Feed-In Tarrifs

Discussion of

Couture, Toby, and Yves Gagnon. "An analysis of feed-in tariff remuneration models: Implications for renewable energy investment." Energy policy 38.2 (2010): 955-965

Main Points

- Discussion of Feed In tariffs.
- This is a way of compensating types of generation you want to encourage.
- Other Alternatives:
  - Net Metering (Small Scale)
  - Renewable Portfolio Standards (Utility Scale)
  - Power Purchase Agreement (General Term)
- Implicit is mandatory purchase of generated power.

Net Metering

Visualize a rooftop PV system.

- You generate electricity
- If you use more than you generate only get charged for the excess.
- If you generate more than you use, the excess is subtracted from your bill at the rate you are charged.
- Most people don't use power (evening) when they generate it (day).

Renewable Portfolio Standards (RPS)

Standard for a utility to have x% of generation come from renewable sources.

- Premium for renewable and minimum standards achieve same result.
- RPS hides the cost while the premium makes it specific.

Simple Static Calc 4 example

$$\min_{b,g} f(b) + n(g)$$
$$s.t. b + g = L \tag{1}$$

- b = brown electricity
- g = green electricity
- f and n = cost of generating brown and green energy.
- L = amount you need.

With RPS

$$\begin{aligned} \min_{b,g} \quad & f(b) + n(g) \\ s.t. \quad & b + g = L \\ & \frac{g}{b+g} \geq R \end{aligned} \tag{2}$$

- R is required fraction that is green.
- RPS is a constraint

With Feed-In Tarfiff

$$\begin{aligned} \min_{b,g} \quad & f(b) + n(g) - rg \\ s.t. \quad & b + g = L \end{aligned} \tag{3}$$

- Subsidized Feed-In tariffs lowers net cost of producing green energy.
- r is the per unit subsidy
- There is always a feed-in tariff that give you your desired proportion of green energy, R, and vice-versa.

Key Considerations in Feed-in tariff

- Uncertainty nominal price
- Uncertainty real price
- Variability in profit
- Incentives to invest in cost minimizing way.

Fixed Price

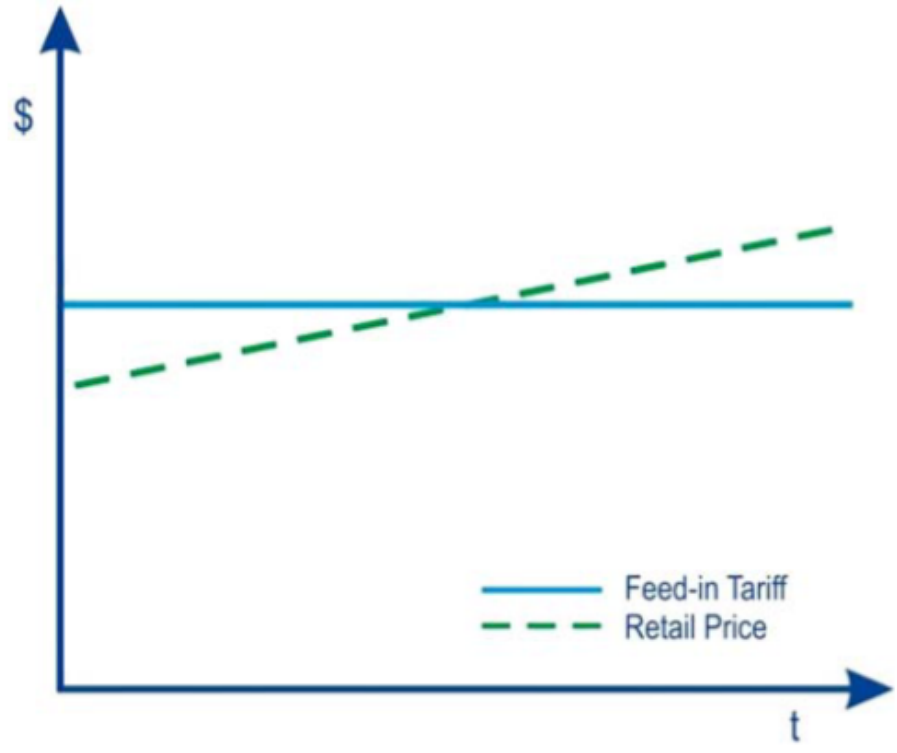

Fig. 1. Fixed price model for FIT policy design.

