Getting the Measure of Wind.

The parameters in **bold** need to be set to suit each nation, the other figures are calculated automatically. The figures presently shown in Table 1 refer to 1 MW of rated capacity and are for the UK. The USA certainly differs in the amount of electricity used per person, and it *may* differ in the peak infeed factor. For a somewhat speculative assessment for the USA, pending better data, see Table 2.

Australia is sufficiently different from the UK and the USA for calculations to be unreliable until better data are available, particularly with regard to the peak infeed factor, and transmission losses from the strong winds of the South West to where the electricity is needed, a couple of thousand km away.

Table 3 calculates, for the UK and USA, how much *additional* natural gas is required to operate "wind plus dominant in-harness backup" instead of just using CCGT plant.

(PERM/Measure of Wind XLS.xls January 2005).

Table 1. Number of people who can be supplied with 20% of their electricity from 1 MW

45	GWe	(GWe = billions of watts of electricity) is the mean power consumption of the nation.
60	million	this is the population of the nation.
0.75	kWe	so this is the electrical consumption of each person.
24%	%	is the infeed factor (the mean over the year).
80%	%	is the peak infeed factor.
30%	%	so this is the wind fraction, i.e. wind infeed divided by (wind infeed + infeed from the dominant in harness backup).
66%	%	is the fraction of the total electrical demand lying below the 'valley' demand.
20%	%	so this is the fraction of the total electrical demand which can be satisfied by wind.
0.15	kW	so this is the maximum contribution per person that the wind can provide.
240	kW	so this is the actual output from a wind turbine with a rated capacity of 1 MW.
1616	so this is the number of people that wind can supply with 20% of their total electricity.	

Table 2. Subsidiary records table

Nation	Result (cell A28)	Parameters used: Row 17	Row 18	Row 20	Row 21	Row 24
The United States.	833 people	422	290	24%	80%	66%

(note that the most uncertain parameter for the USA is the peak infeed factor (row 21). As almost a placeholder, it is assumed to be the same as for the E.ON Netz area, which covers 800 km in Germany).

Table 3. Additional natural gas required when integrating wind into a gas-fired system

70%	%	this is the fraction:- infeed from the dominant in-harness backup divided by (wind infeed + infeed from the dominant in harness backup). (1-A22)
100	MWe	this is a nominal required infeed from the wind + the dominant in-harness backup.
70	MWe	(million watts of electricity) so this is the input from the dominant in-harness backup.
35%	%	this is the assumed efficiency of the open cycle gas turbines when operating in harness.
200	MWyr/yr	so this is the amount of gas energy needed each year using wind + dominant backup.
		(a MWyr is a MW of power for a year. The only reason for expressing the gas value in terms of MWyr/yr, instead of MW, is that it is hard to visualize natural gas as mean power.)
60%	%	This is the assumed efficiency of CCGT plant running at constant full output i.e. without having to adjust itself to varying wind output.
167	MWyr/yr	so this is the amount of gas energy needed each year without using wind.
20%	%	**so this is the additional natural gas input needed when wind plus dominant in-harness backup is used, instead of just using CCGT plant.**