Work Done Calculation by Force Displacement Graph.

Let a body, whose initial position is x_i , is acted upon by a variable force (whose magnitude is changing continuously) and consequently the body acquires its final position x_f .

Let \vec{F} be the average value of variable force within the interval dx from position x to (x + dx) i.e. for small displacement dx. The work done will be the area of the shaded strip of width dx. The work done on the body in displacing it from position x_i to x_f will be equal to the sum of areas of all the such strips

$$dW = \vec{F} \, dx$$

$$\therefore W = \int_{x_i}^{x_f} dW = \int_{x_i}^{x_f} \vec{F} \, dx$$

 $\therefore W = \int_{x_i}^{x_f} (\text{Area of strip of width } dx)$

 $\therefore W =$ Area under curveBetween x_i and x_f



i.e. Area under force displacement curve with proper algebraic sign represents work done by the force.