

LCN Fund Full Submission

Supplementary Answer Form

Tick if this answer is Confidential: ☐

Tick if this answer has been provided verbally: ☐

Project code:	WPDT205	Question Number	18
Question date	03/10/13	Answer date	08/10/13
Submission section question relates to	Expert Panel Bilateral		
Topic	Technical		
Question	<p>Given the load profile you have provided, and revenues the generator could expect, please describe the possible responses for the wind farm developer in seeking connection. For instance 6MW firm connection, 3MW flexible connection, the proposed electrolyser, other alternatives. What are the costs of those different possible investments?</p>		
Notes on question			
Answer	<p>Please note, the answer provided below differs from that provided during the panel session given the underlying model has been updated to address panel challenges and revisions to the modelling approach.</p> <p>The table below demonstrates how the various Methods compare with:</p> <ul style="list-style-type: none"> • A 1MW wind farm with a 1MW unconstrained connection • A 6MW wind farm with a reinforced 6MW unconstrained connection <p>It can be seen that the key Methods outperform the above in most scenarios. Where there is a large diversity of generation the constraint scheme (Method 1) prevails. However when there is low generation diversity and/or a low firm connection, the other Methods outperform Method 1.</p> <p>The second scenario below demonstrates a flexible 3MW connection, i.e. 2MW based on the available PV capacity and 1MW firm.</p> <p>Depending on the specific context of the connection request, the connection options can therefore be determined based on the above.</p>		