Figure 1:

Fixed Price

- Uncertainty nominal price: Known with certainty
- Uncertainty real price: Inflation is unknown
- Variability in profit: Future costs are unknown
- Incentives to invest in cost minimizing way: Very hard to pick the right price. Once established, strong incentives to reduce operating costs.

Fixed Price with Inflation

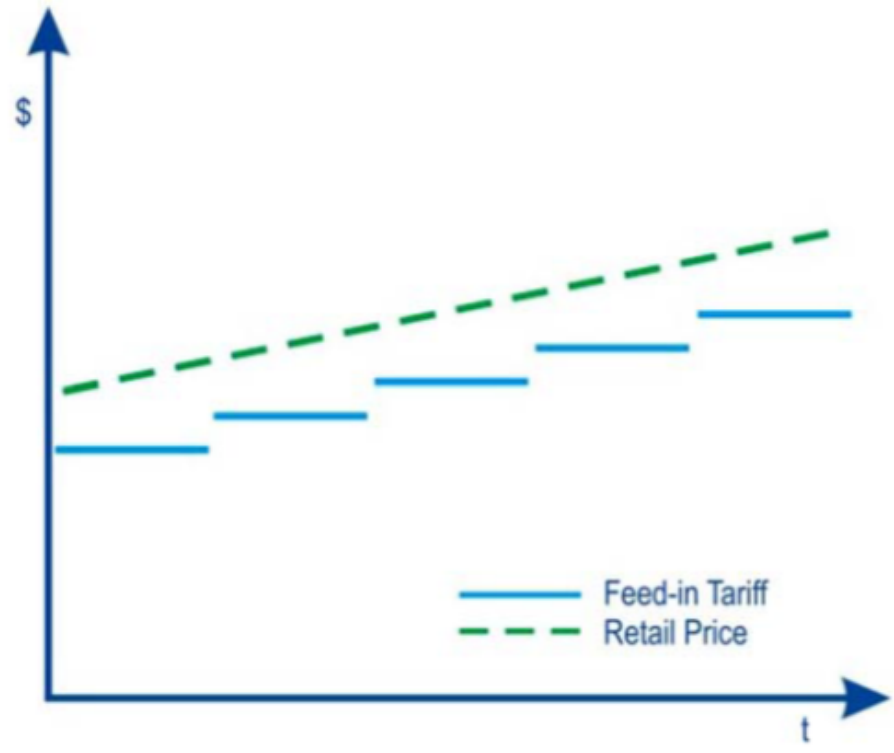

Fig. 2. Fixed price model with full or partial inflation adjustment.

Figure 2:

Fixed Price with Inflation

- Uncertainty nominal price: Known with certainty in next time period.
- Uncertainty real price: Inflation included in price. (Note that is commonly lagged inflation.)
- Variability in profit: Future costs are unknown.
- Incentives to invest in cost minimizing way: Very hard to pick the right price. Once established, strong incentives to reduce operating costs.

