(y) \leq 0$$

at $y = y_s^* = 0$.



The Firm's Short-Run Supply Decision

For the interior case of $y_s^* > 0$, the **first-order maximum profit condition** is

$$\frac{d\Pi_s(y)}{dy} = p - MC_s(y) = 0.$$

That is, $p = MC_s(y_s^*)$.

So at a profit maximum with $y_s^* > 0$, the market price p equals the marginal cost of production at $y = y_s^*$.

The Firm's Short-Run Supply Decision

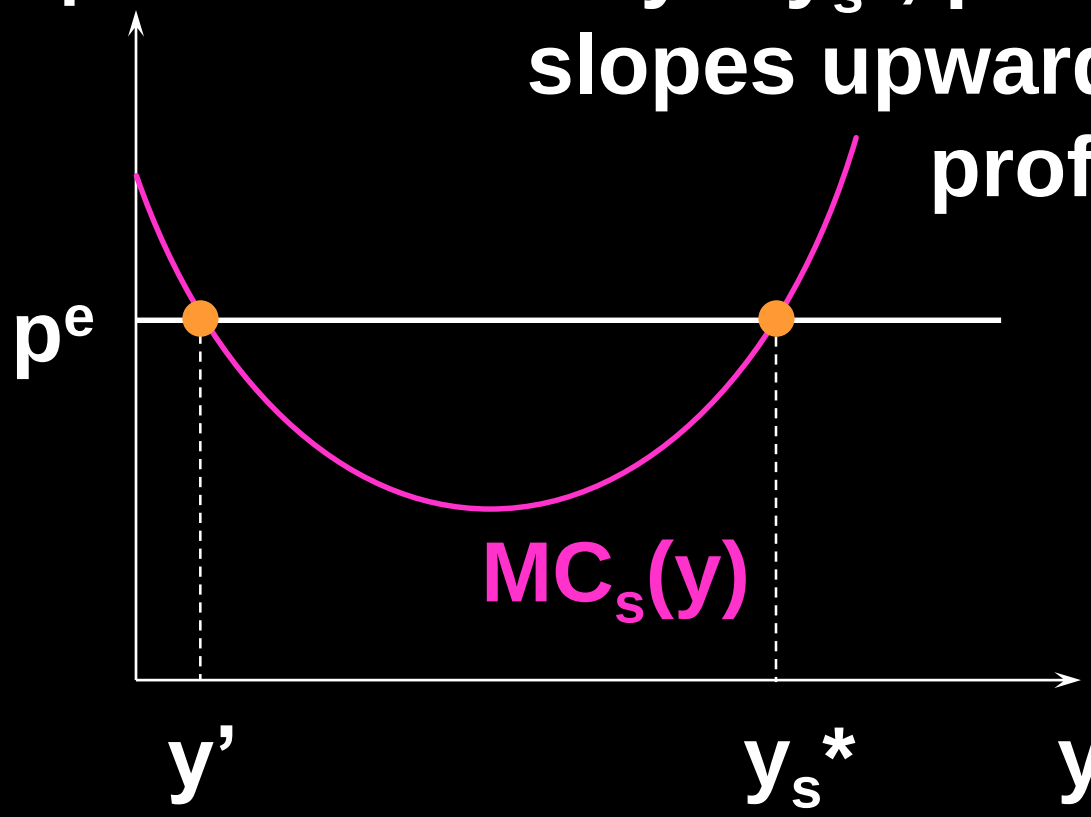
For the interior case of $y_s^* > 0$, the **second-order maximum profit condition** is

$$\frac{d^2\Pi_s(y)}{dy^2} = \frac{d}{dy}\left(p - MC_s(y)\right) = -\frac{dMC_s(y)}{dy} < 0.$$

That is, $\dfrac{dMC_s(y_s^*)}{dy} > 0.$

So at a profit maximum with $y_s^* > 0$, the firm's MC curve must be upward-sloping.

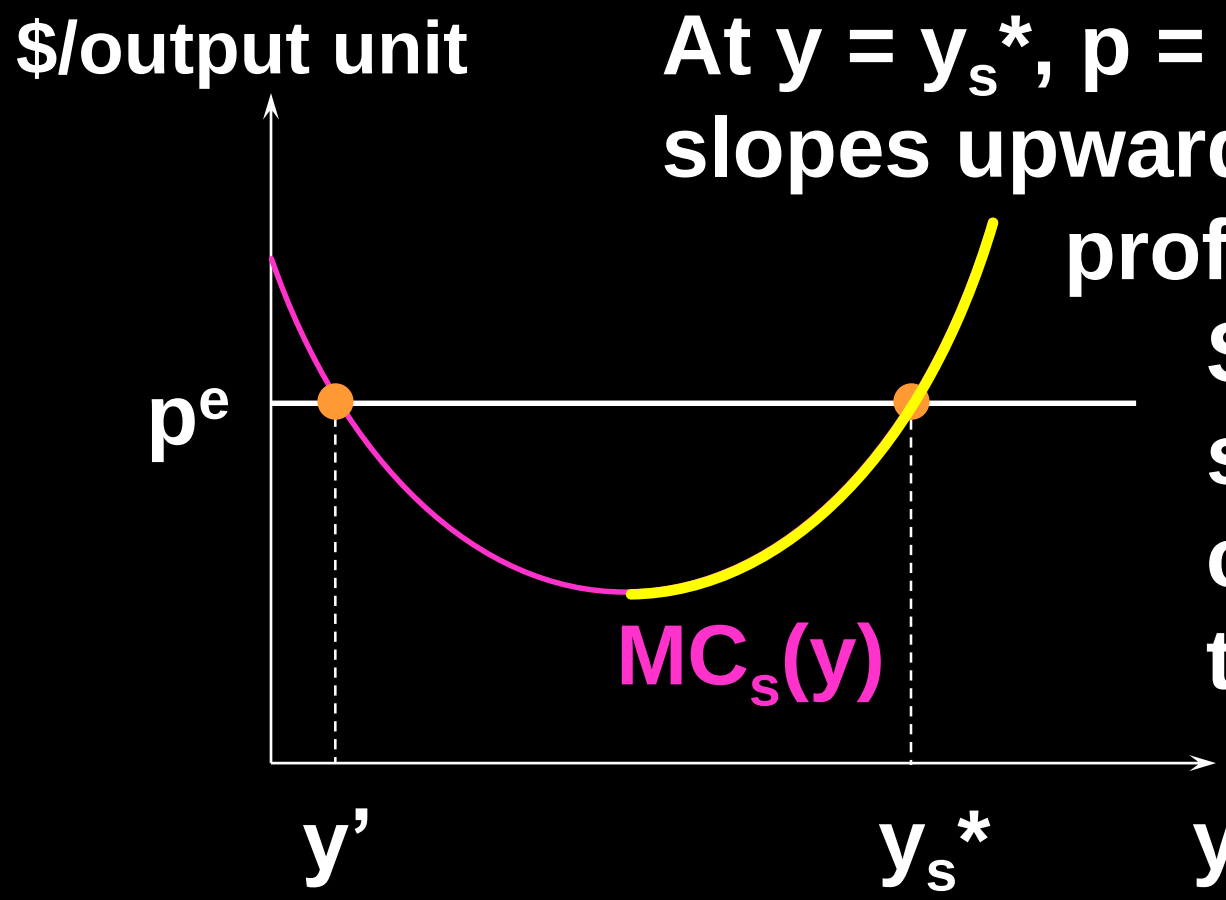
The Firm's Short-Run Supply Decision



At $y = y_s^*$, p = MC and MC slopes upwards. $y = y_s^*$ is profit-maximizing.

At y = y', p = MC and MC slopes downwards. y = y' is profit-minimizing.

The Firm's Short-Run Supply Decision



At $y = y_s^*$, p = MC and MC slopes upwards. $y = y_s^*$ is profit-maximizing. So a profit-max. supply level can lie only on the upwards sloping part of the firm's MC curve.

The Firm's Short-Run Supply Decision

- But not every point on the upward-sloping part of the firm's MC curve represents a profit-maximum.
- The firm's profit function is