	<table><tr><th>Methods</th><th>Wind (MW)</th><th>PV (MW)</th><th>ELY (MW)</th><th>Firm (MW)</th><th>GE (MW)</th><th>Thrash ELY (Y/N)</th><th>ELY Util</th><th>Connection + Non-Wind Costs (£m)</th><th>GWh/ Anum</th><th>Tonnes CO2 PA saved</th><th>20 Year IRR</th><th>20 Year NPV (£m)</th><th>Pay Back Year</th></tr><tr><td>1MW/1MW</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>N/A</td><td>0%</td><td>0.60</td><td>2.76</td><td>1,261</td><td>10.5%</td><td>1.61</td><td>12</td></tr><tr><td>Method 0</td><td>6</td><td>0</td><td>0</td><td>6</td><td>0</td><td>N/A</td><td>0%</td><td>7.40</td><td>18.43</td><td>8,422</td><td>8.4%</td><td>8.33</td><td>14</td></tr><tr><td>Method 1</td><td>6</td><td>6</td><td>0</td><td>3</td><td>0</td><td>N/A</td><td>N/A</td><td>0.76</td><td>18.39</td><td>8,403</td><td>16.5%</td><td>14.68</td><td>9</td></tr><tr><td>Method 2</td><td>6</td><td>6</td><td>1</td><td>3</td><td>1.4</td><td>N</td><td>0.4%</td><td>2.44</td><td>30.59</td><td>8,412</td><td>14.0%</td><td>13.31</td><td>10</td></tr><tr><td>Method 3</td><td>6</td><td>6</td><td>1</td><td>3</td><td>0</td><td>N</td><td>0.4%</td><td>2.20</td><td>18.41</td><td>8,412</td><td>13.6%</td><td>12.39</td><td>10</td></tr><tr><td>Method 4</td><td>6</td><td>6</td><td>1</td><td>3</td><td>1.4</td><td>N</td><td>0.4%</td><td>3.04</td><td>30.59</td><td>8,412</td><td>12.8%</td><td>12.09</td><td>10</td></tr><tr><td>Method 5</td><td>6</td><td>6</td><td>0</td><td>3</td><td>0</td><td>N/A</td><td>N/A</td><td>3.01</td><td>2.28</td><td>811</td><td>24.9%</td><td>4.78</td><td>6</td></tr><tr><td>Method 6</td><td>6</td><td>6</td><td>1</td><td>3</td><td>0</td><td>N</td><td>0.4%</td><td>5.21</td><td>20.70</td><td>8,412</td><td>15.1%</td><td>16.47</td><td>9</td></tr><tr><td>Method 7</td><td>6</td><td>6</td><td>1</td><td>3</td><td>1.4</td><td>N</td><td>0.4%</td><td>6.05</td><td>32.87</td><td>8,412</td><td>15.3%</td><td>19.26</td><td>9</td></tr><tr><td>Method 1+5</td><td>6</td><td>6</td><td>0</td><td>3</td><td>0</td><td>N/A</td><td>0.4%</td><td>3.77</td><td>20.67</td><td>8,403</td><td>17.6%</td><td>18.76</td><td>8</td></tr><tr><td>Method 2+5</td><td>6</td><td>6</td><td>1</td><td>3</td><td>1.4</td><td>N</td><td>0.4%</td><td>5.45</td><td>32.87</td><td>8,412</td><td>15.2%</td><td>16.99</td><td>9</td></tr><tr><td>Method 1</td><td>6</td><td>2</td><td>0</td><td>1</td><td>0</td><td>N/A</td><td>0%</td><td>0.76</td><td>13.46</td><td>6,152</td><td>10.2%</td><td>6.58</td><td>12</td></tr><tr><td>Method 2</td><td>6</td><td>2</td><td>3</td><td>1</td><td>2.8</td><td>Y</td><td>19%</td><td>3.94</td><td>33.69</td><td>7,444</td><td>11.2%</td><td>10.30</td><td>12</td></tr><tr><td>Method 3</td><td>6</td><td>2</td><td>3</td><td>1</td><td>0</td><td>Y</td><td>19%</td><td>2.86</td><td>17.10</td><td>7,444</td><td>10.1%</td><td>7.80</td><td>12</td></tr><tr><td>Method 4</td><td>6</td><td>2</td><td>3</td><td>1</td><td>2.8</td><td>Y</td><td>19%</td><td>4.54</td><td>33.69</td><td>7,444</td><td>10.1%</td><td>8.96</td><td>12</td></tr><tr><td>Method 5</td><td>6</td><td>2</td><td>0</td><td>1</td><td>0</td><td>N/A</td><td>0%</td><td>3.01</td><td>2.28</td><td>811</td><td>24.9%</td><td>4.78</td><td>6</td></tr><tr><td>Method 6</td><td>6</td><td>2</td><td>3</td><td>1</td><td>0</td><td>Y</td><td>19%</td><td>5.87</td><td>19.38</td><td>7,444</td><td>12.0%</td><td>11.94</td><td>10</td></tr><tr><td>Method 7</td><td>6</td><td>2</td><td>3</td><td>1</td><td>2.8</td><td>Y</td><td>19%</td><td>7.55</td><td>35.97</td><td>7,444</td><td>12.9%</td><td>16.13</td><td>10</td></tr><tr><td>Method 1+5</td><td>6</td><td>2</td><td>0</td><td>1</td><td>0</td><td>N/A</td><td>0%</td><td>3.77</td><td>15.75</td><td>6,152</td><td>12.6%</td><td>10.83</td><td>10</td></tr><tr><td>Method 2+5</td><td>6</td><td>2</td><td>3</td><td>1</td><td>2.8</td><td>N</td><td>19%</td><td>6.95</td><td>35.97</td><td>7,444</td><td>12.6%</td><td>13.80</td><td>10</td></tr><tr><td>Method 1</td><td>6</td><td>1</td><td>0</td><td>1</td><td>0</td><td>N/A</td><td>0%</td><td>0.76</td><td>10.57</td><td>4,830</td><td>5.9%</td><td>1.83</td><td>17</td></tr><tr><td>Method 2</td><td>6</td><td>1</td><td>4</td><td>1</td><td>4.2</td><td>Y</td><td>22%</td><td>5.31</td><td>38.73</td><td>6,915</td><td>10.4%</td><td>9.89</td><td>12</td></tr><tr><td>Method 