Front Loaded

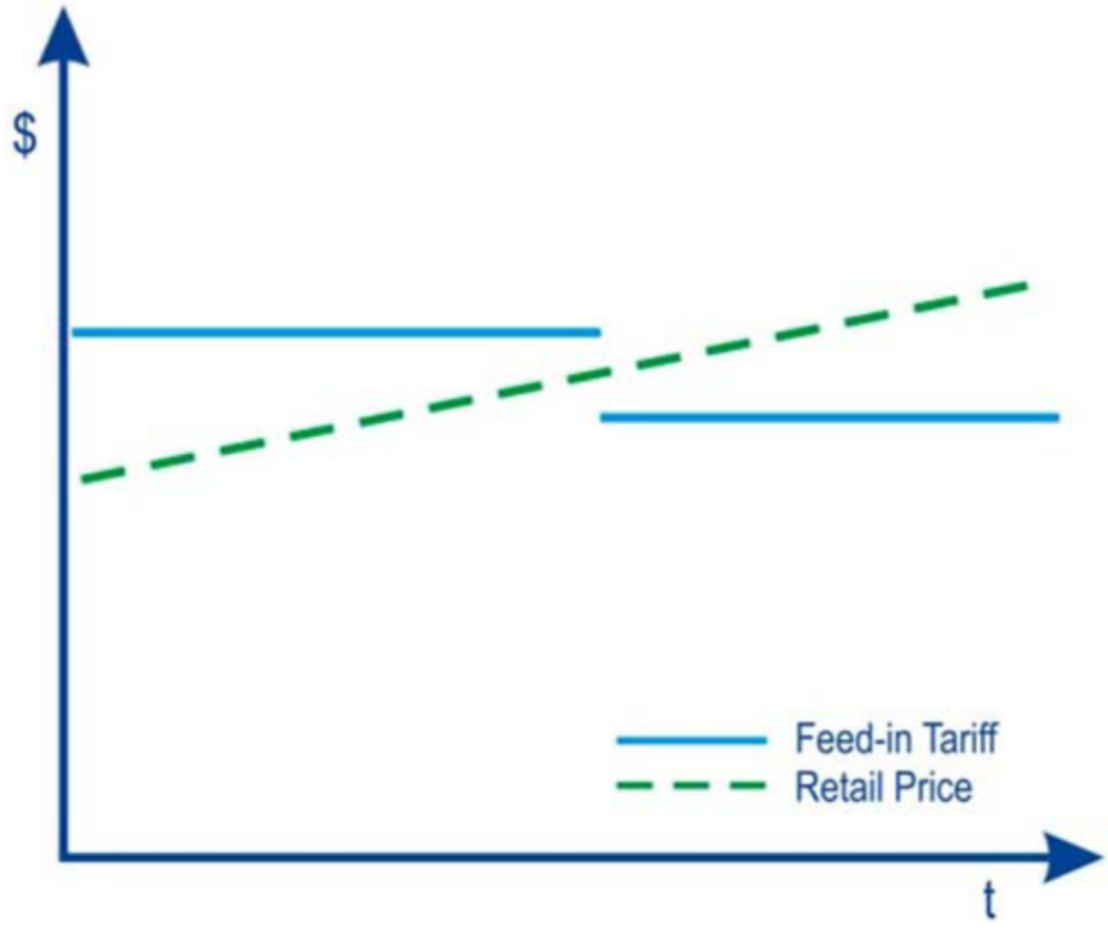

Fig. 3. Front-end loaded tariff model.

Figure 3:

Front Loaded

- Uncertainty nominal price: Known with certainty
- Uncertainty real price: Inflation is unknown
- Variability in profit: Future costs are unknown but if costs are inversely correlated with time, reduces uncertainty.
- Incentives to invest in cost minimizing way: ?