$$\Pi_s(y) = py - c_s(y) = py - F - c_v(y).$$

- If the firm chooses y = 0 then its profit is

$$\Pi_s(y) = 0 - F - c_v(0) = -F.$$

The Firm's Short-Run Supply Decision

- So the firm will choose an output level y > 0 only if

$$\Pi_s(y) = py - F - c_v(y) \geq -F.$$

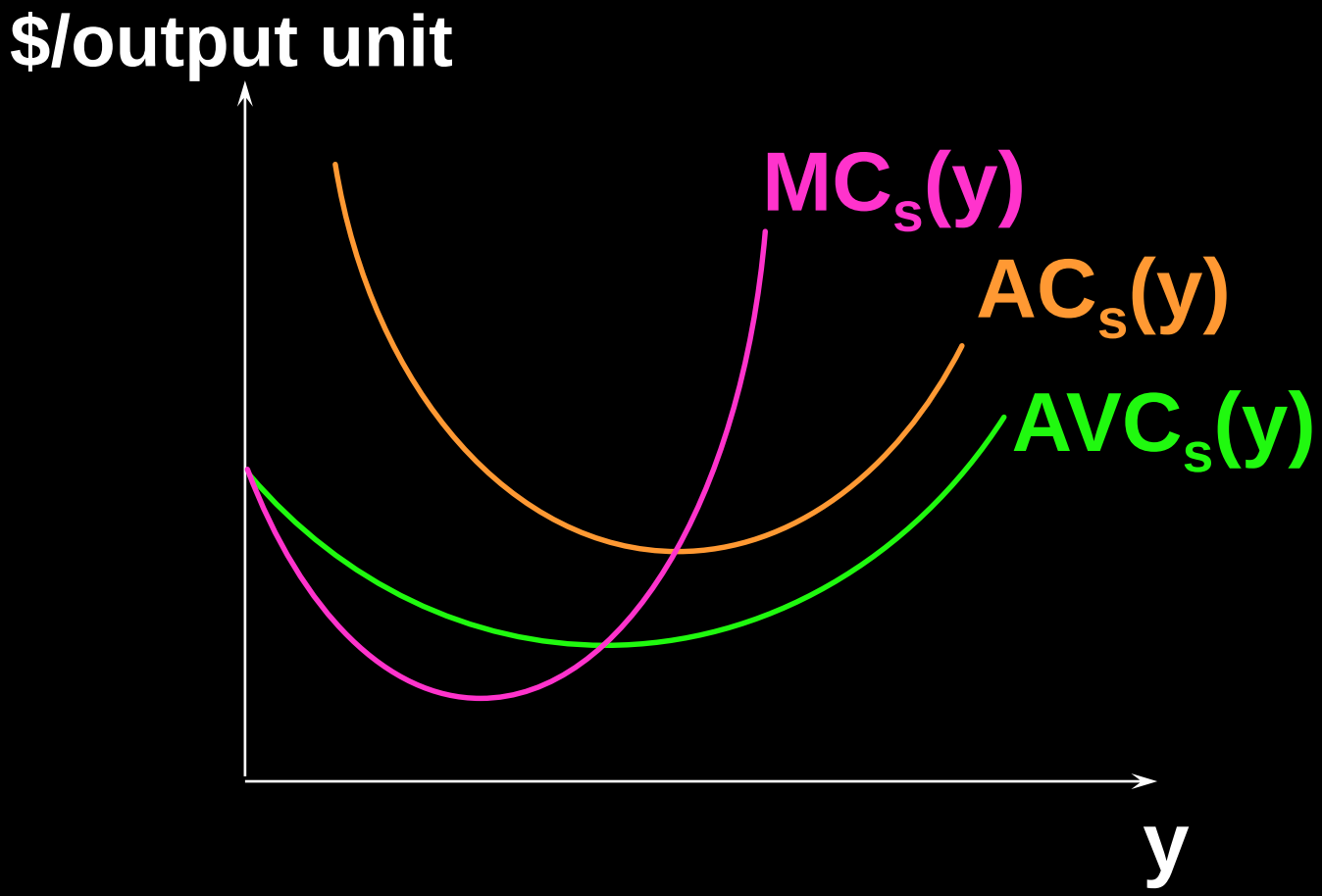
- I.e., only if

$$py - c_v(y) \geq 0$$

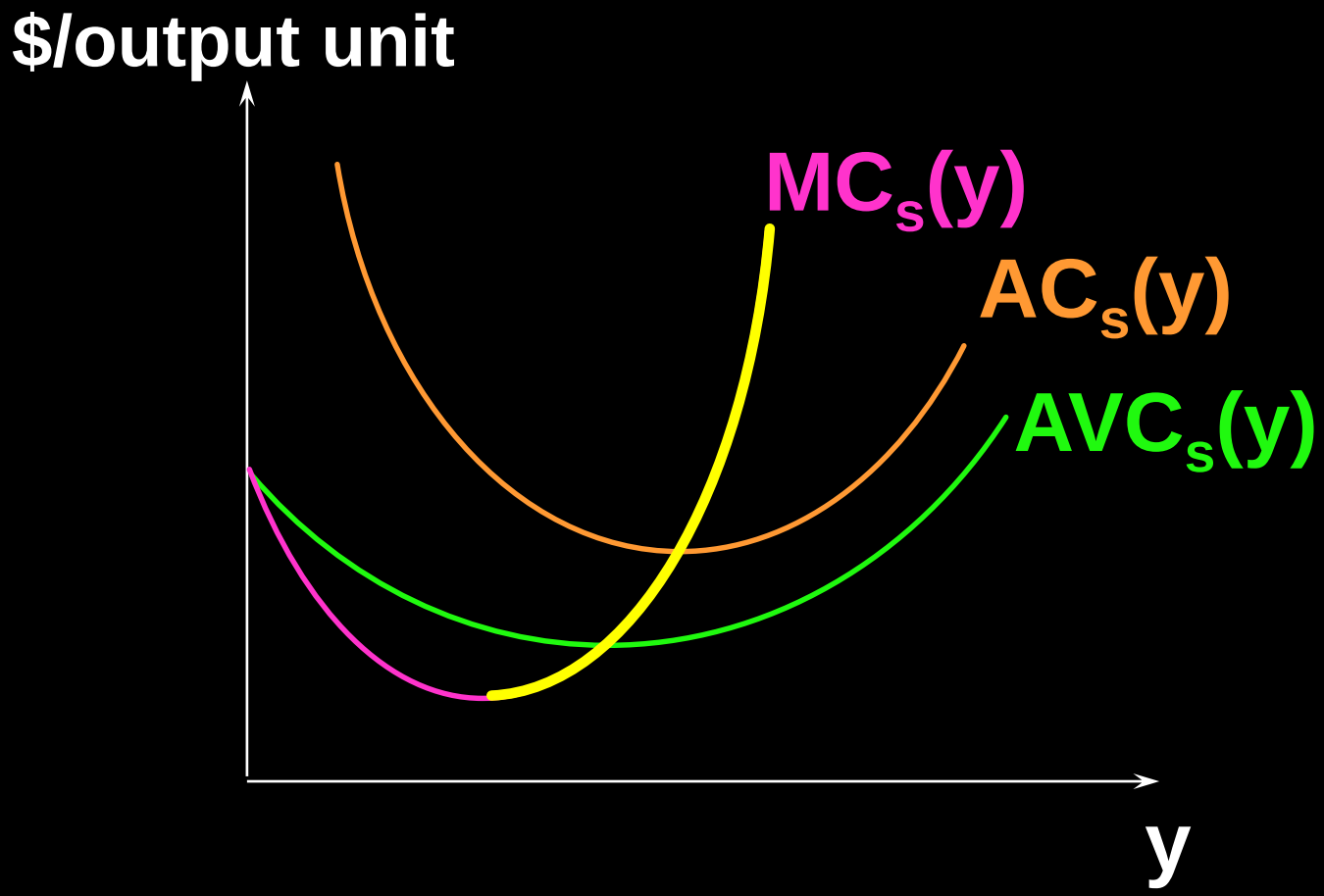
Equivalently, only if

$$p \geq \frac{c_v(y)}{y} = AVC_s(y).$$

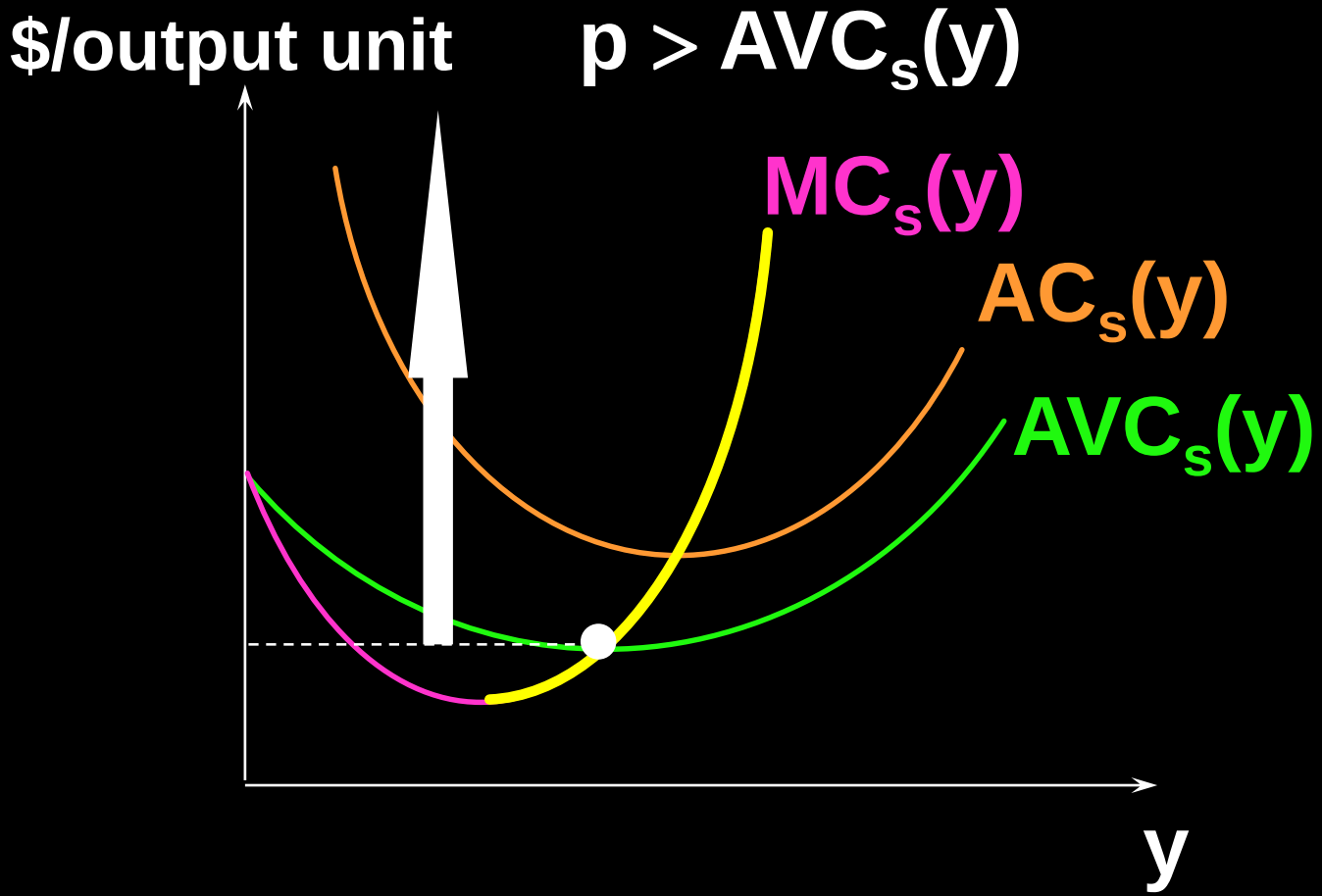
The Firm's Short-Run Supply Decision



The Firm's Short-Run Supply Decision



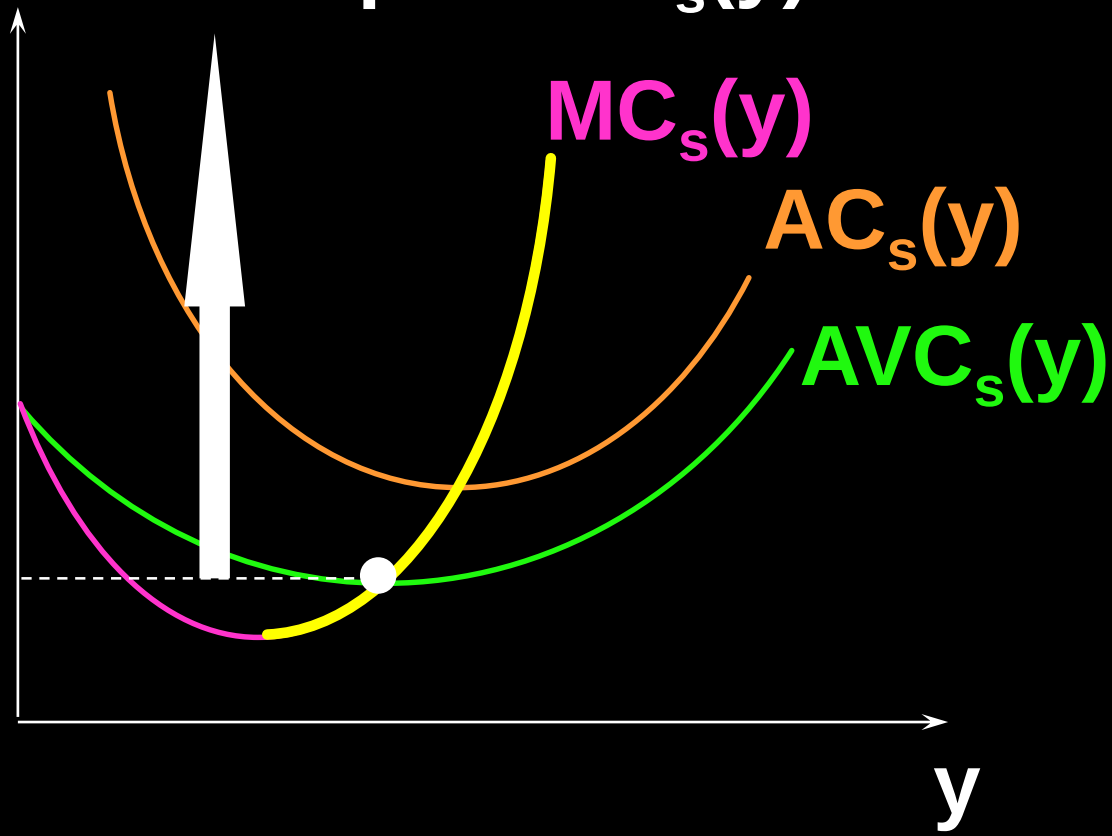
The Firm's Short-Run Supply Decision



The Firm's Short-Run Supply Decision

$/output unit

$p > AVC_s(y) \Rightarrow y_s^* > 0.$



The Firm's Short-Run Supply Decision

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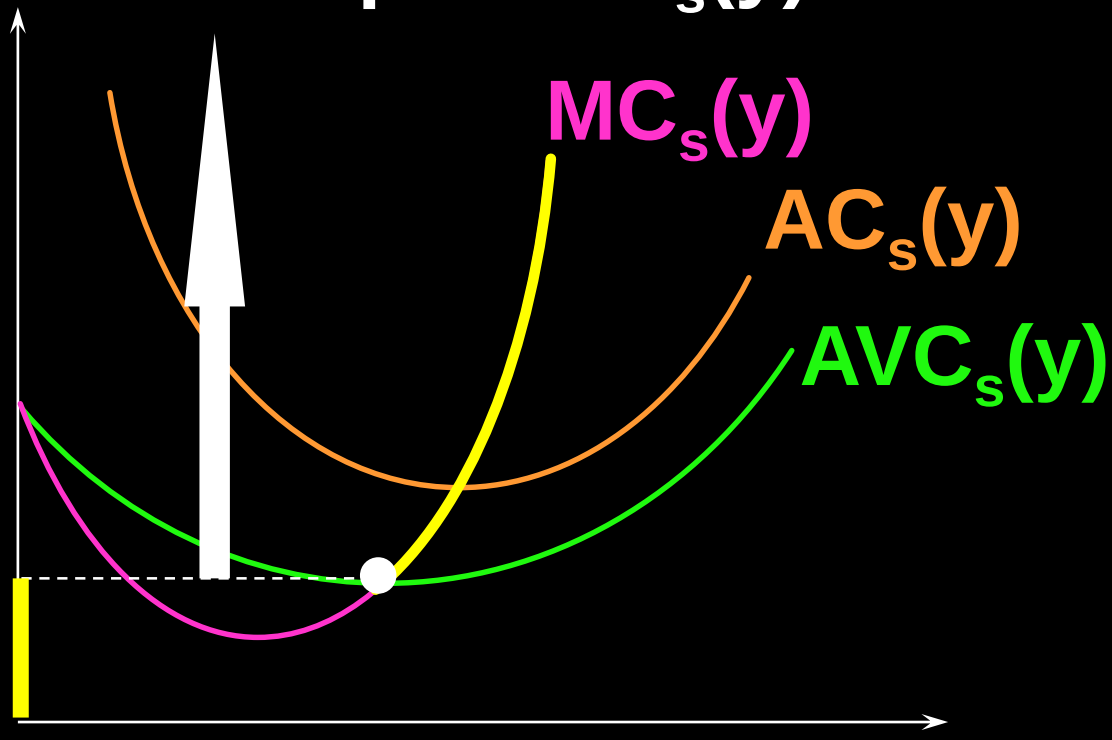
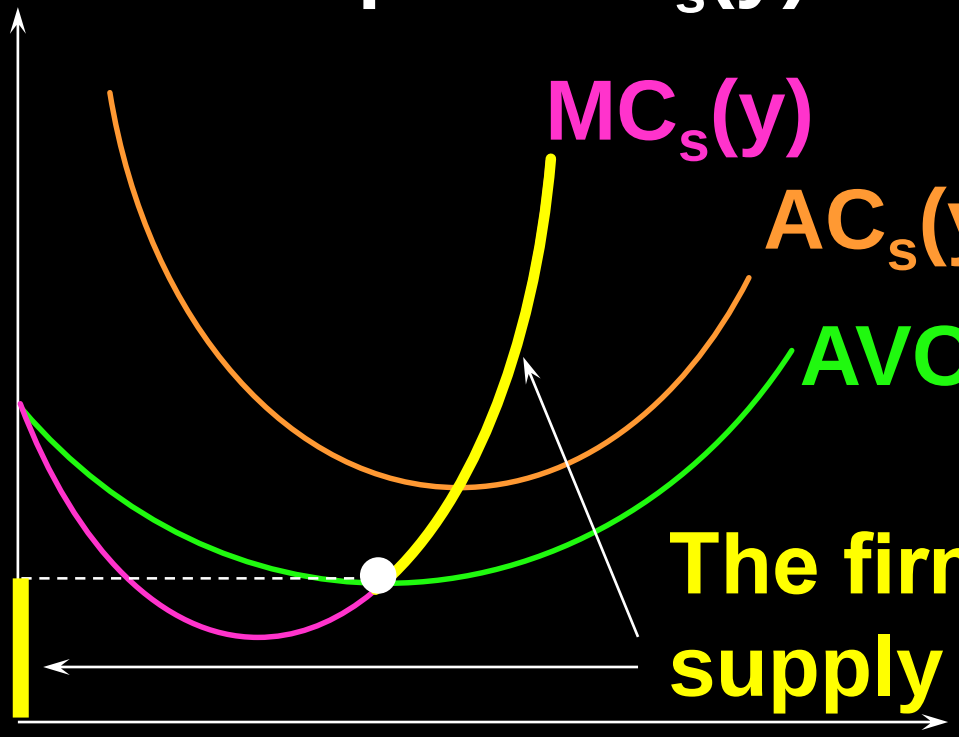


$p < AVC_s(y) \Rightarrow y_s^* = 0.$

The Firm's Short-Run Supply Decision

$/output unit

$p > AVC_s(y) \Rightarrow y_s^* > 0.$



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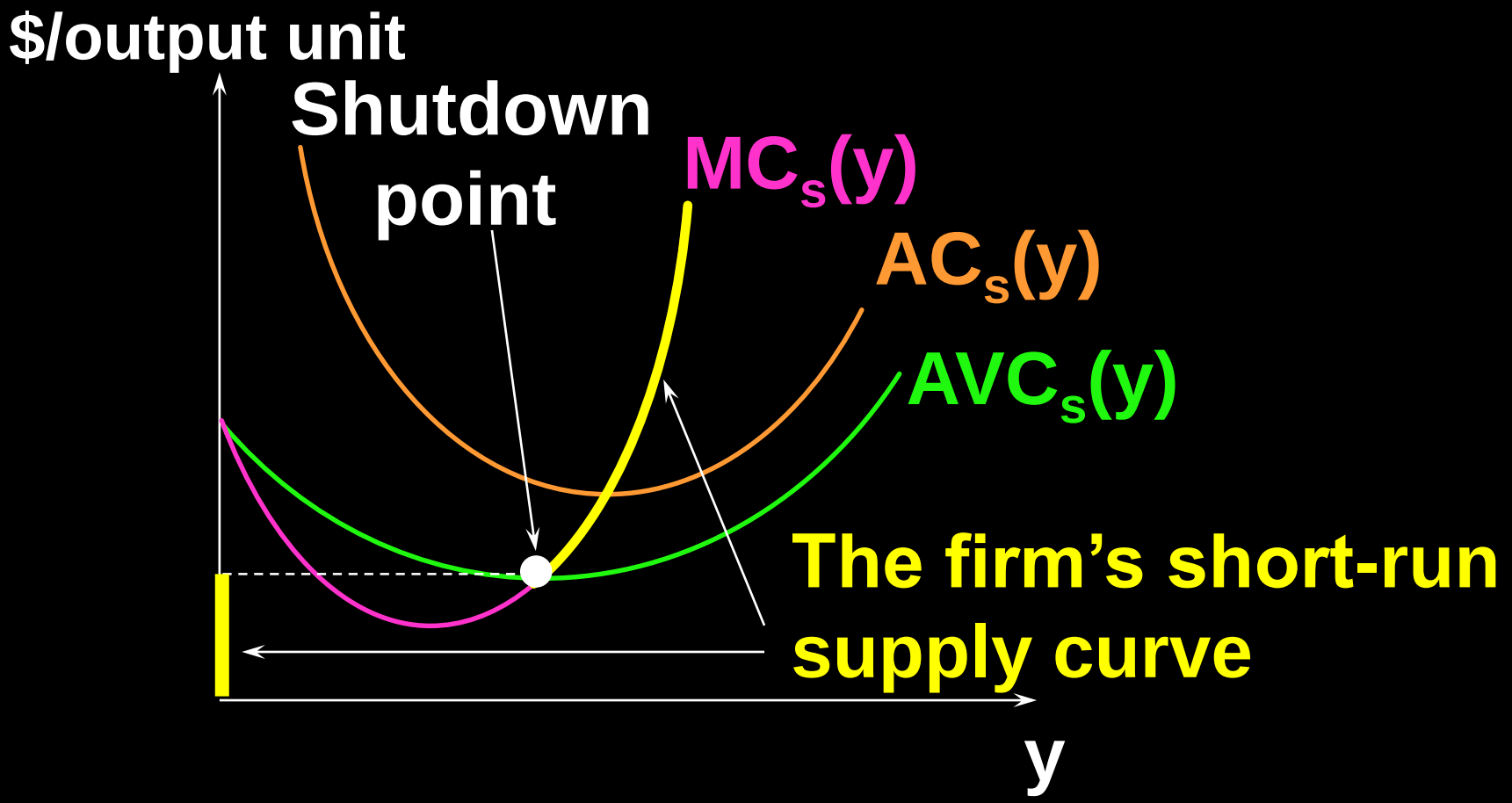
The Firm's Short-Run Supply Decision



The Firm's Short-Run Supply Decision

- **Shut-down is not the same as exit.**
- **Shutting-down means producing no output (but the firm is still in the industry and suffers its fixed cost).**
- **Exiting means leaving the industry, which the firm can do only in the long-run.**

The Firm's Long-Run Supply Decision

- **The long-run is the circumstance in which the firm can choose amongst all of its short-run circumstances.**
- **How does the firm's long-run supply decision compare to its short-run supply decisions?**

The Firm's Long-Run Supply Decision

- A competitive firm's long-run profit function is

$$\Pi(y) = py - c(y).$$

- The long-run cost c(y) of producing y units of output consists only of variable costs since all inputs are variable in the long-run.

The Firm's Long-Run Supply Decision

- **The firm's long-run supply level decision is to**

$$\max_{y \geq 0} \Pi(y) = py - c(y).$$

- **The 1st and 2nd-order maximization conditions are, for $y^* > 0$,**

$$p = MC(y) \text{ and } \frac{dMC(y)}{dy} > 0.$$

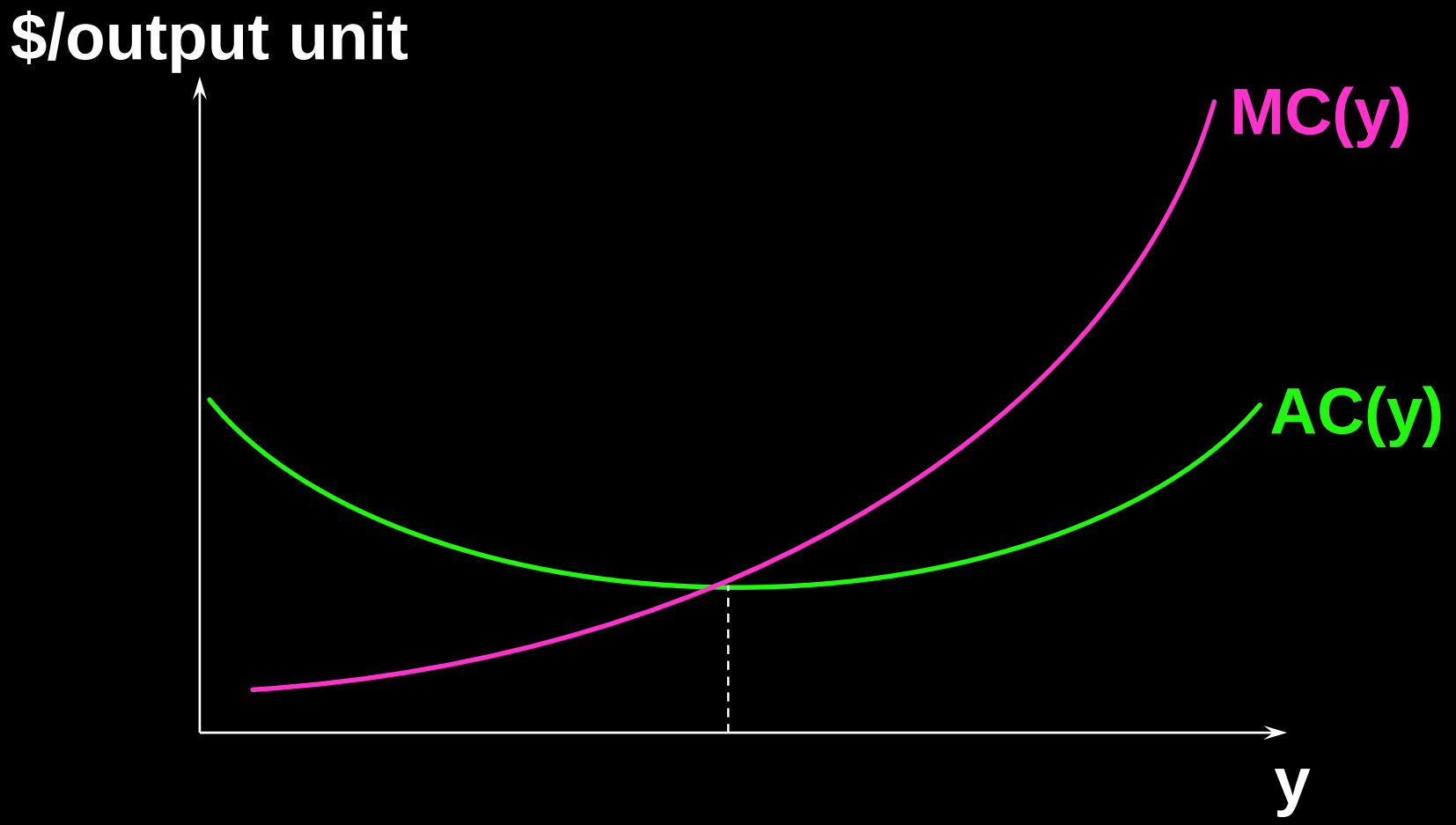
The Firm's Long-Run Supply Decision

- **Additionally, the firm's economic profit level must not be negative since then the firm would exit the industry. So,**

