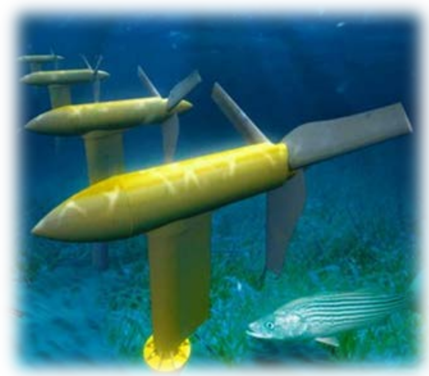
# Power in the Current/Tide: Calculation Worksheet

It is very important to understand the amount of power that can be produced by a turbine in the ocean at a given current speed. Once a drifter or ADCP has recorded data over the 4 seasons, this information is used to understand the potential power production, and thus, the payback of the turbine. Let's go through an example:

$$P = \frac{1}{2} \rho A V^3$$

*Where P is power in Watts ($kgm^2/s^3$), ρ is the density of seawater in $kg/m^3$, A is the swept area of the turbine in $m^2$ (based on the rotor diameter in meters) and V is the speed of the current in m/s.*



ρ = 1025 $kg/m^3$ *for seawater – at what depth?*
Max current speed = 8.3 m/s – get actual data for Gulf Stream
Average current speed = 6.9 m/s
Mean current speed = 7.8 m/s
Rotor diameter = 3m *for a GE 2.5 MW* *turbine*
A = _____________ $m^2$
Hours in a year = ______________

1) What is the average annual power output (in kWh) from this current/tide turbine? Max? Min?

   Ask a similar question with actual data from Bay of Fundy for tide calcs
   Have students compare the 2 calcs and make decision on which is better and why

2) According to the US Department of Energy, the average home uses 10,656 kWh of energy every year. How many homes could be powered by this one underwater turbine at average current speed?

3) How long will it take to pay off this $2 million turbine through savings on electricity if the cost of electricity in the area is $0.08/kWh (assume average current speed)?

4) How would an underwater turbine effect the marine environment? Give specific examples. Would these effects stop you from putting a turbine in the ocean?