This better tracks the cost pattern, more tax depreciation in early years,

Spot Market Plus

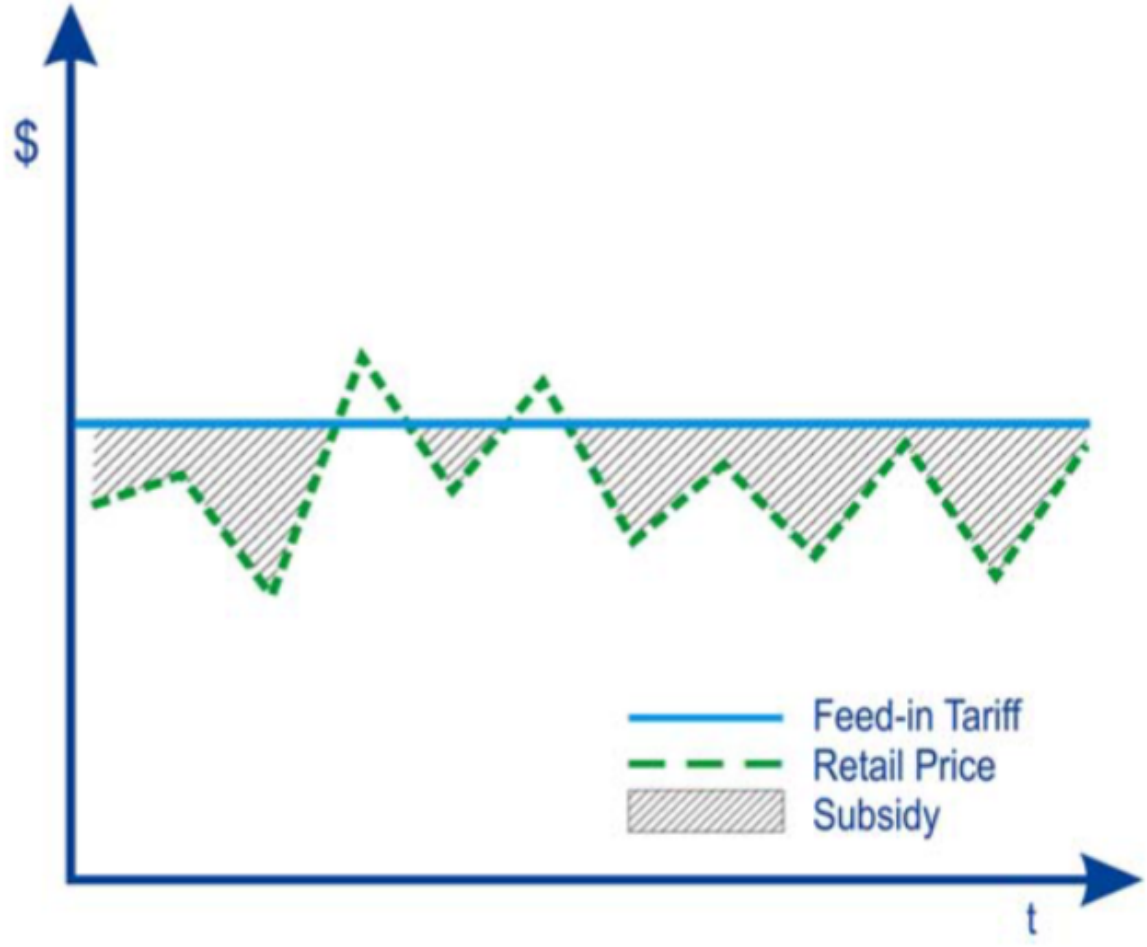

Fig. 4. Spot market gap model.

Figure 4:

Spot Market Plus

- Uncertainty nominal price: Cuts off the downside
- Uncertainty real price: Similar but does not adjust the floor with inflation.
- Variability in profit: Reduced uncertainty and allows firms to capture profits when prices are high.
- Incentives to invest in cost minimizing way: ?

Given that the generator is in an ISO, wholesale markets that are easy to access, this provides strong incentives to invest.