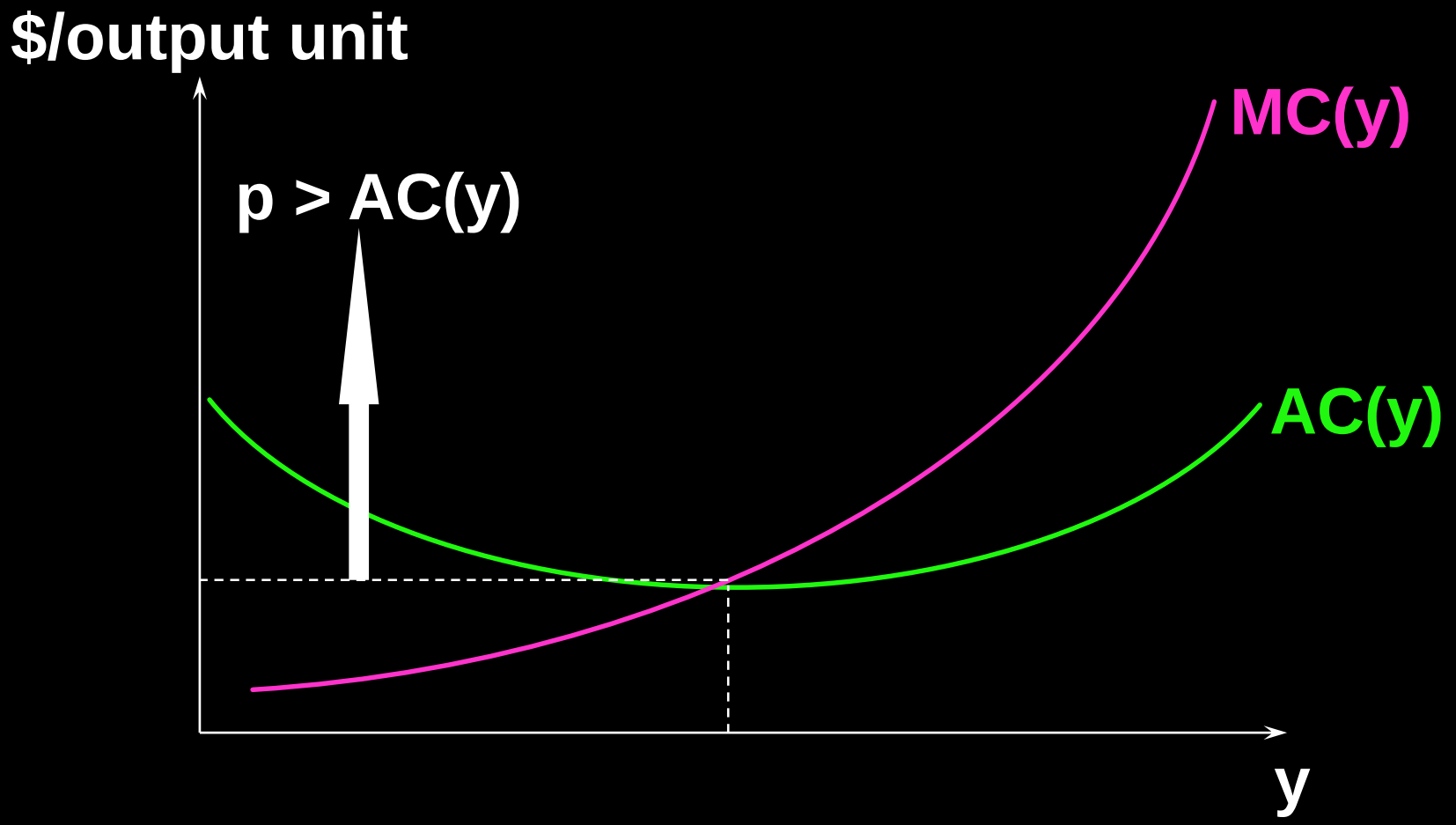
$$\Pi(y) = py - c(y) \geq 0$$

$$\Rightarrow \quad p \geq \frac{c(y)}{y} = AC(y).$$

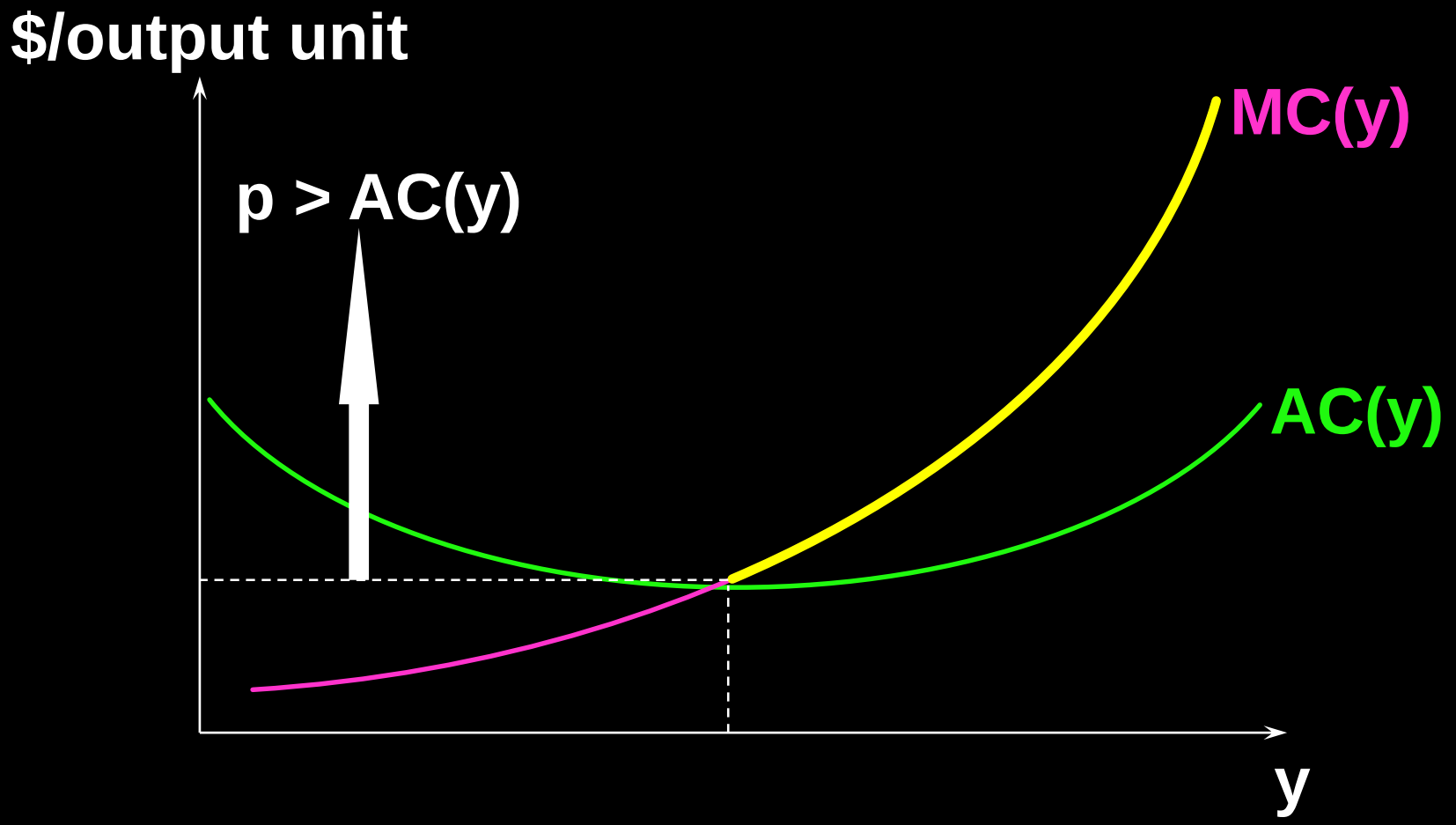
The Firm's Long-Run Supply Decision



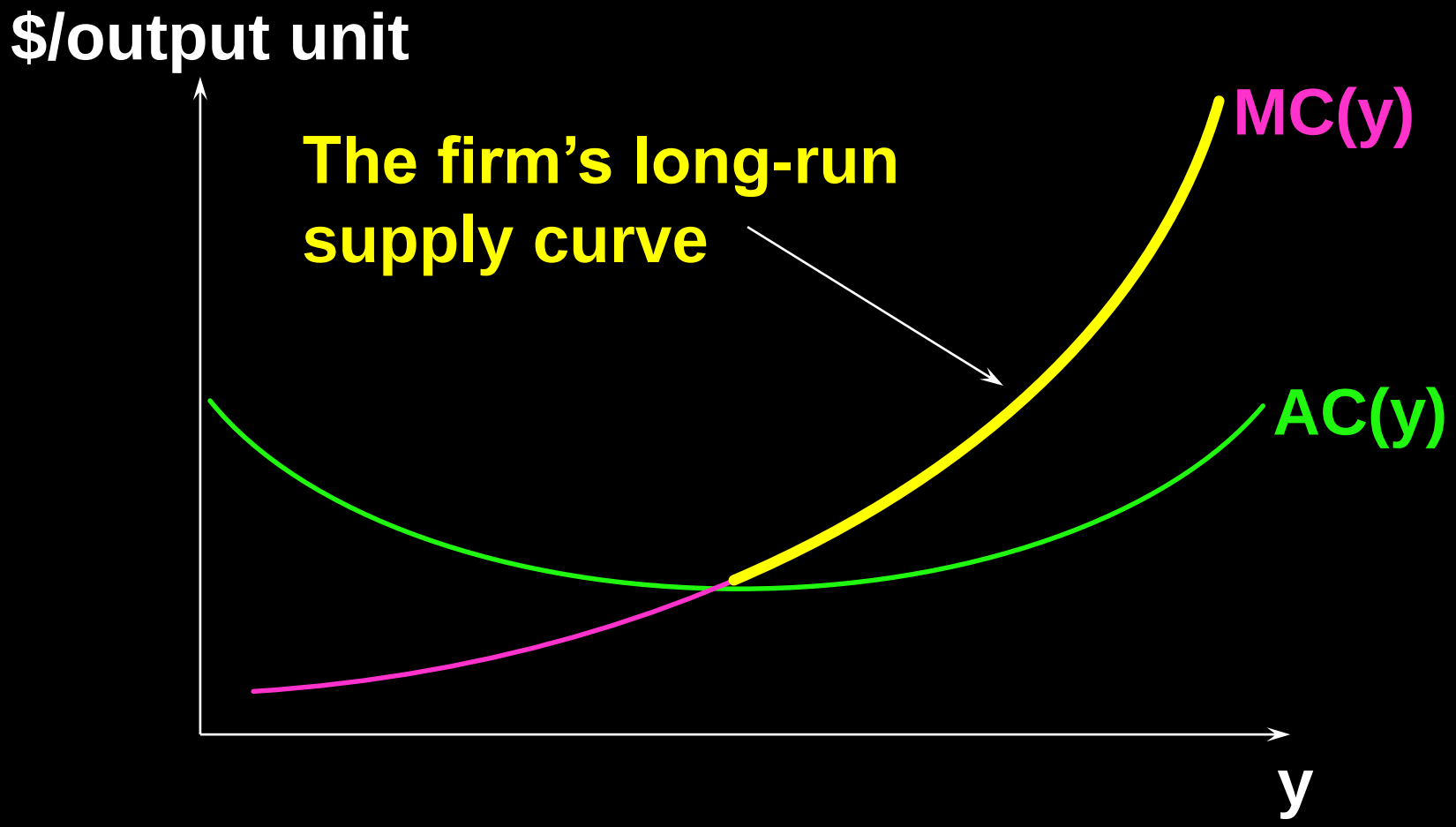
The Firm's Long-Run Supply Decision



The Firm's Long-Run Supply Decision



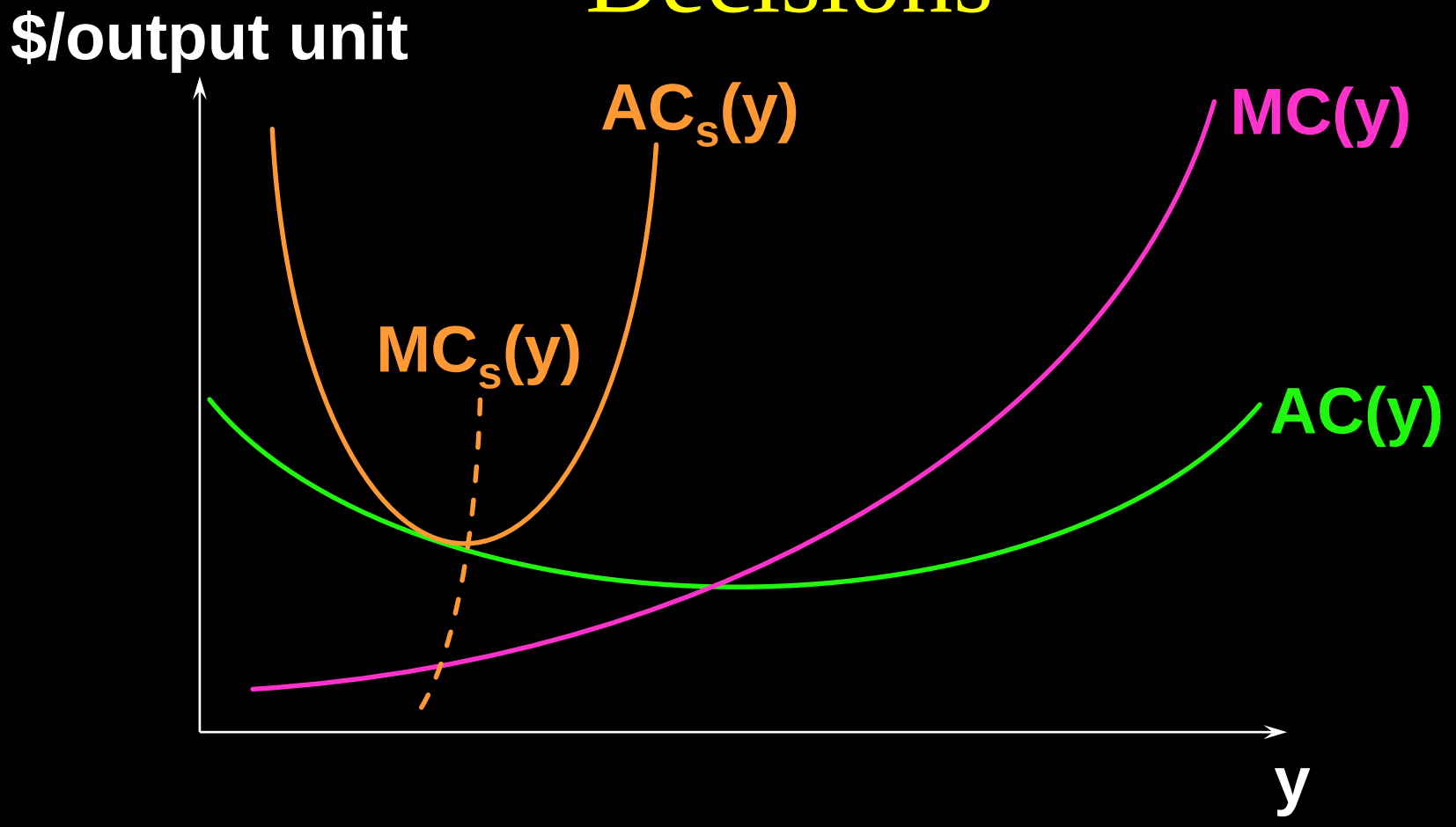
The Firm's Long-Run Supply Decision



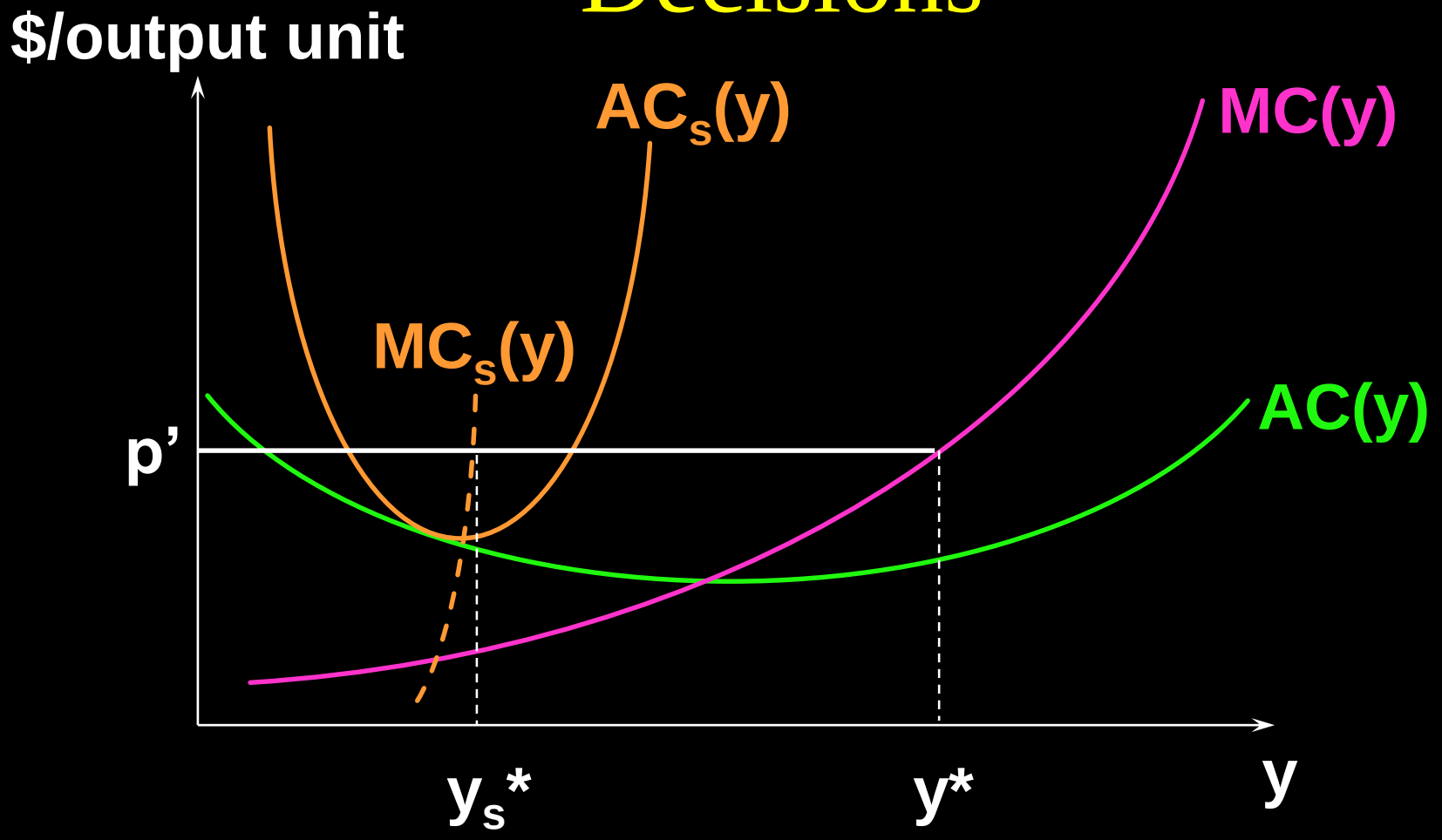
The Firm's Long-Run Supply Decision

- **How is the firm's long-run supply curve related to all of its short-run supply curves?**

