Electric Sector Market Share Logit Description

The electric sector uses a modified logit choice function to choose which generating technologies to build. First, a typical logit is used to determine an ideal market share, ***MS****. The ideal market share is calculated by dividing the utility, **υ**, from each technology by the sum of utility from all technologies. Utility is determined by raising the levelized cost of energy, ***LCOE***, for the various generating technologies to a scaling factor, **α**, which is set to 10 for the electric sector. The scaling factor determines how sensitive the logit is to differences in LCOE; if the scaling factor equals zero, then equal market share will be given to each technology, whereas, if the scaling factor is much greater than 1, the technologies with the lowest levelized costs of energy will gain most of the market share. Because this calculation does not take into account any production growth constraints, there is a possibility that the logit could allocate large shares of new capacity to technologies whose production infrastructure realistically would not be able to handle such dramatic growth. For this reason, it is necessary to "damp" the ideal market share, preventing extreme growth. To achieve this damping, a damping factor, **β**, is used. The damping factor can range from zero to one, with zero being undamped and one being highly damped. A single damping factor is used for mature technologies, whereas each nascent technology can be assigned a different damping factor. Using the ideal market share, a corresponding share of the absolute load growth, ***Load***, is assigned to each technology, giving the ideal capacity additions, ***Add****. The average of the last three time period's actual additions, ***Avg***, is computed for nascent and mature technologies. For nascent technologies the average is determined by the individual technology's past additions. For mature techs, the average is based on the past sums of additions for all mature techs. This approach allows market share to be quickly swapped between mature technologies if prices dictate that it is appropriate without applying any damping (historic capacity additions data shows that mature techs such as coal and natural gas plants have been able to rapidly switch roles as dominant market share holders). The ratio of the current ideal capacity additions to the average, ***Avg***, of the last three periods' actual additions, ***Add***, is compared to 1. If the ratio is larger than one, then it is raised to the damping factor, which creates a damping term, **δ**, that becomes small for significant growth in ideal capacity additions. This damping term is then multiplied by the utility from each technology to determine an adjusted utility to be used in the damped market share, ***MS***.

$$\upsilon_{i,t} = LCOE_{i,t}^{-\alpha}$$

For Nascent Technologies: $$Avg_{j,t} = \frac{Add_{j,t-3} + Add_{j,t-2} + Add_{j,t-1}}{3}$$

For Mature Technologies: $$Avg_{k,t} = \frac{\sum_k Add_{k,t-3} + \sum_k Add_{k,t-2} + \sum_k Add_{k,t-2}}{3}$$

$$MS_{i,t}^{*} = \frac{\upsilon_{i,t}}{\sum_t \upsilon_{i,t}}$$

$$Add_{i,t}^{*} = Load_t \bullet MS_{i,t}^{*}$$

For $\left(\frac{Add_{i,t}^{*}}{Avg_{i,t}}\right) \succ 1, \quad \delta_{i,t} = \left(\frac{Add_{i,t}^{*}}{Avg_{i,t}}\right)^{-\beta_i}$, Else $\delta_{i,t} = 1$

$$MS_{i,t} = \frac{\upsilon_{i,t} \bullet \delta_{i,t}}{\sum_t (\upsilon_{i,t} \bullet \delta_{i,t})}$$

$$Add_{i,t} = Load_t \bullet MS_{i,t}$$

where,

Add = average additions

Add^* = ideal additions

$\overline{Add}$ = damped additions

$Load$ = absolute growth in load

MS^* = ideal market share

$\overline{MS}$ = damped market share

$LCOE$ = levelized cost of energy

υ = utility

β = damping factor

δ = damping term

α = scaling factor

i = all technology types

j = nascent technology type

k = mature technology type

t = time