Premium Price

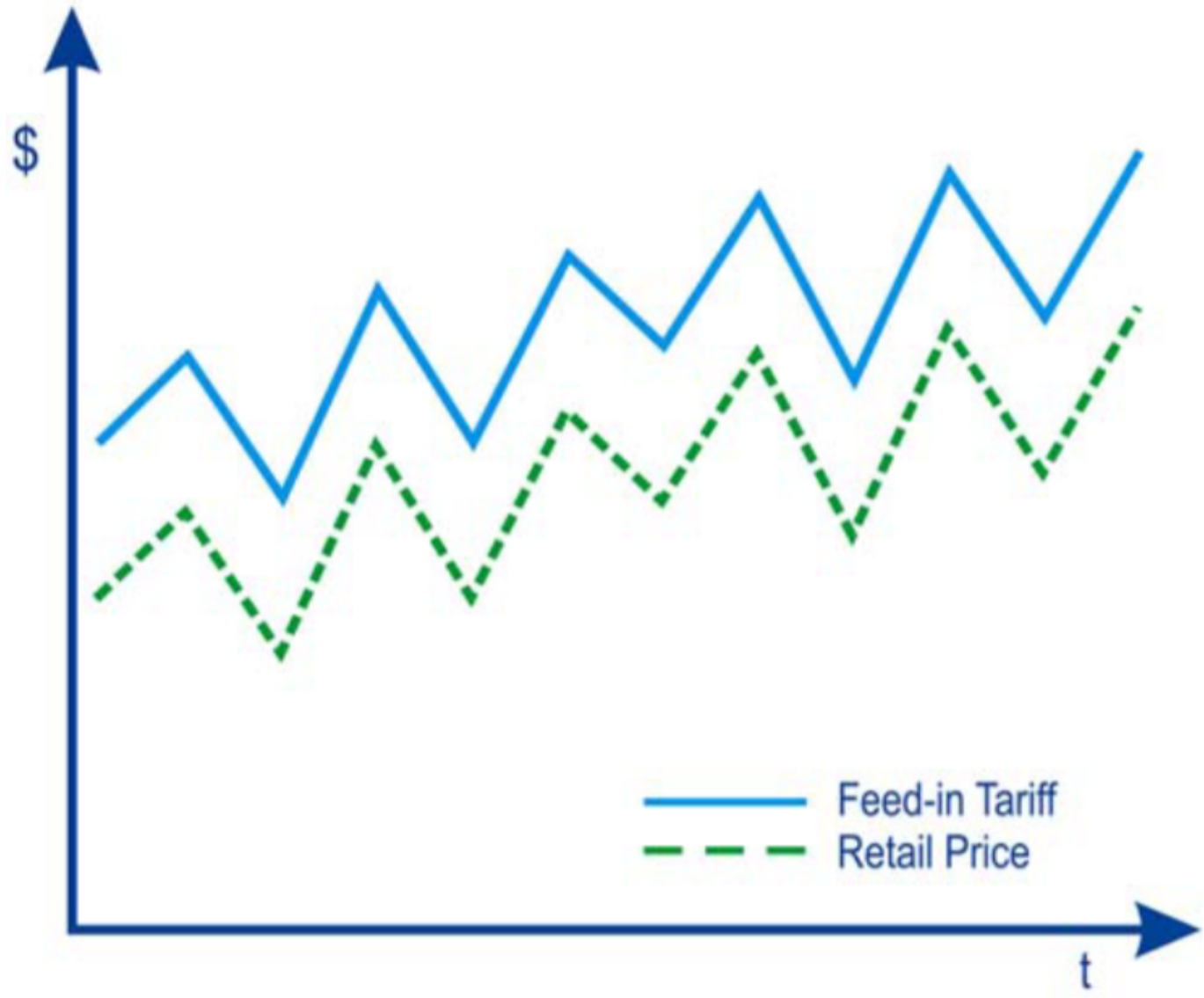

Fig. 5. Premium price model.

Premium Price

- Same uncertainty in price and profit as market exposure
- Higher average prices and profits