The Firm's Long & Short-Run Supply Decisions

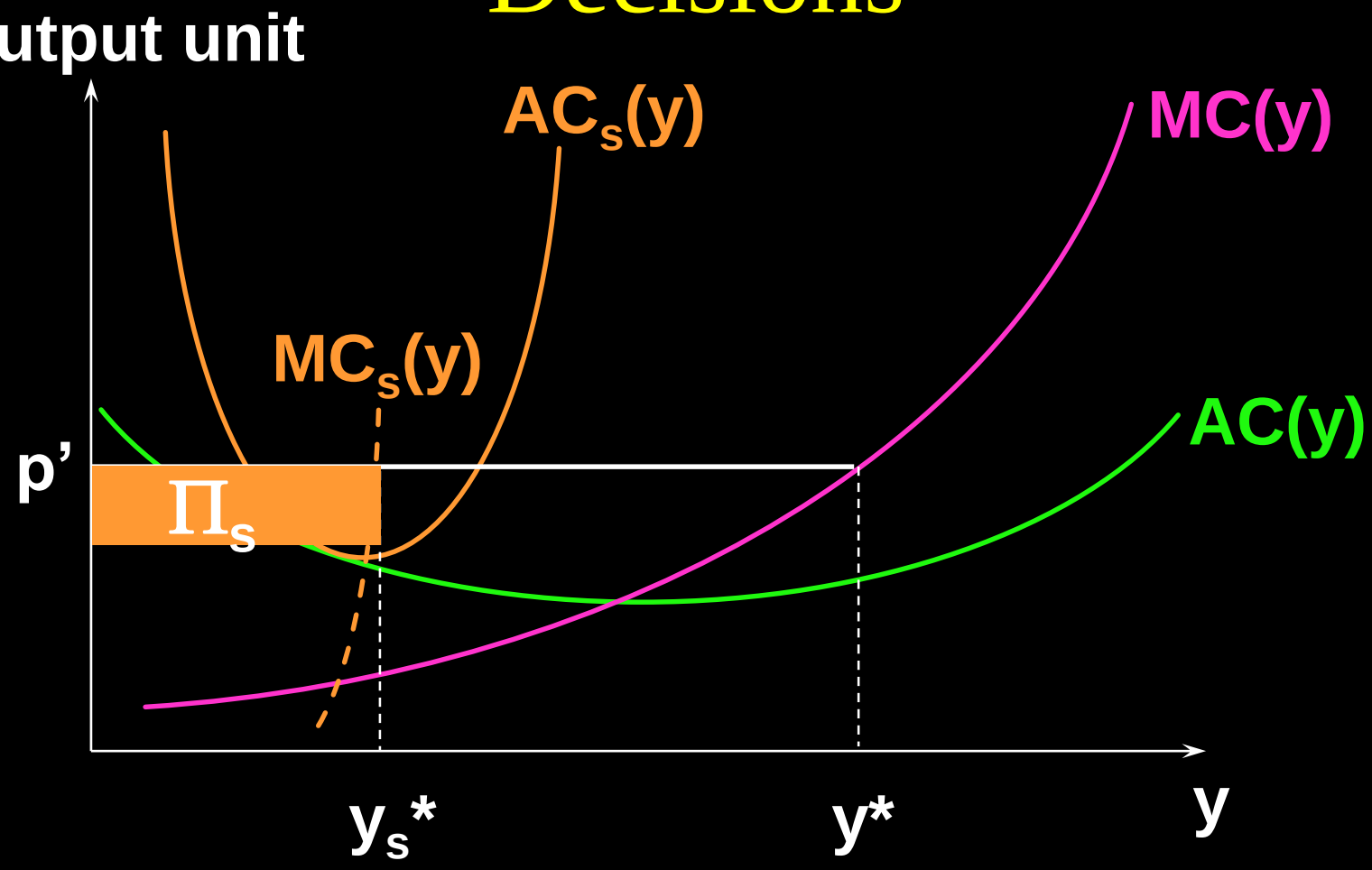


The Firm's Long & Short-Run Supply Decisions



y_s^* is profit-maximizing in this short-run.

The Firm's Long & Short-Run Supply Decisions



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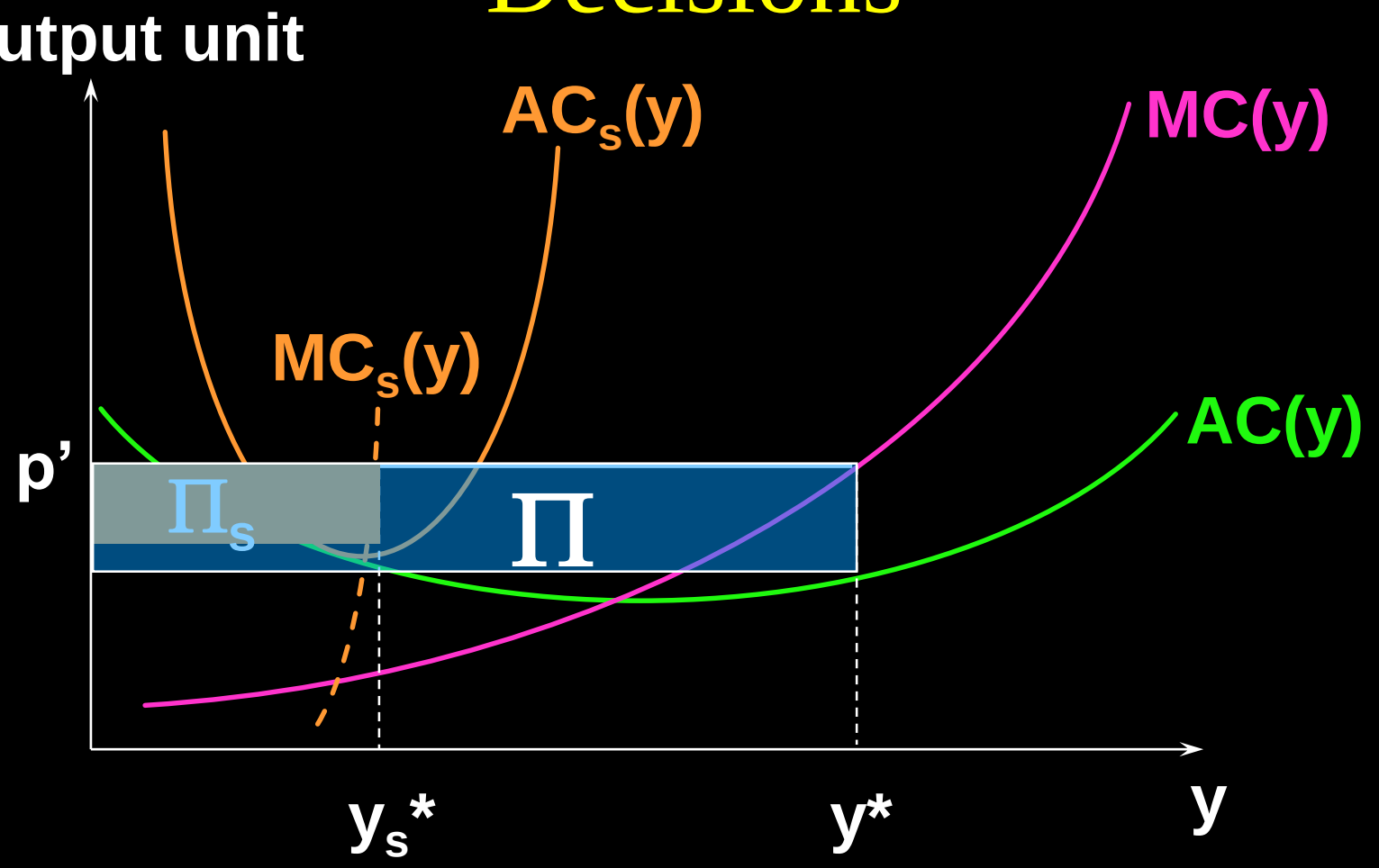
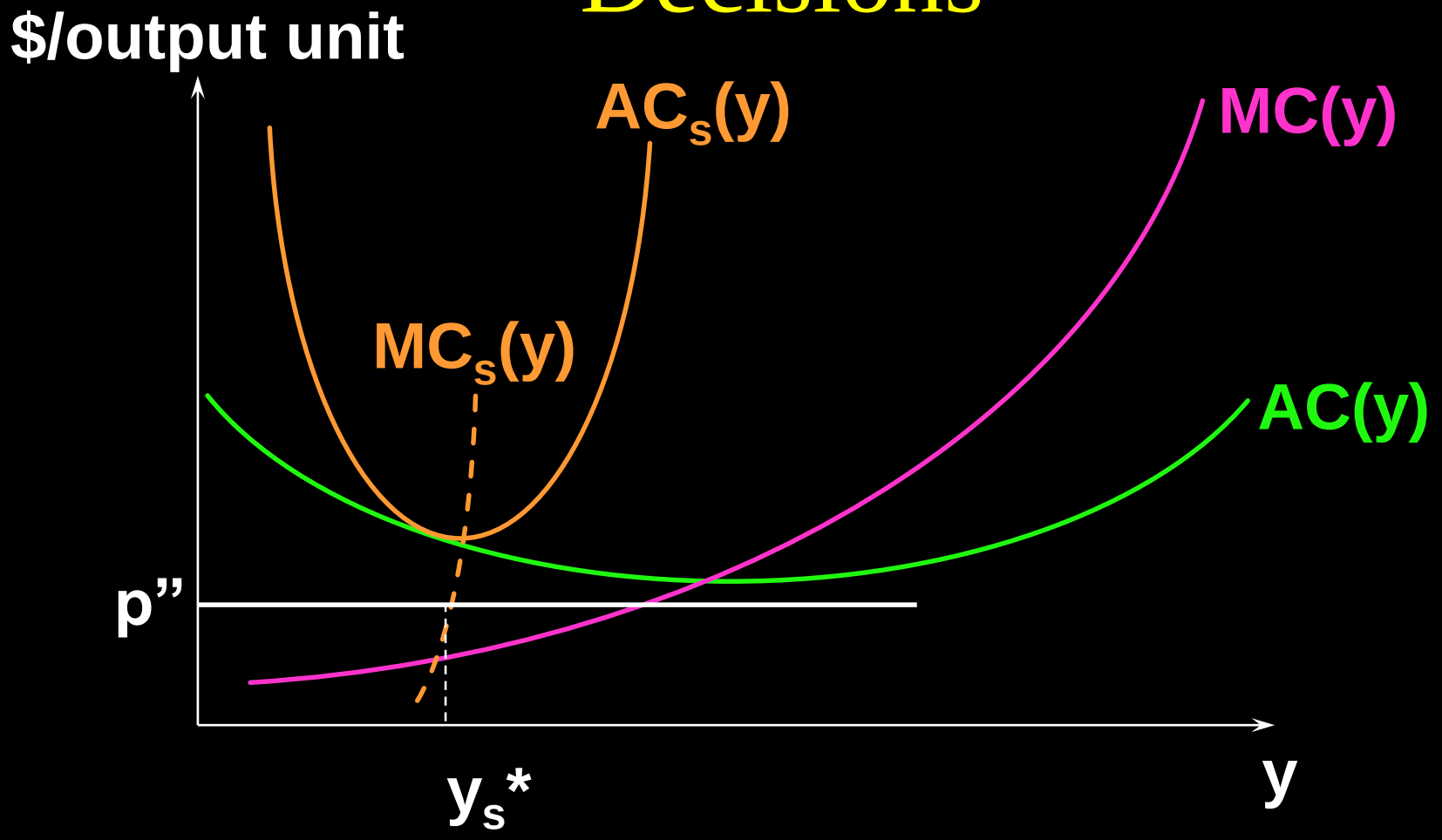
The Firm's Long & Short-Run Supply Decisions



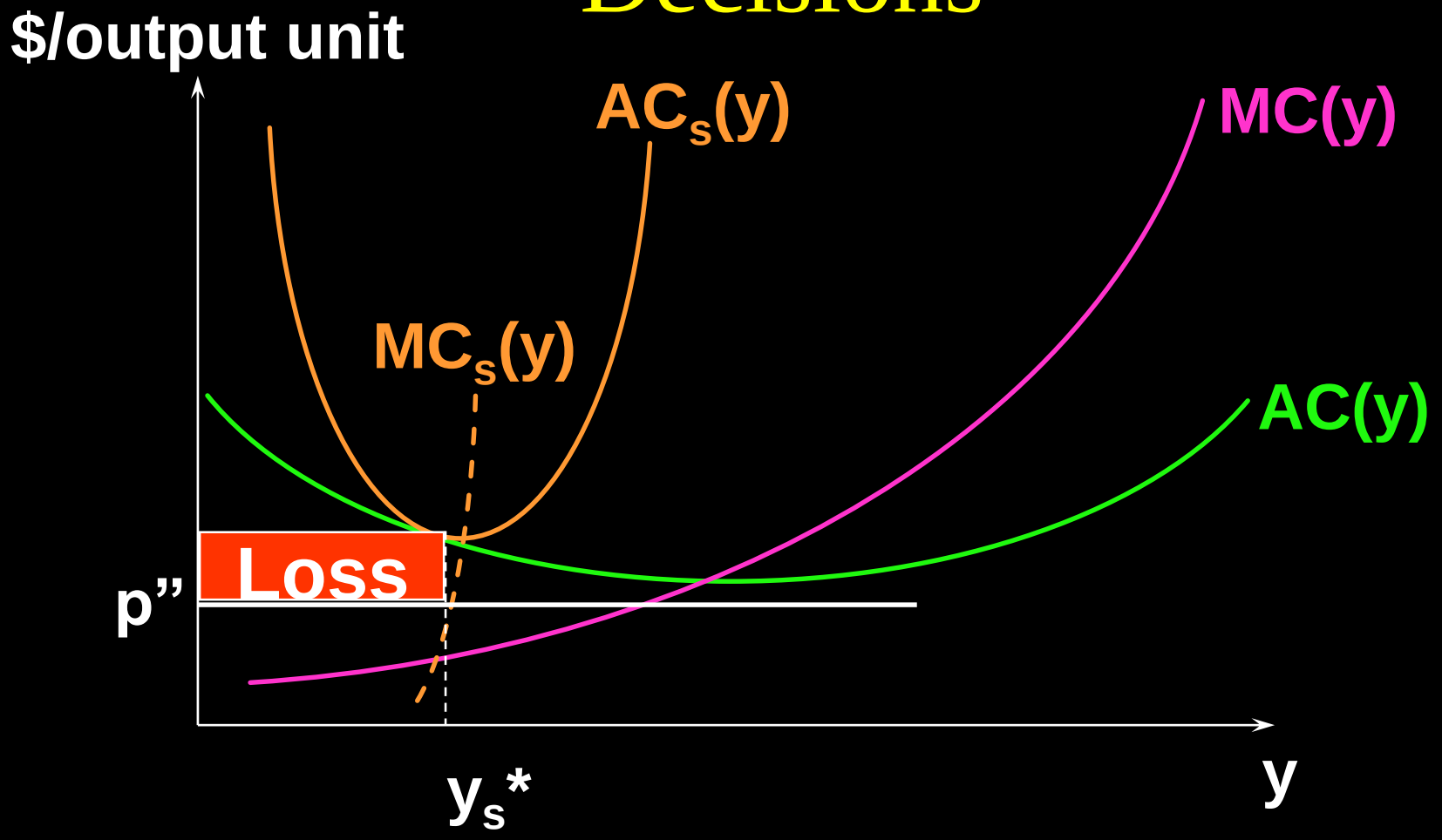
The firm can increase profit by increasing x_2 and producing y* output units.

The Firm's Long & Short-Run Supply Decisions



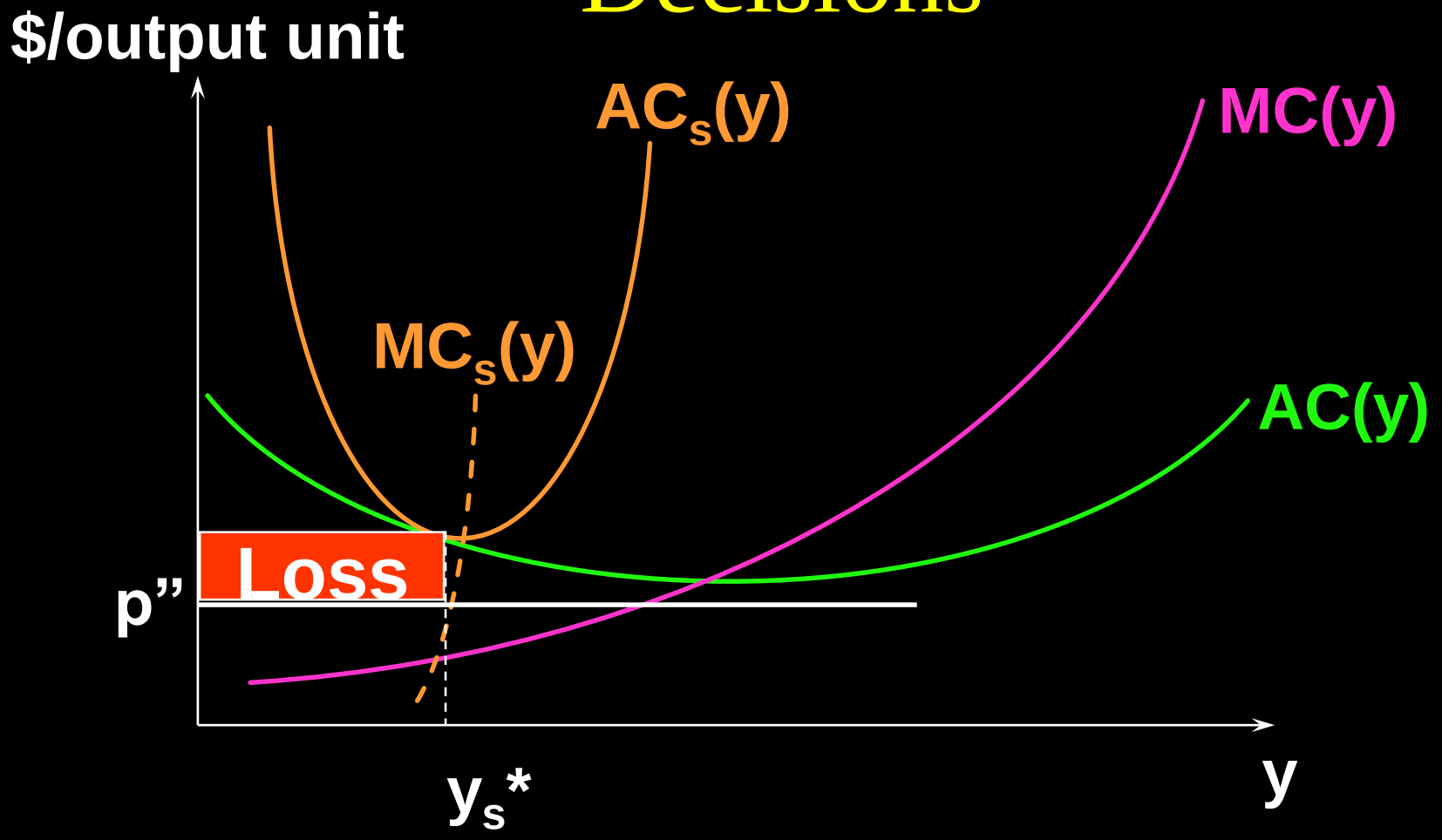
y_s^* is loss-minimizing in this short-run.

