

Bond Energy Changes

Bond dissociation energies are a useful way to estimate chemical potential. Values for bond dissociation energies are summarized in the table below. **Note that by convention, all bond energies are assigned a negative value.** In working these calculations, be sure to note all bond changes that take place on both sides of the reaction arrow (\rightarrow). An example is provided on the next slide. Hint: Drawing the implied hydrogen atoms is often **VERY helpful!**

Average Bond Energies (kcal mole ⁻¹)										
H	C	N	O	F	Si	S	Cl	Br	I	
104	99	93	111	135	76	83	103	87	71	H
	83 ^a	73 ^b	86 ^c	116 ^d	72	65	81	68	52	C
		39	53 ^e	65			46			N
			47	45	108		52	48	56	O
				37	135					F
					53		91	74	56	Si
						60	61	52		S
							58			Cl
								46		Br
									36	I

^aC=C 146, C≡C 200

^bC=N 147, C≡N 213

^cC=O 176 (aldehydes)
179 (ketones)

^dIn CF₄

^eIn nitrites and nitrates

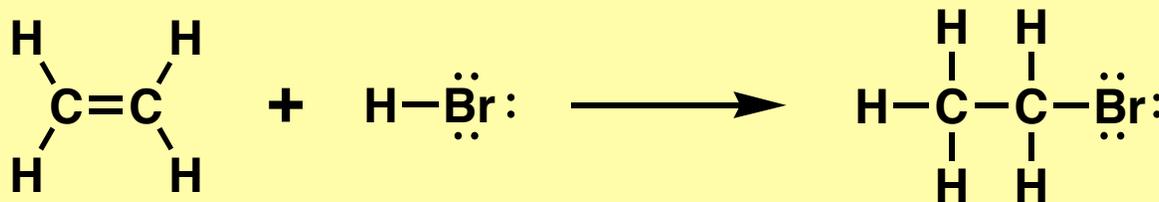
All bond energies are assigned a negative value by convention.

For a more extensive list see: <http://www.jhu.edu/chem/lectka/Bond%20Strengths.html>



Bond Energy Changes: Example Calculation

To determine the net change in bond energy, we first must determine which bonds undergo change. For the reaction:



the H–Br and C=C double bond are broken. The energy of the C=C double bond is not entirely lost, however, as the double bond becomes a C–C single bond. Thus, we will take this change into account by assuming that a C=C bond is broken and a C–C bond is made. Other new bonds include C–H and C–Br. The energies of all bonds broken and all bonds made are then summarized as shown in the table below. The reaction is favorable by 17 kcal/mol as a result of the increased net bond strength. Note that this calculation is for bond enthalpies (ΔH), not ΔG .

<i>Bonds changes (reactants)</i>		<i>Bonds changes (products)</i>	
bond	Energy (kcal/mol)	bond	Energy (kcal/mol)
C=C	-146	C-C	-83
H-Br	-87	C-H	-99
		C-Br	-68
net	-233	net	-250
Overall change = bonds made – bonds broken = (-250) – (-233) = -17 kcal/mol			