

WORK – ENERGY – POWER

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The BMW X5 xDrive40e, a Hybrid for the Future



The hybrid 2016 BMW X5 xDrive40e starts at \$63,095.

INEXPENSIVE gasoline has fueled sales of the crossovers and sport utility vehicles that Americans love. That's good for the automakers' bottom line, but it also presents a challenge as fuel economy standards get stricter.

What's a company to do? Build something like the [BMW X5](#) xDrive40e, a **plug-in hybrid**. With a pure battery range of 14 miles, the 40e is no Volt. It charges in three hours on 220-volt current, seven hours on 110. It can reach 75 miles an hour on battery power alone; the gas engine assists from there. It does not have to be charged up to operate, but that defeats the purpose, right? **BMW's eDrive consists of a turbocharged 2-liter, 4-cylinder engine assisted by a 111-horsepower alternating-current electric motor tucked into the 8-speed**

transmission housing. (((In total, there are 308 horses))) and a healthy 332 pound-feet of torque. The lithium-ion battery pack is beneath the cargo floor where in the X5 35i, the 40e's fully fossil-fuel sibling, the third row of seats would live. The 40e is strictly a five-seat affair. Quicker than a Prius, **(((the 40e bolts from zero to 60 miles an hour in 6.5 seconds with a standard all-wheel-drive system that's always active. It drives well, though at 5,220 pounds)))**.

INTRODUCTION: The purpose of this application is to find efficiency X of this hybrid (part gasoline turbocharged and part electric) BMW 40e car.

Output Power $P_{\text{OUTPUT}} = X P_{\text{INPUT}} = \text{Work}/\text{time} = W/t =$

$$[1/2 m v^2]/t = X P_{\text{INPUT}} \quad \text{eq. 1}$$

Output work(actual energy passed on to wheels) goes to cars kinetic energy $1/2 m v^2$.

HINTS: 60 mph = 88 ft./s. , 550 ft. lb./s. = 1 HP,
Weight = (mass) g , $g = 32 \text{ ft./s.}^2$

QUESTIONS: (a) Find mass in slugs of this BMW 40e ? (b) Convert 308 HP to ft. lb./s. ?
(c) Using equation 1 (above) find this cars efficiency X ?

ANSWERS: (a) 163.125 slugs , (b) 169,400 ft. lb./s. (c) ~ 57.4 %

COMMENT: At fuelconomy.gov it is said....." Electric vehicles convert about 59% to 62% of electric energy from the grid to power at the wheels." So, in our application above the efficiency computed was 57.4 % . This seems appropriate since ALL electric powered cars are listed at the government economy site as being 59% to 62% efficient. The BMW 40e is a hybrid being part turbocharged traditional gasoline engine and part electric (111 HP) and thus slightly LESS efficient than ALL electric as we found (~ 57.4 %). This result