The Firm's Long & Short-Run Supply Decisions



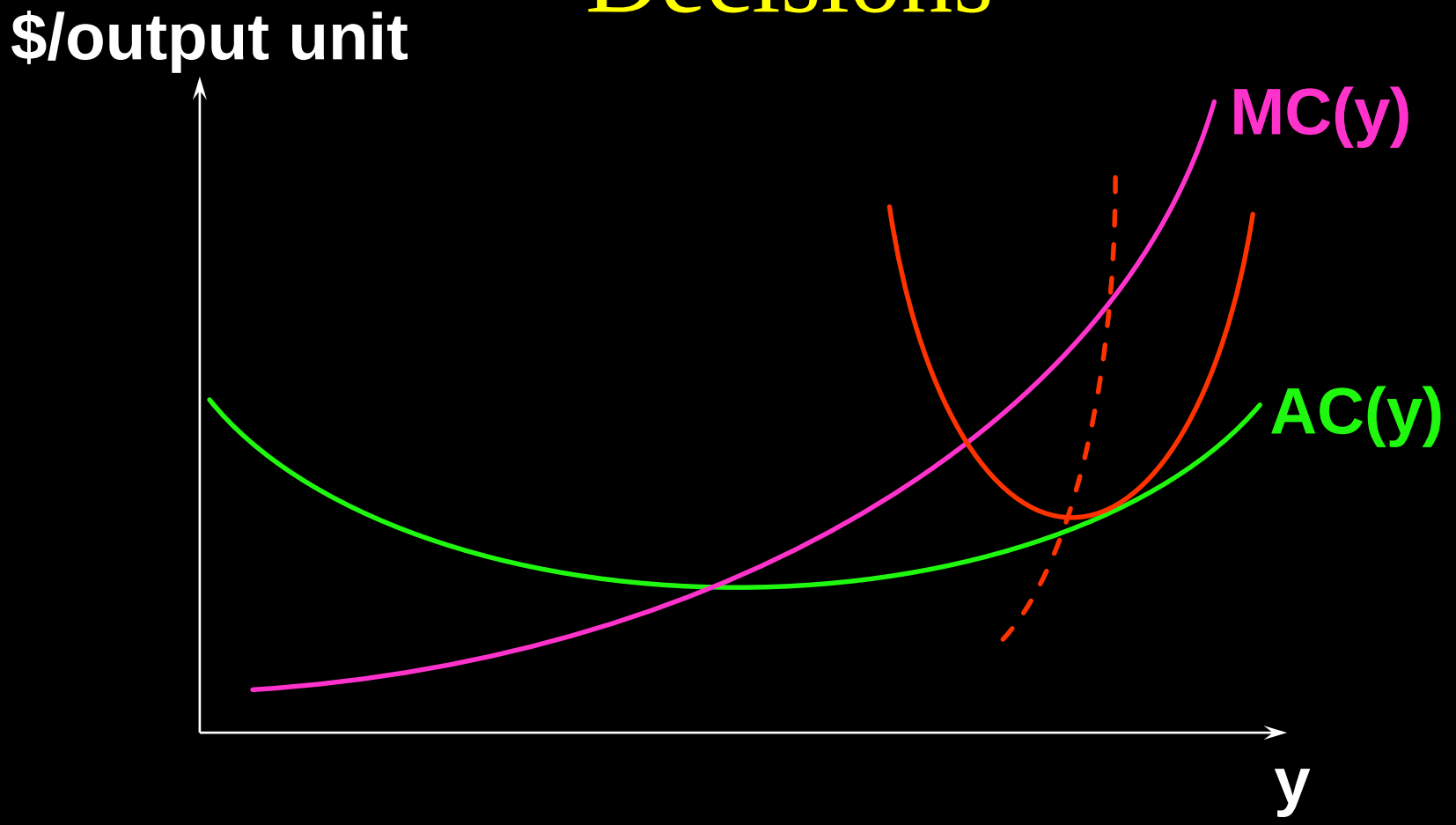
y_s^* is loss-minimizing in this short-run.

The Firm's Long & Short-Run Supply Decisions

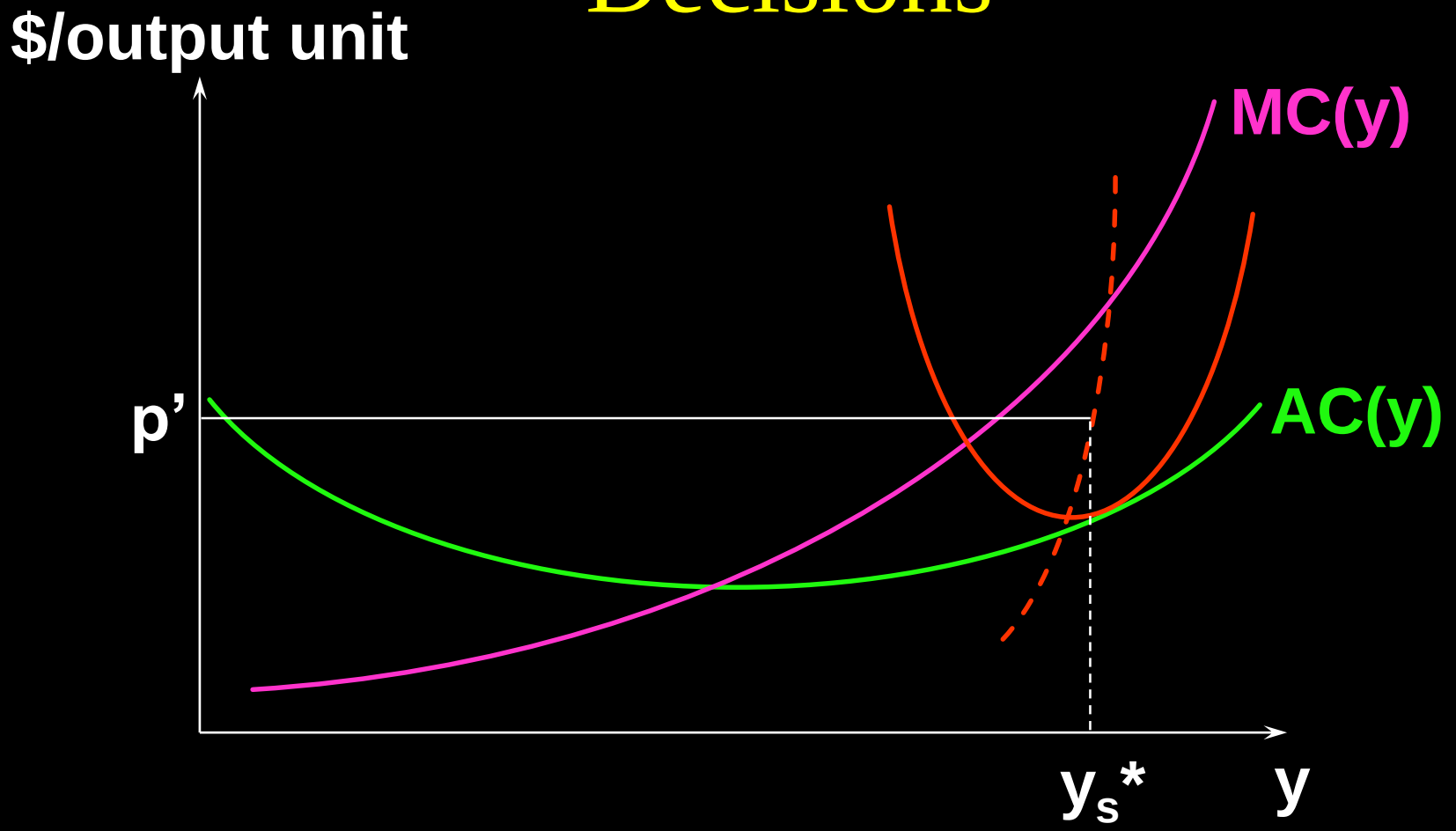


This loss can be eliminated in the long-run by the firm exiting the industry.

The Firm's Long & Short-Run Supply Decisions

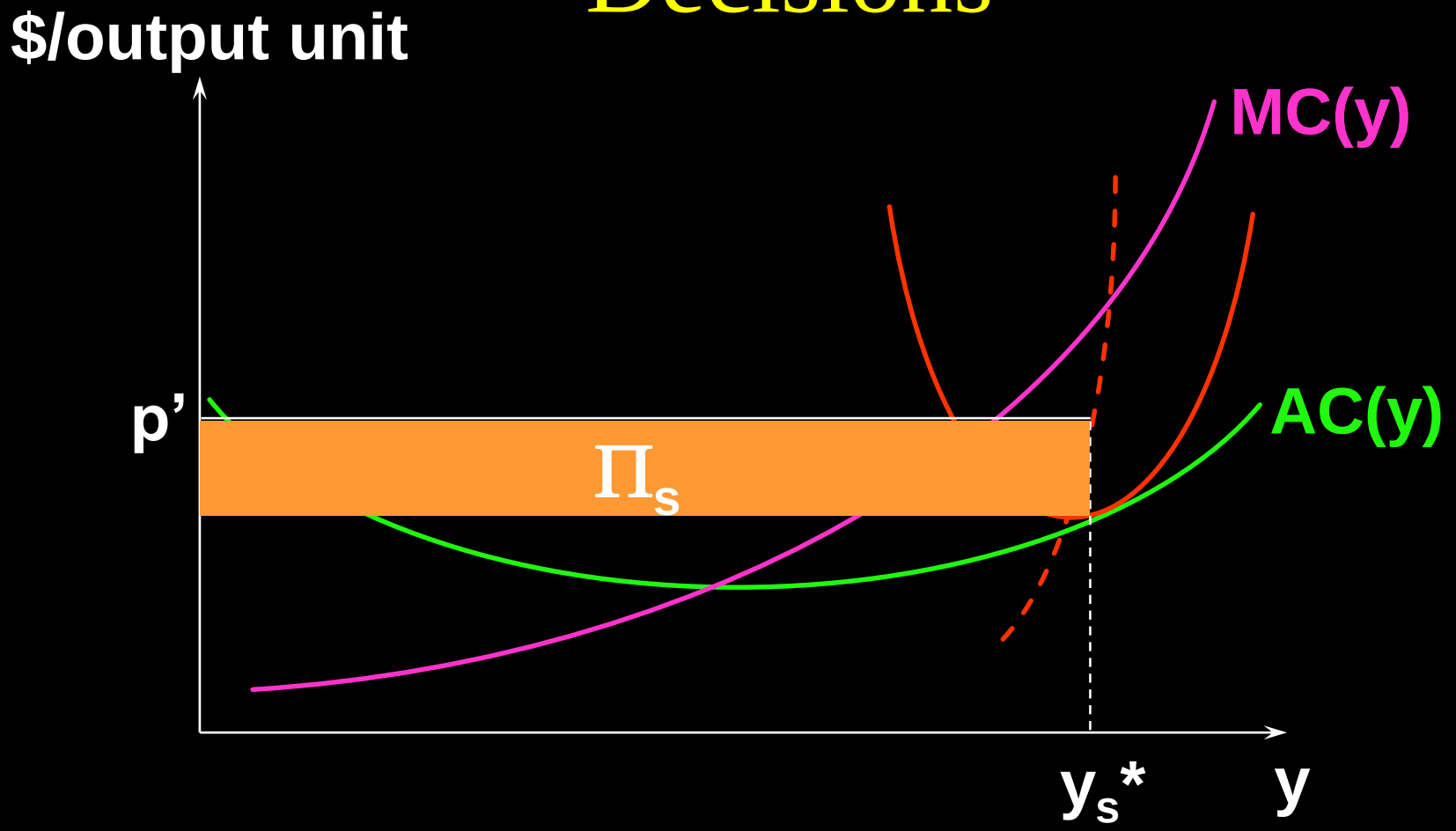


The Firm's Long & Short-Run Supply Decisions



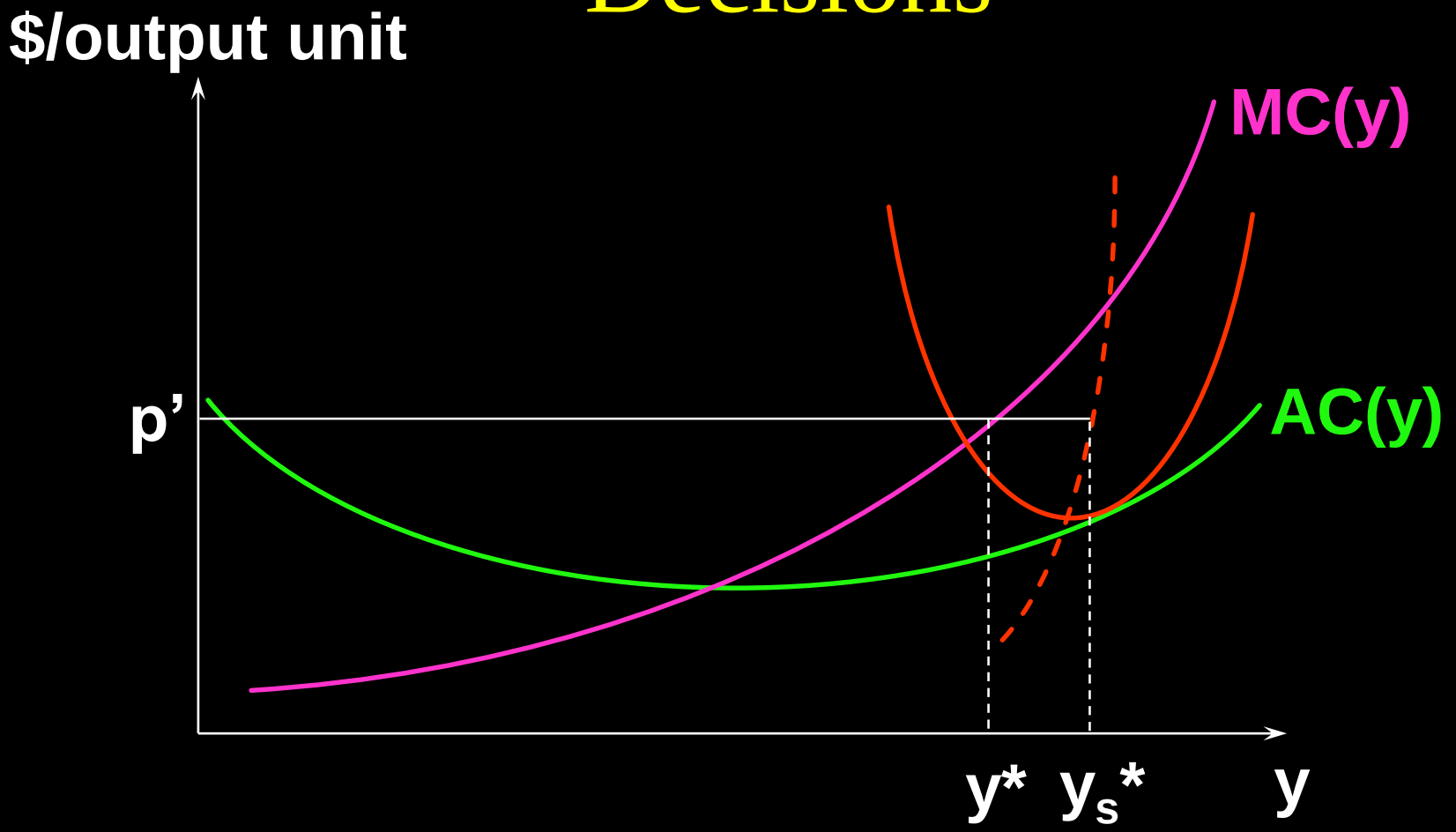
y_s^* is profit-maximizing in this short-run.

The Firm's Long & Short-Run Supply Decisions



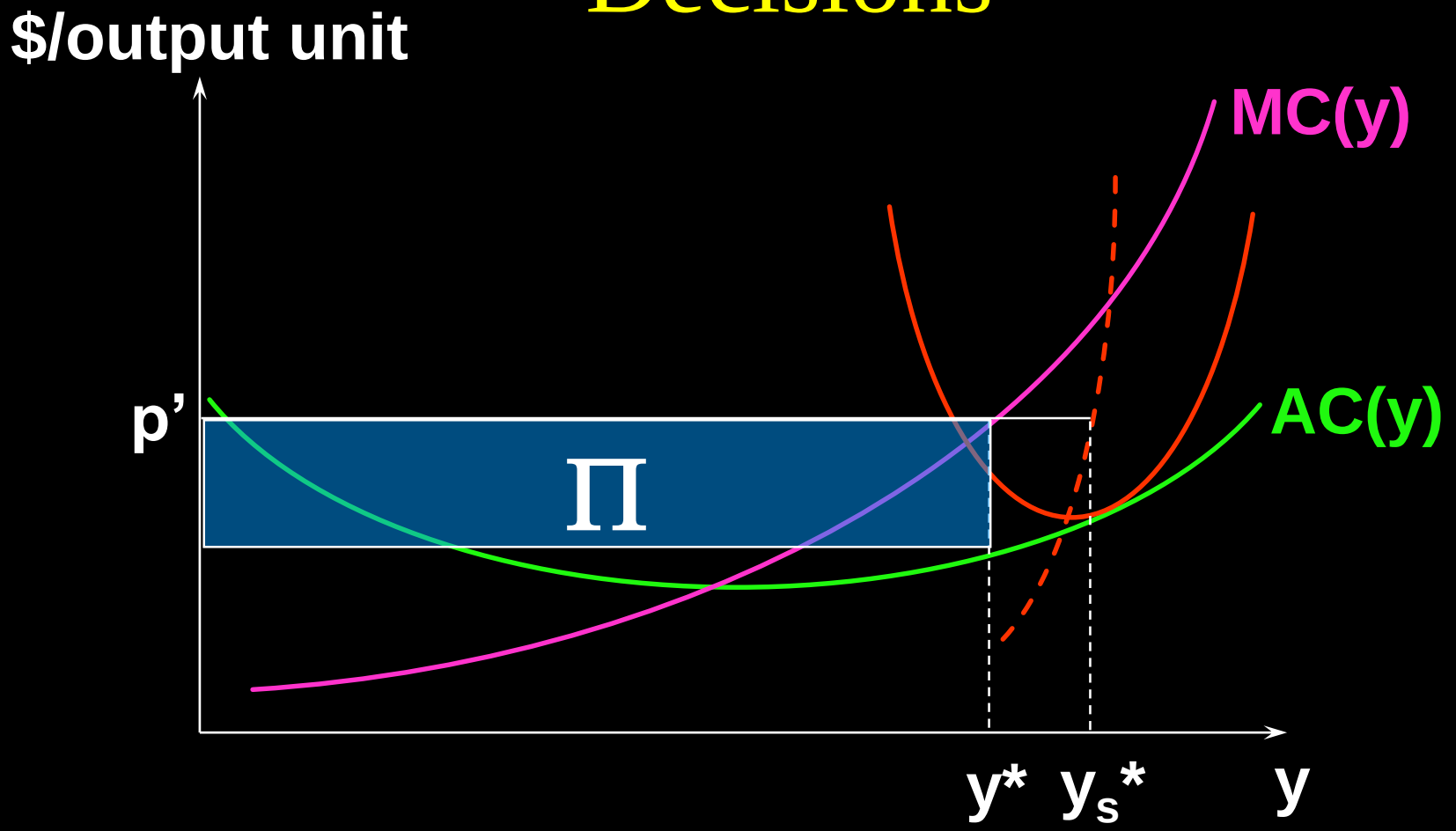
y_s^* is profit-maximizing in this short-run.