Variable Premium

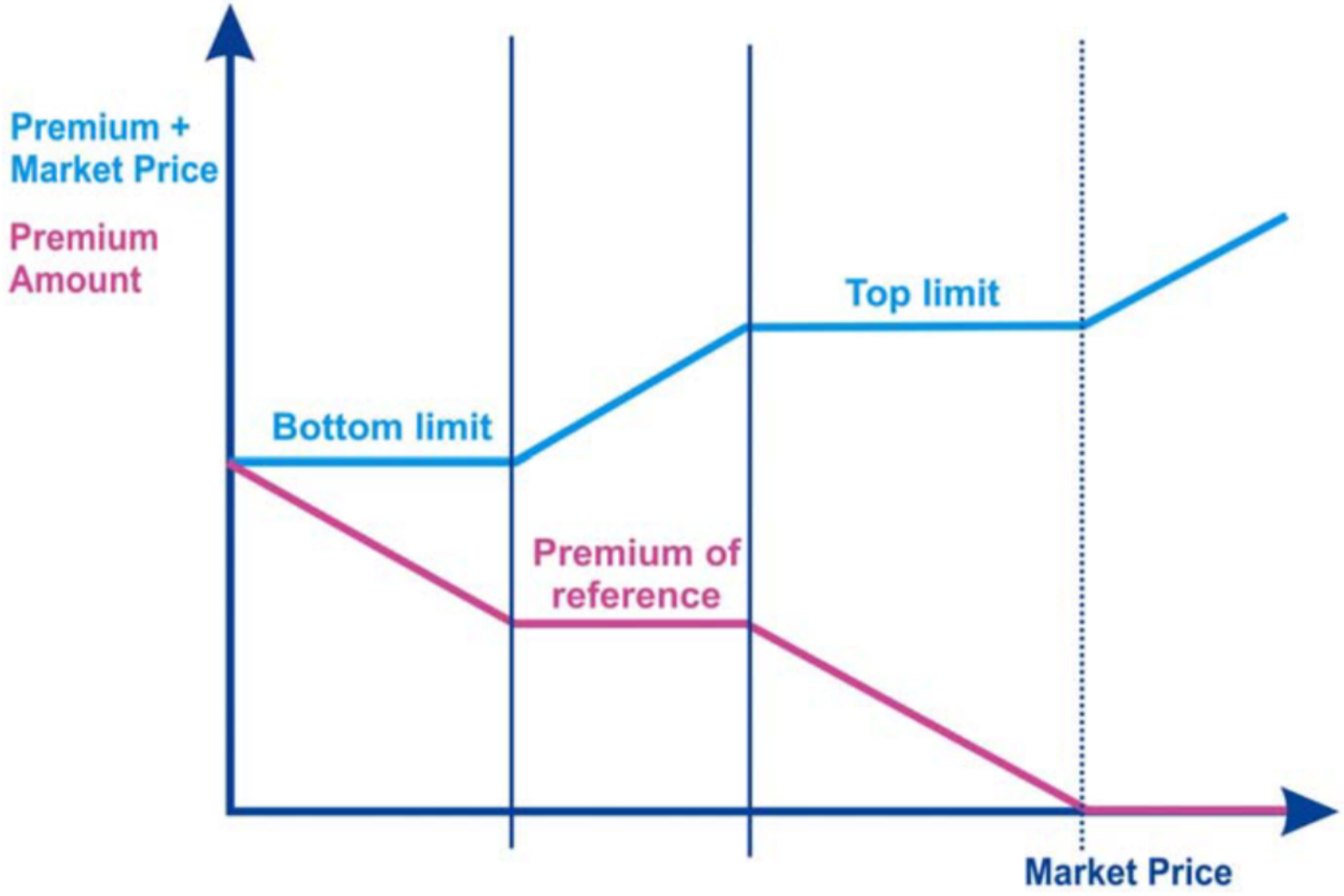

Fig. 6. Variable premium FIT policy design.

Figure 6:

Variable Premium

- Puts a lower and upper bound on the premium price subsidy.

Percent Retail

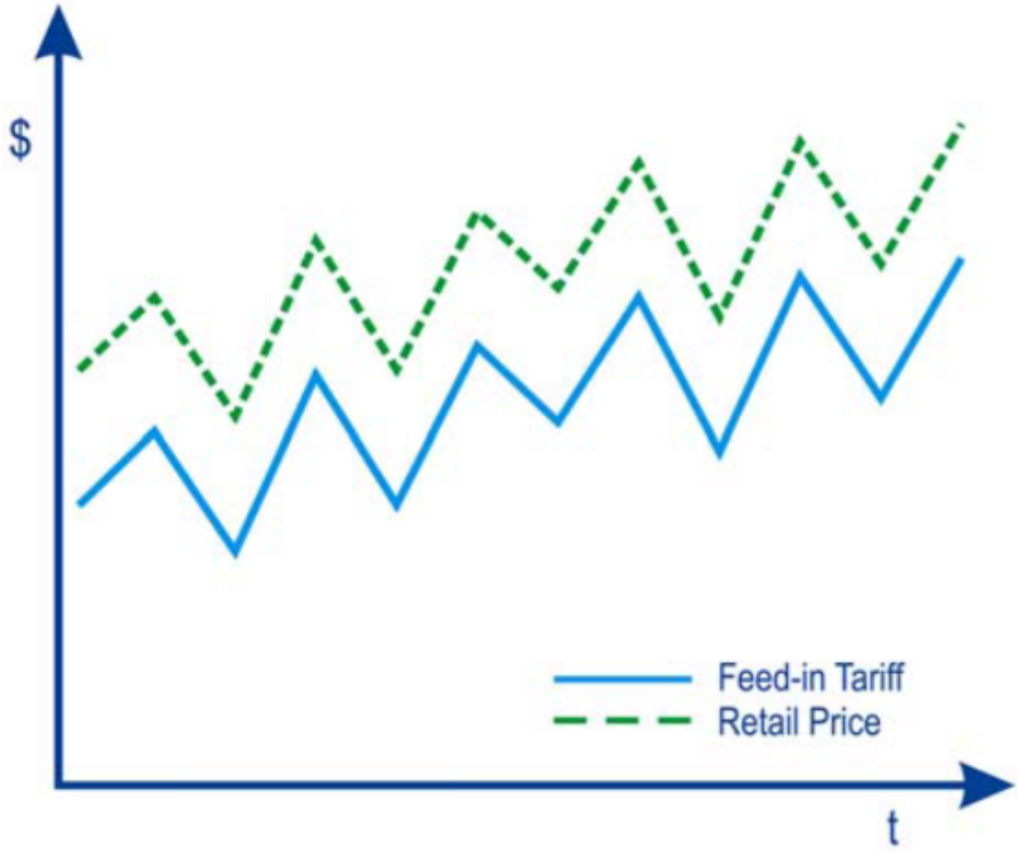

Fig. 7. Percentage of retail price model.

Figure 7:

Percent Retail

- Graph is funny but this is a multiplicative version of premium price.