The Firm's Long & Short-Run Supply Decisions



y_s* is profit-maximizing in this short-run.
y* is profit-maximizing in the long-run.

The Firm's Long & Short-Run Supply Decisions



y_s* is profit-maximizing in this short-run.
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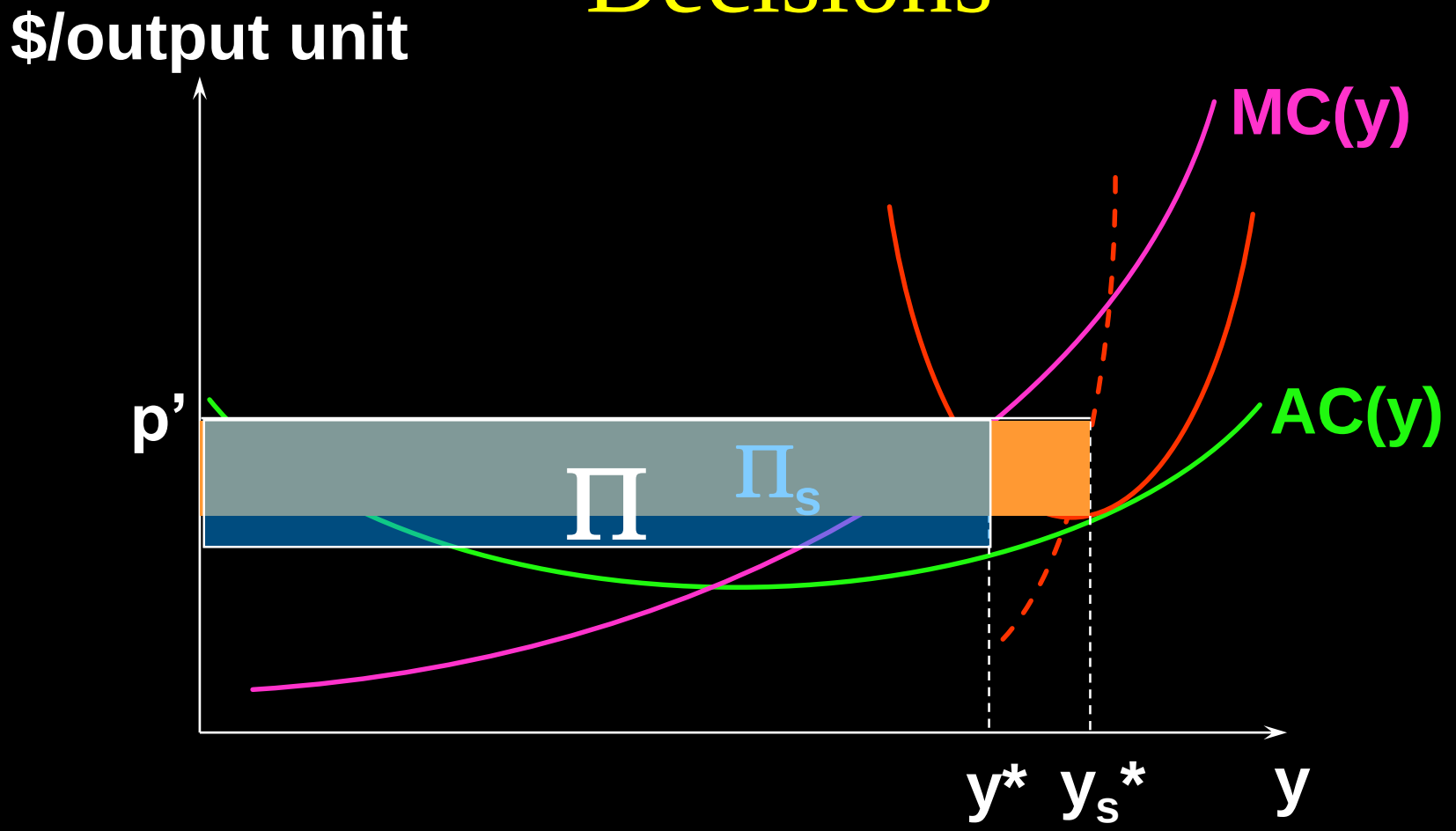
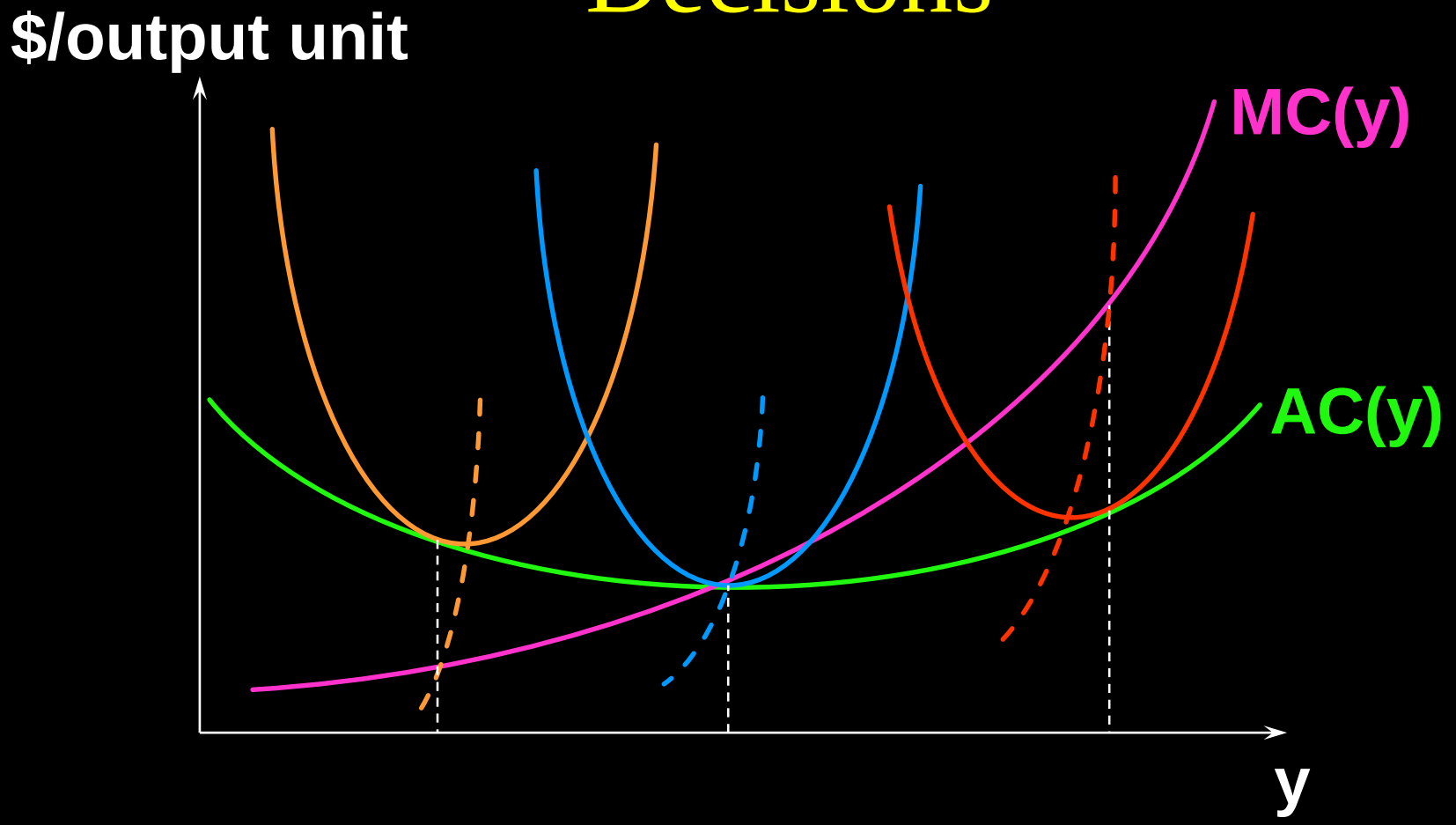
The Firm's Long & Short-Run Supply Decisions



The firm can increase profit by reducing x_2 and producing y* units of output.

The Firm's Long & Short-Run Supply Decisions



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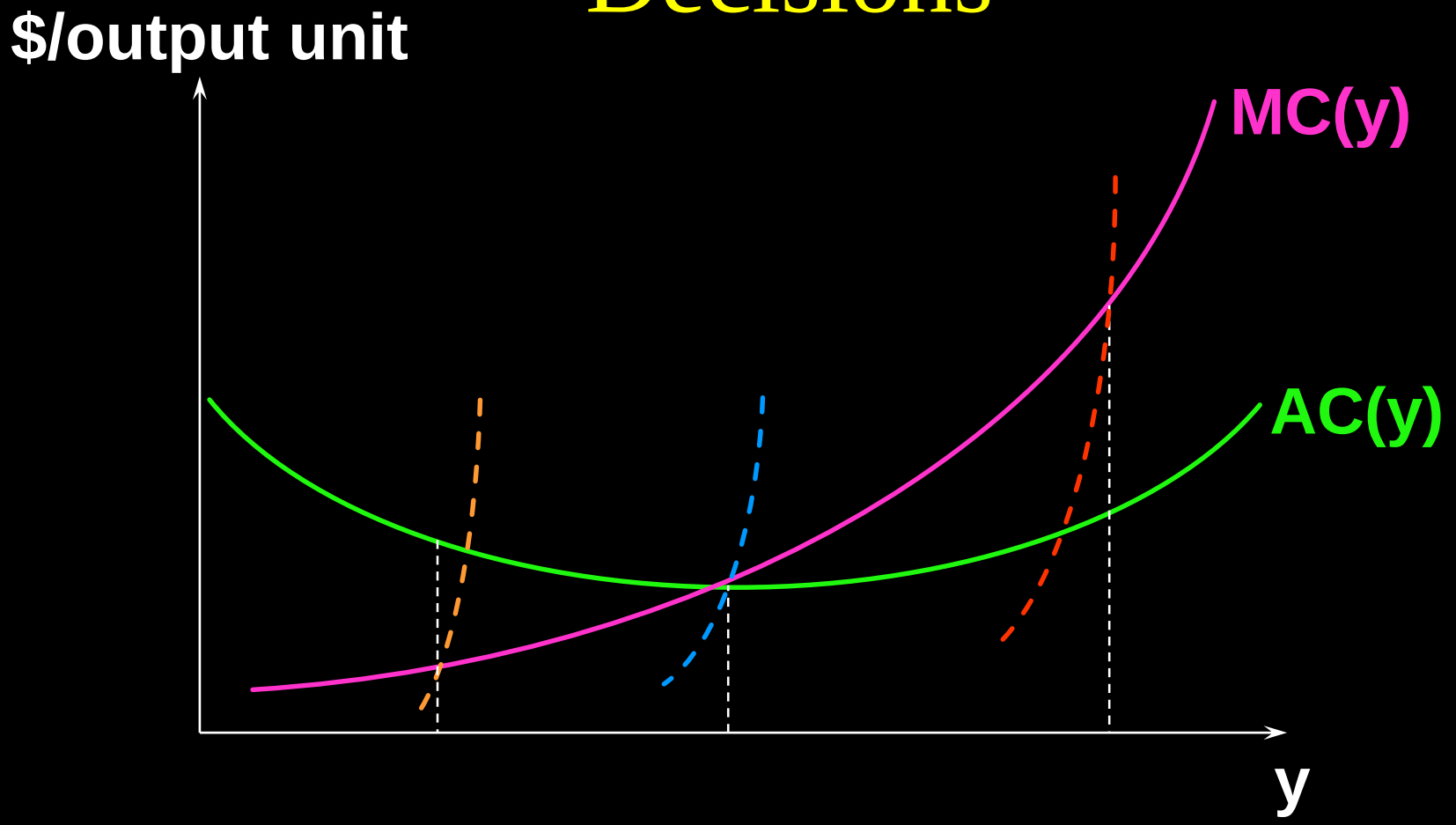

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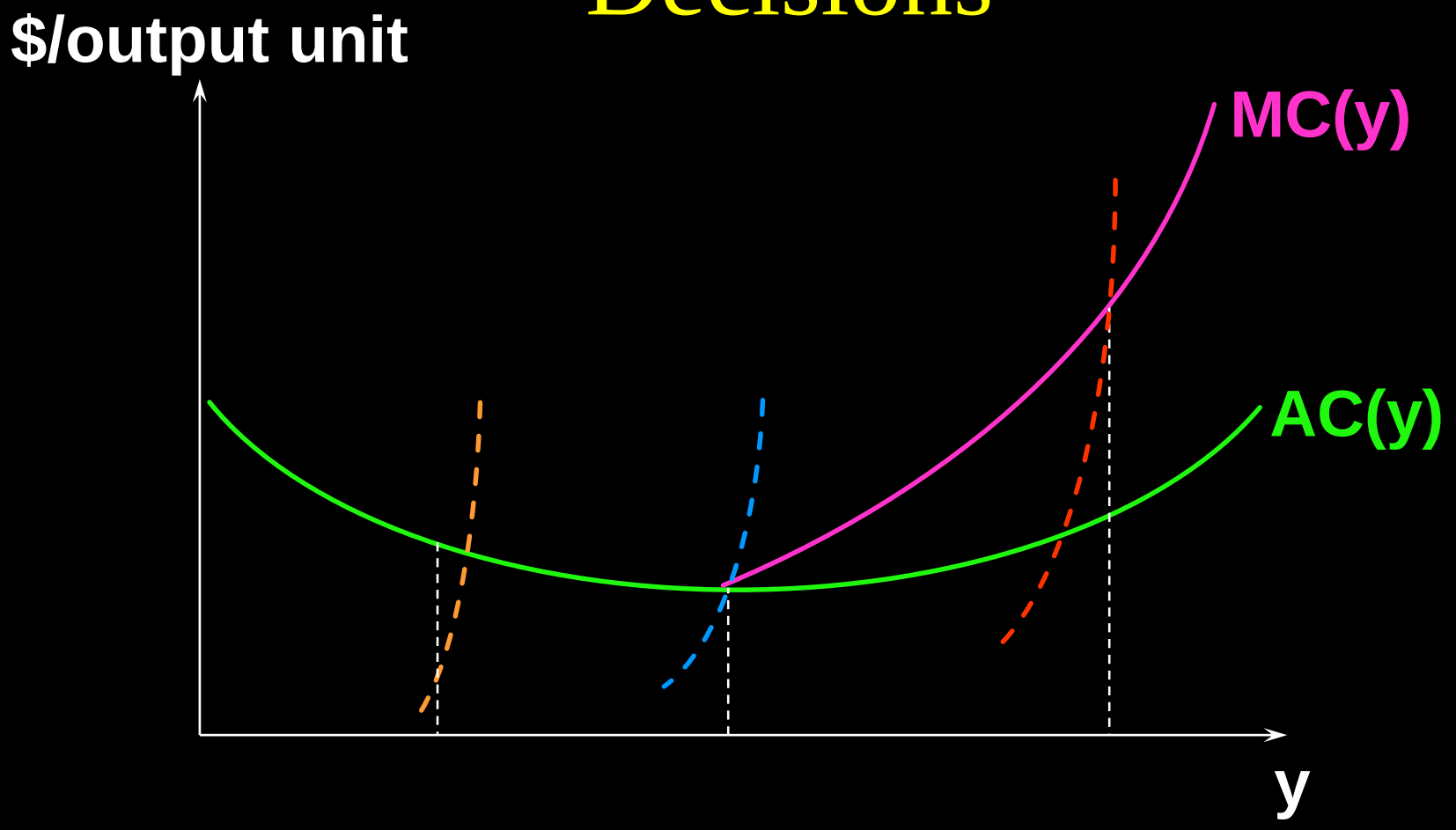

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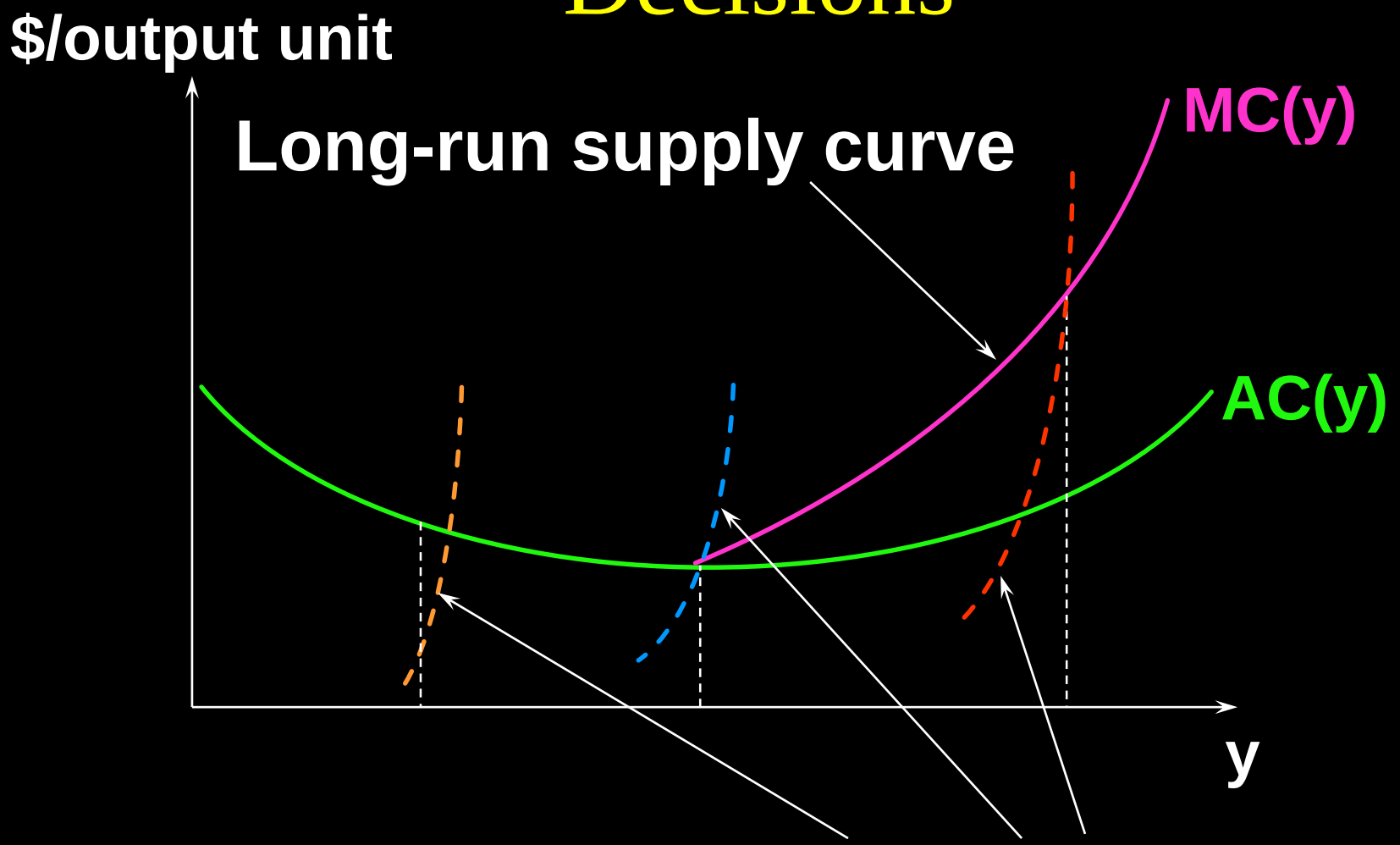
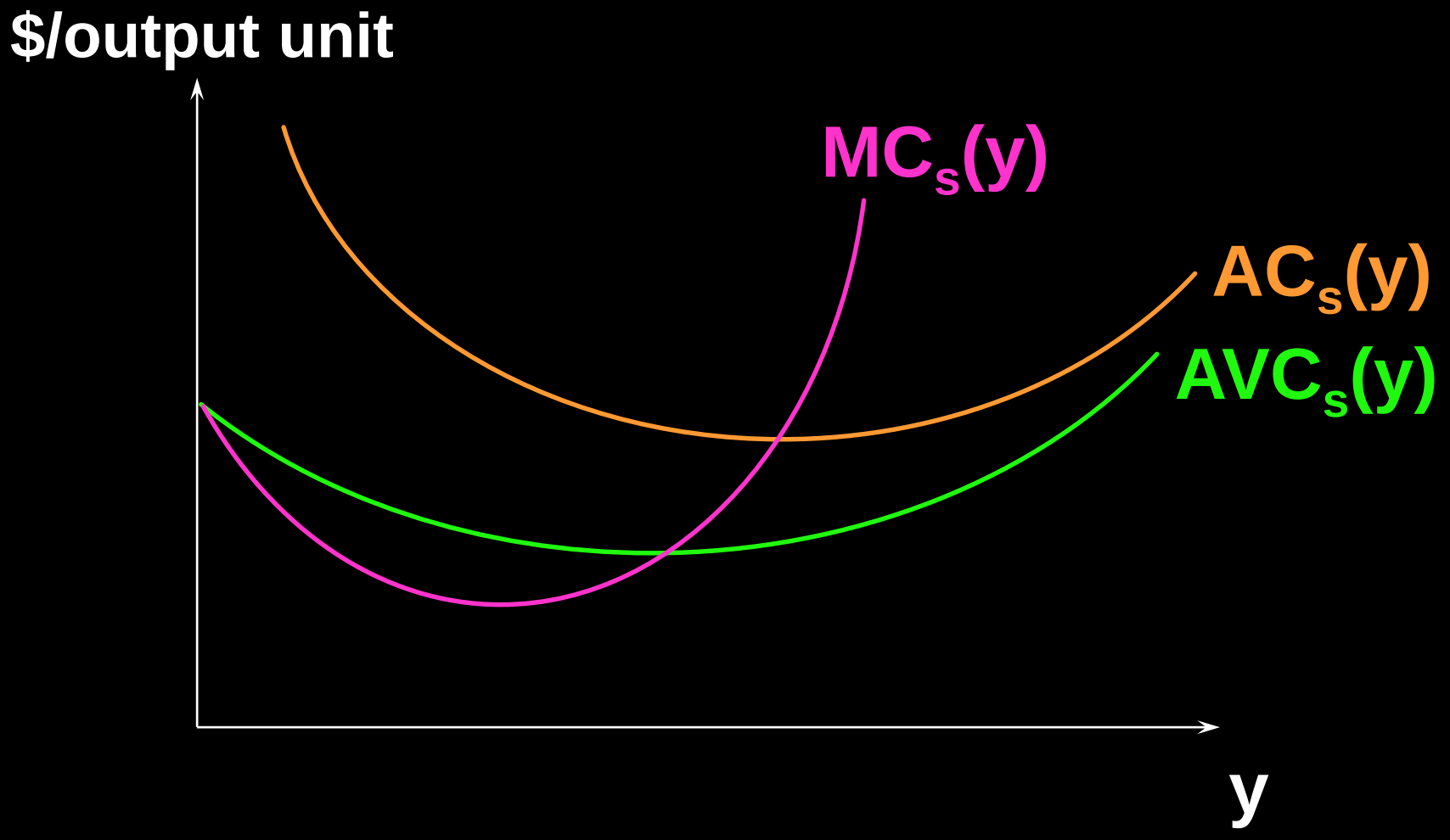


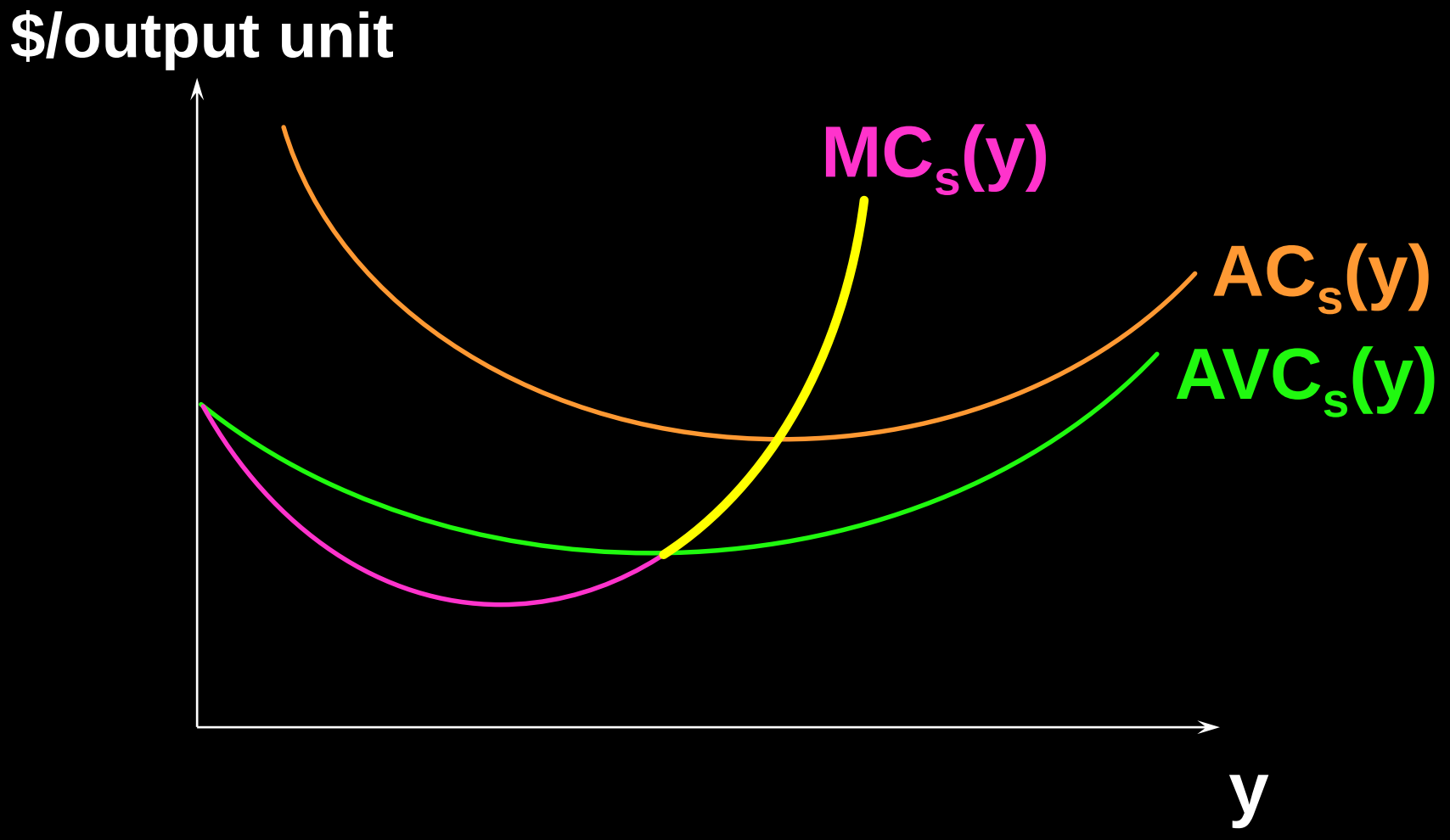
Producer's Surplus Revisited

- **The firm's producer's surplus is the accumulation, unit by extra unit of output, of extra revenue less extra production cost.**
- **How is producer's surplus related profit?**

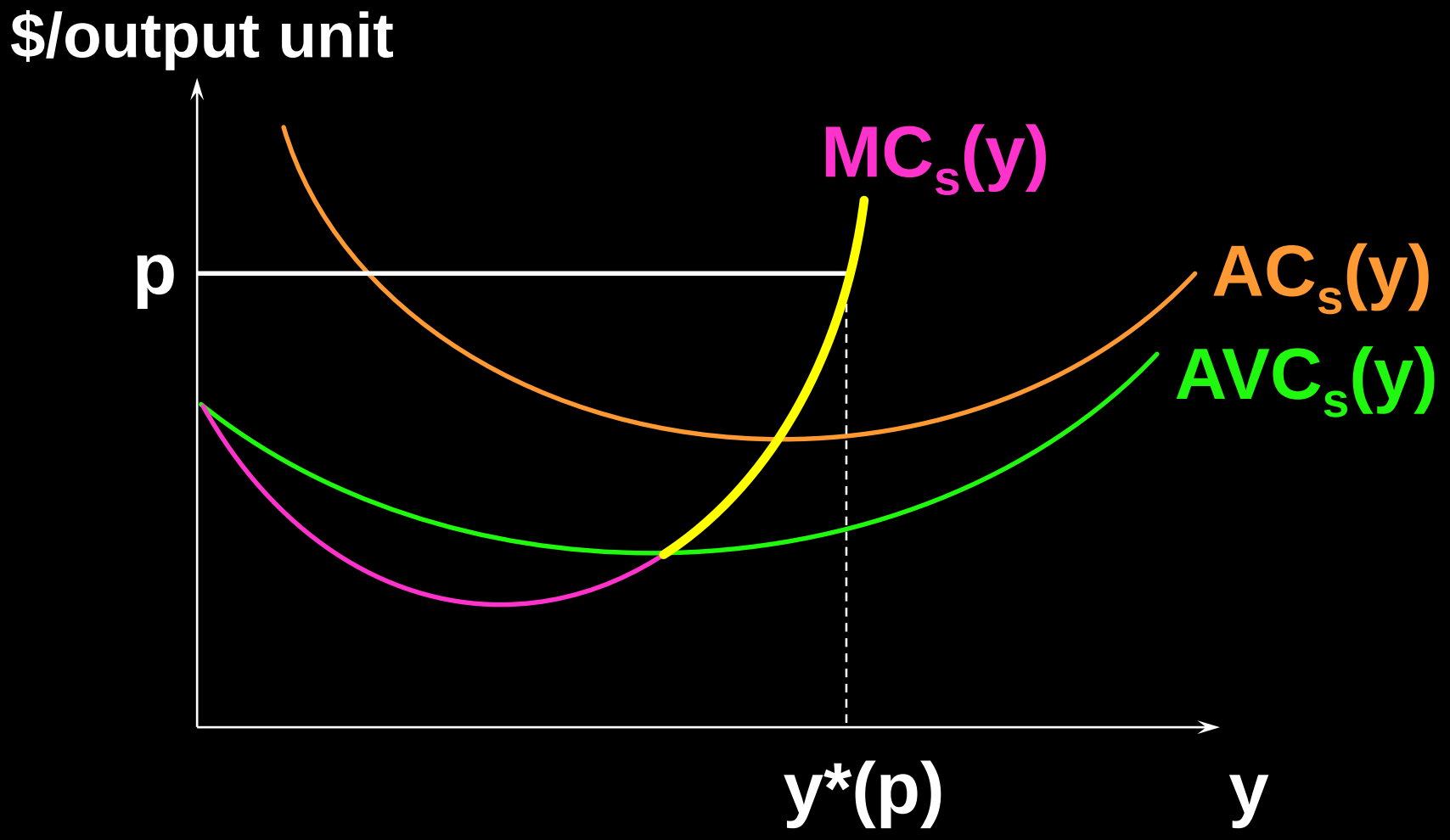
Producer's Surplus Revisited



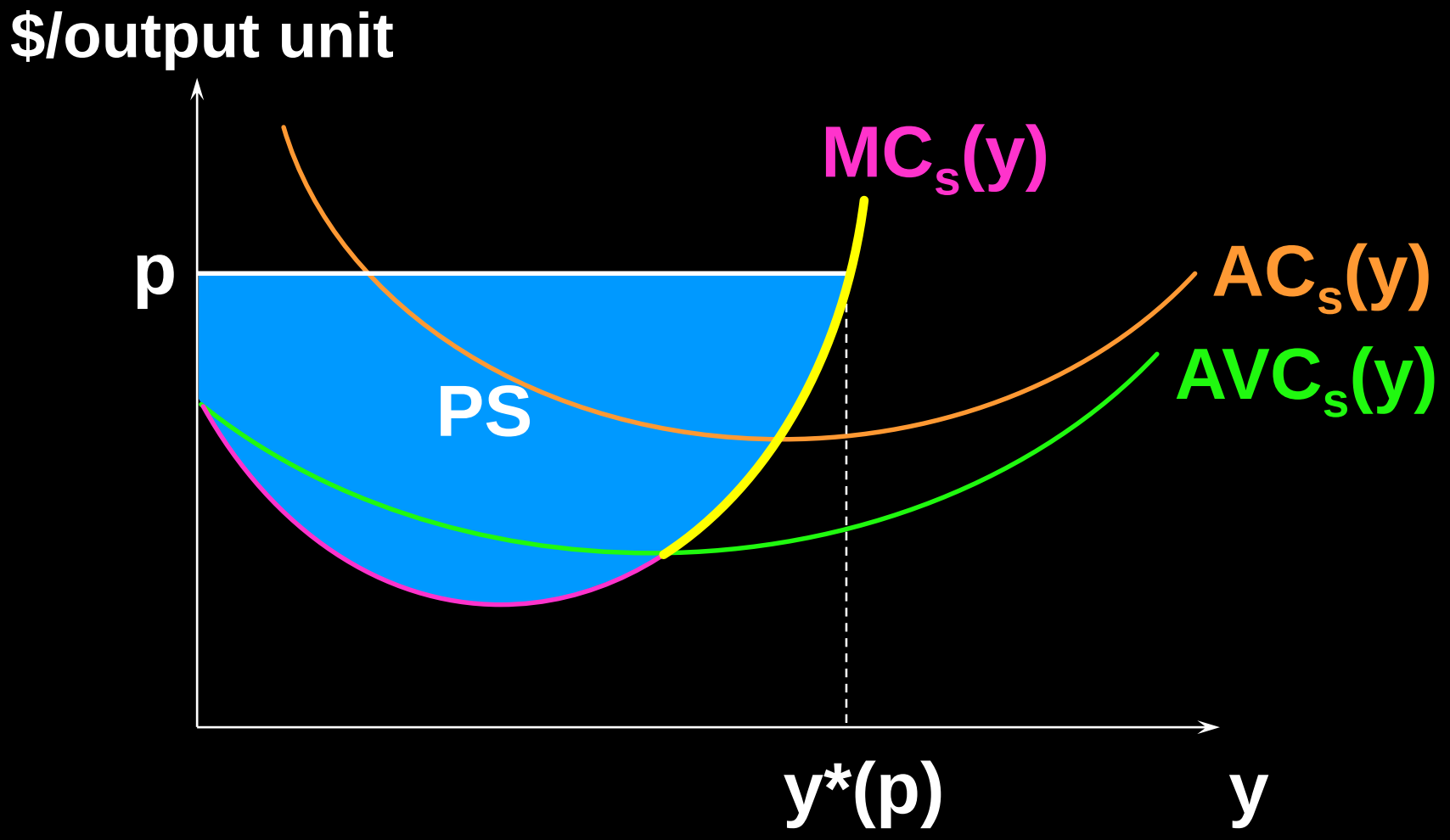
Producer's Surplus Revisited



Producer's Surplus Revisited



Producer's Surplus Revisited



Producer's Surplus Revisited

So the firm's producer's surplus is

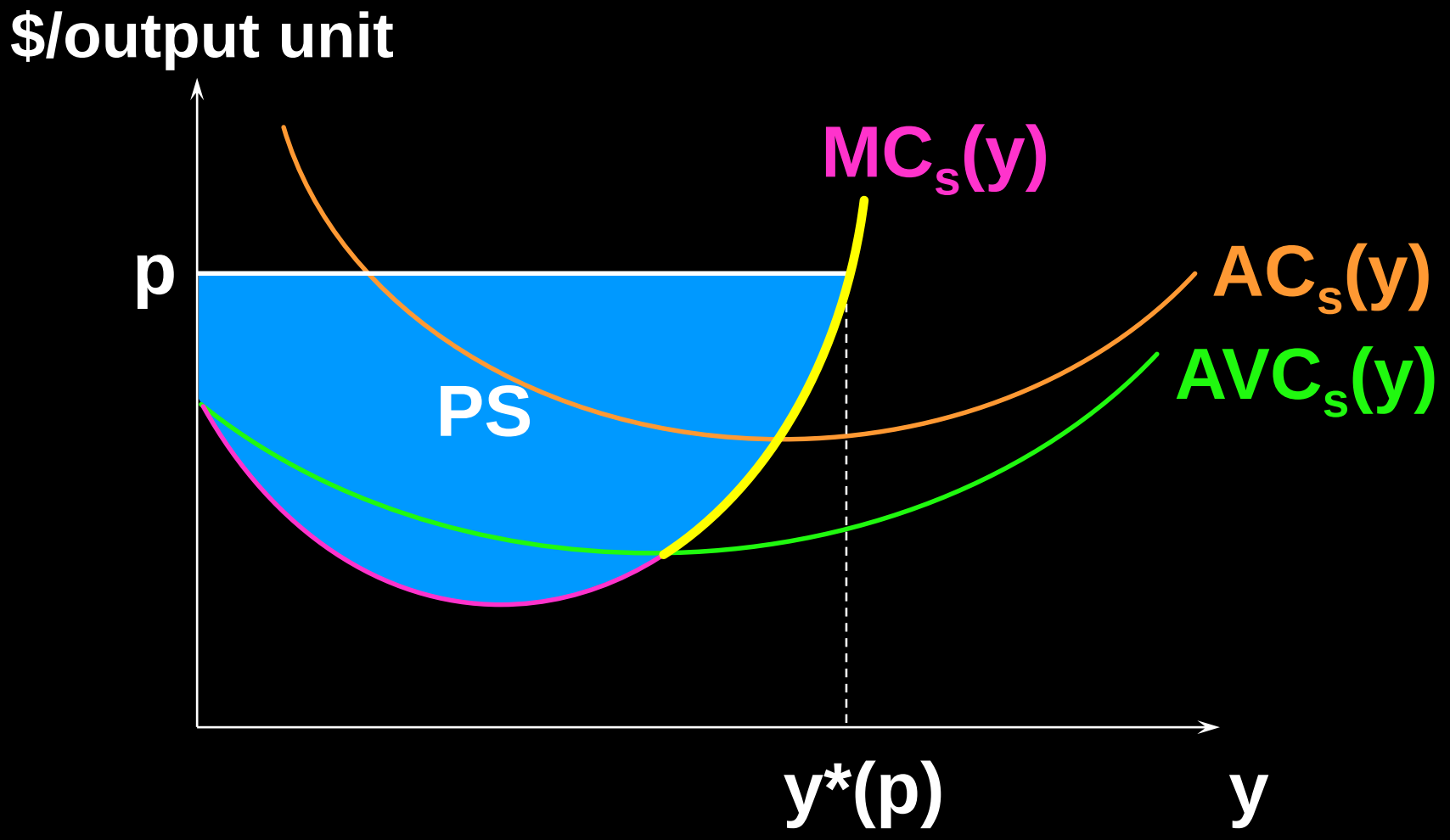
$$PS(p) = \int_0^{y^*(p)} [p - MC_s(z)]\,d(z)$$

$$= py^*(p) - \int_0^{y^*(p)} MC_s(z)\,d(z)$$

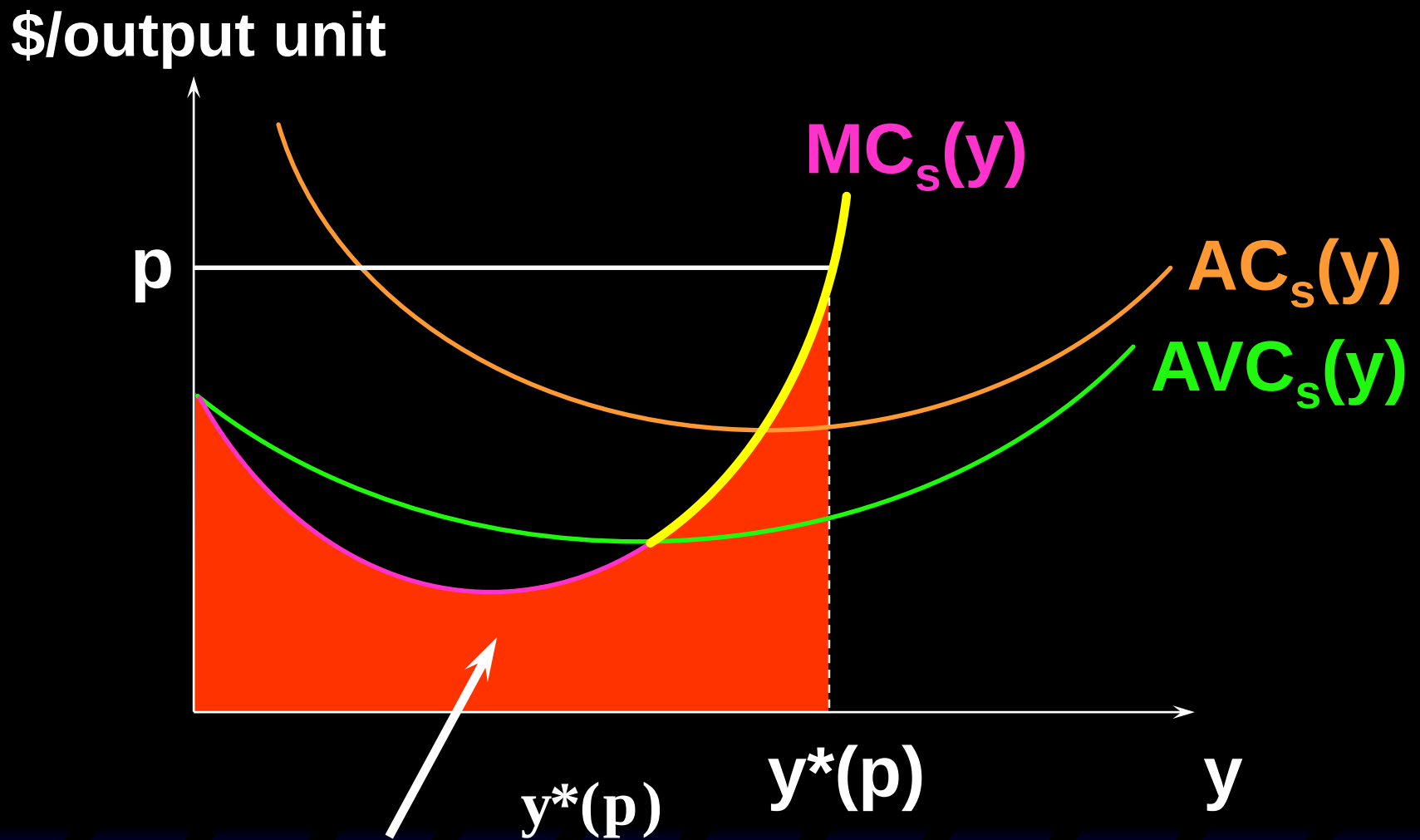
$$= py^*(p) - c_v\left(y^*(p)\right).$$

That is, PS = Revenue - Variable Cost.

Producer's Surplus Revisited

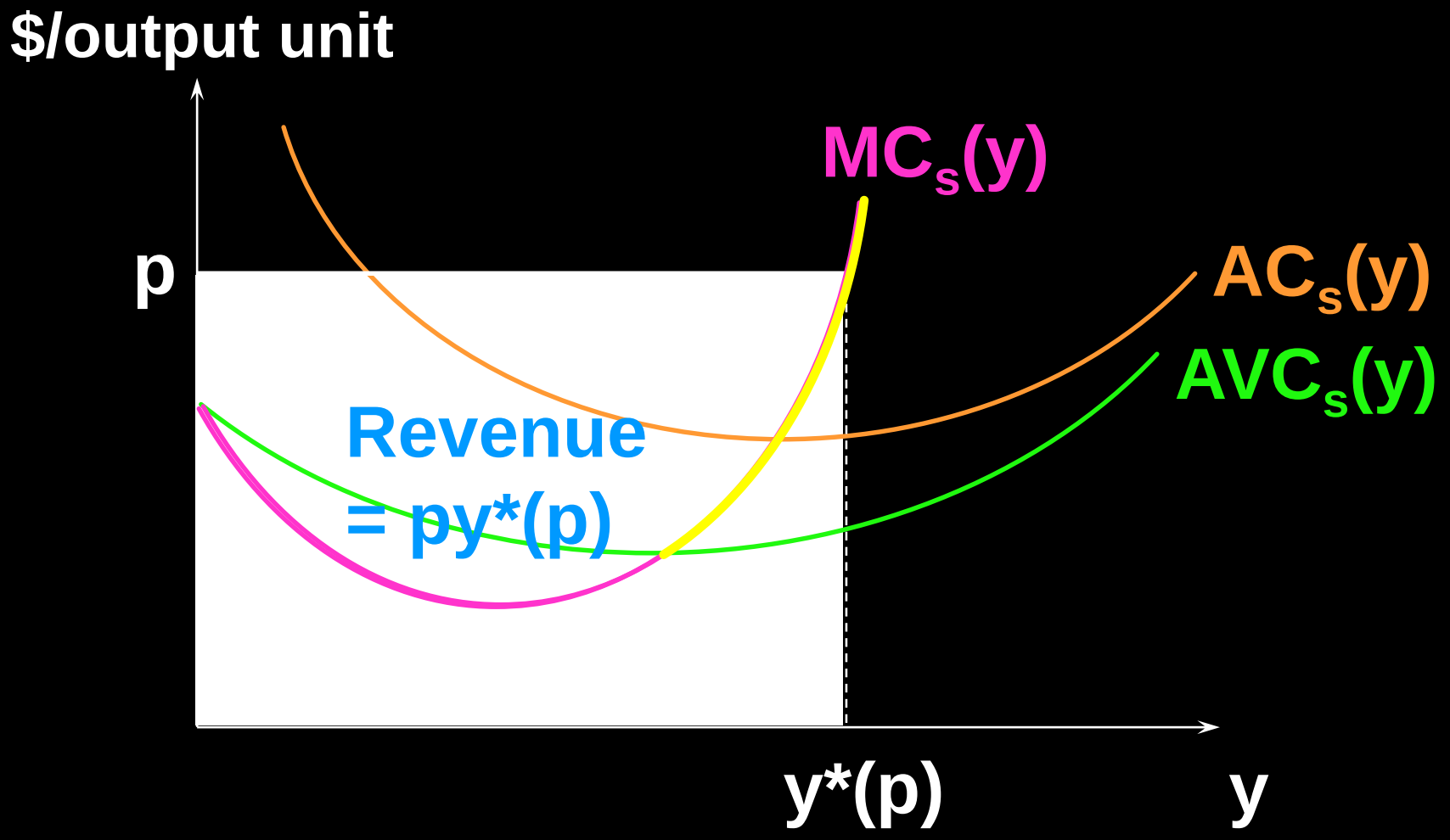


Producer's Surplus Revisited

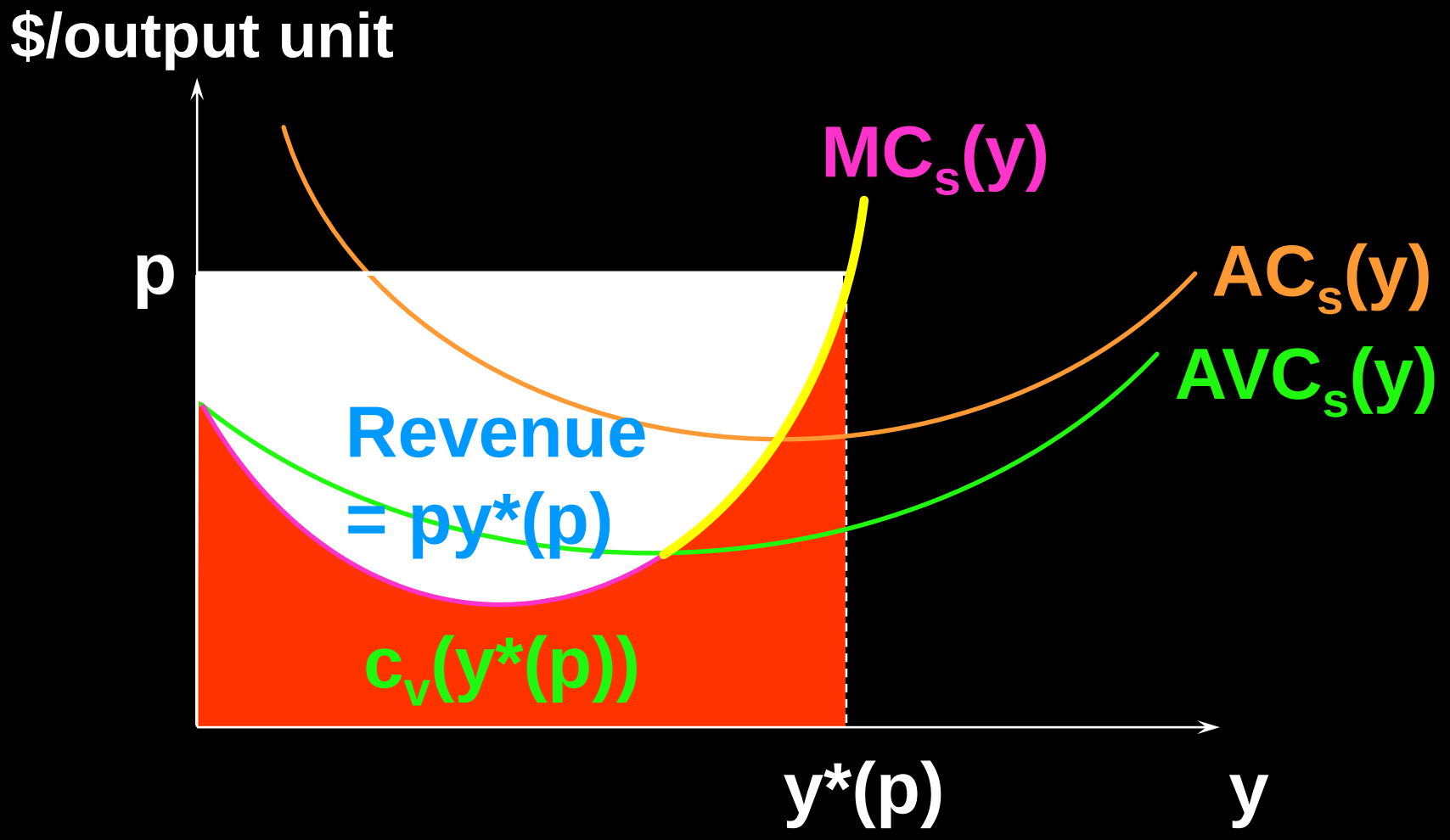


$$c_v(y^*(p)) = \int_0^{y^*(p)} MC_s(z)d(z)$$

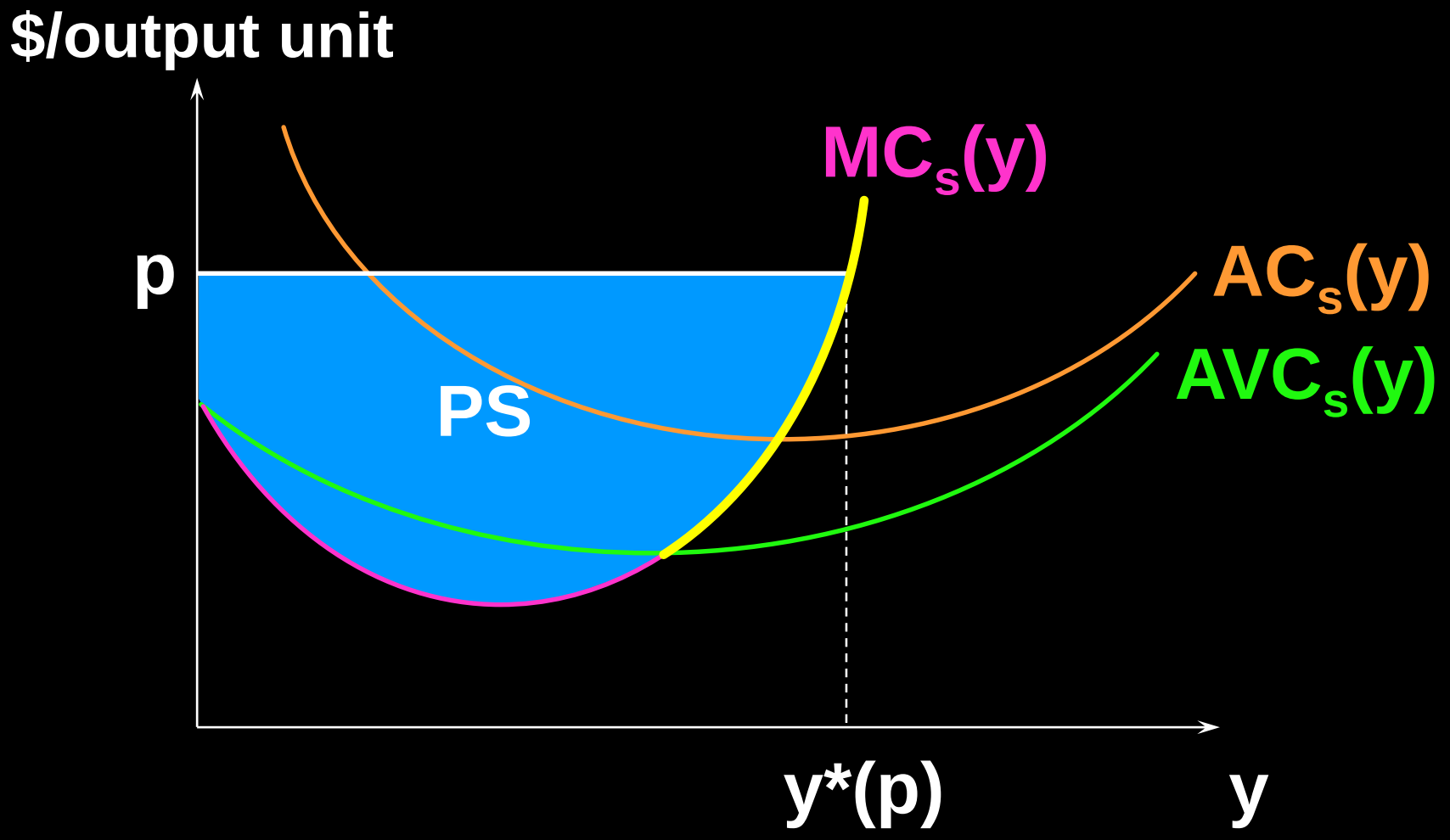
Producer's Surplus Revisited



Producer's Surplus Revisited



Producer's Surplus Revisited



Producer's Surplus Revisited

- **PS = Revenue - Variable Cost.**
- **Profit = Revenue - Total Cost**
  = Revenue - Fixed Cost
  - Variable Cost.
- **So, PS = Profit + Fixed Cost.**
- **Only if fixed cost is zero (the long-run) are PS and profit the same.**