3</td><td>6</td><td>1</td><td>4</td><td>1</td><td>0</td><td>Y</td><td>22%</td><td>3.39</td><td>16.44</td><td>6,915</td><td>8.0%</td><td>5.11</td><td>15</td></tr><tr><td>Method 4</td><td>6</td><td>1</td><td>4</td><td>1</td><td>4.2</td><td>Y</td><td>22%</td><td>5.91</td><td>38.73</td><td>6,915</td><td>9.3%</td><td>8.43</td><td>13</td></tr><tr><td>Method 5</td><td>6</td><td>1</td><td>0</td><td>1</td><td>0</td><td>N/A</td><td>0%</td><td>3.01</td><td>2.28</td><td>811</td><td>24.9%</td><td>4.78</td><td>6</td></tr><tr><td>Method 6</td><td>6</td><td>1</td><td>4</td><td>1</td><td>0</td><td>Y</td><td>22%</td><td>6.40</td><td>18.73</td><td>6,915</td><td>10.2%</td><td>9.28</td><td>12</td></tr><tr><td>Method 7</td><td>6</td><td>1</td><td>4</td><td>1</td><td>4.2</td><td>Y</td><td>22%</td><td>8.92</td><td>41.01</td><td>6,915</td><td>12.1%</td><td>15.60</td><td>11</td></tr><tr><td>Method 1+5</td><td>6</td><td>1</td><td>0</td><td>1</td><td>0</td><td>N/A</td><td>0%</td><td>3.77</td><td>12.85</td><td>4,830</td><td>9.2%</td><td>6.18</td><td>13</td></tr><tr><td>Method 2+5</td><td>6</td><td>1</td><td>4</td><td>1</td><td>4.2</td><td>Y</td><td>22%</td><td>8.32</td><td>41.01</td><td>6,915</td><td>12%</td><td>13</td><td>10</td></tr></table> <p>* Figures based on pre-tax cashflows</p>	Methods	Wind (MW)	PV (MW)	ELY (MW)	Firm (MW)	GE (MW)	Thrash ELY (Y/N)	ELY Util	Connection + Non-Wind Costs (£m)	GWh/ Anum	Tonnes CO2 PA saved	20 Year IRR	20 Year NPV (£m)	Pay Back Year	1MW/1MW	1	0	0	1	0	N/A	0%	0.60	2.76	1,261	10.5%	1.61	12	Method 0	6	0	0	6	0	N/A	0%	7.40	18.43	8,422	8.4%	8.33	14	Method 1	6	6	0	3	0	N/A	N/A	0.76	18.39	8,403	16.5%	14.68	9	Method 2	6	6	1	3	1.4	N	0.4%	2.44	30.59	8,412	14.0%	13.31	10	Method 3	6	6	1	3	0	N	0.4%	2.20	18.41	8,412	13.6%	12.39	10	Method 4	6	6	1	3	1.4	N	0.4%	3.04	30.59	8,412	12.8%	12.09	10	Method 5	6	6	0	3	0	N/A	N/A	3.01	2.28	811	24.9%	4.78	6	Method 6	6	6	1	3	0	N	0.4%	5.21	20.70	8,412	15.1%	16.47	9	Method 7	6	6	1	3	1.4	N	0.4%	6.05	32.87	8,412	15.3%	19.26	9	Method 1+5	6	6	0	3	0	N/A	0.4%	3.77	20.67	8,403	17.6%	18.76	8	Method 2+5	6	6	1	3	1.4	N	0.4%	5.45	32.87	8,412	15.2%	16.99	9	Method 1	6	2	0	1	0	N/A	0%	0.76	13.46	6,152	10.2%	6.58	12	Method 2	6	2	3	1	2.8	Y	19%	3.94	33.69	7,444	11.2%	10.30	12	Method 3	6	2	3	1	0	Y	19%	2.86	17.10	7,444	10.1%	7.80	12	Method 4	6	2	3	1	2.8	Y	19%	4.54	33.69	7,444	10.1%	8.96	12	Method 5	6	2	0	1	0	N/A	0%	3.01	2.28	811	24.9%	4.78	6	Method 6	6	2	3	1	0	Y	19%	5.87	19.38	7,444	12.0%	11.94	10	Method 7	6	2	3	1	2.8	Y	19%	7.55	35.97	7,444	12.9%	16.13	10	Method 1+5	6	2	0	1	0	N/A	0%	3.77	15.75	6,152	12.6%	10.83	10	Method 2+5	6	2	3	1	2.8	N	19%	6.95	35.97	7,444	12.6%	13.80	10	Method 1	6	1	0	1	0	N/A	0%	0.76	10.57	4,830	5.9%	1.83	17	Method 2	6	1	4	1	4.2	Y	22%	5.31	38.73	6,915	10.4%	9.89	12	Method 3	6	1	4	1	0	Y	22%	3.39	16.44	6,915	8.0%	5.11	15	Method 4	6	1	4	1	4.2	Y	22%	5.91	38.73	6,915	9.3%	8.43	13	Method 5	6	1	0	1	0	N/A	0%	3.01	2.28	811	24.9%	4.78	6	Method 6	6	1	4	1	0	Y	22%	6.40	18.73	6,915	10.2%	9.28	12	Method 7	6	1	4	1	4.2	Y	22%	8.92	41.01	6,915	12.1%	15.60	11	Method 1+5	6	1	0	1	0	N/A	0%	3.77	12.85	4,830	9.2%	6.18	13	Method 2+5	6	1	4	1	4.2	Y	22%	8.32	41.01	6,915	12%	13	10	<div>Firm 1MW Firm 6MW</div> <div>Large Diverse Generation</div> <div>Low Firm/ Large Electrolyser/ Thrash Electrolyser</div> <div>Low Diversity/ Low Firm/ Large Electrolyser/ Large Gas Engine/ Thrash Electrolyser</div>
Methods	Wind (MW)	PV (MW)	ELY (MW)	Firm (MW)	GE (MW)	Thrash ELY (Y/N)	ELY Util	Connection + Non-Wind Costs (£m)	GWh/ Anum	Tonnes CO2 PA saved	20 Year IRR	20 Year NPV (£m)	Pay Back Year																																																																																																																																																																																																																																																																																																																																																																																																																									
1MW/1MW	1	0	0	1	0	N/A	0%	0.60	2.76	1,261	10.5%	1.61	12																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 0	6	0	0	6	0	N/A	0%	7.40	18.43	8,422	8.4%	8.33	14																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 1	6	6	0	3	0	N/A	N/A	0.76	18.39	8,403	16.5%	14.68	9																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 2	6	6	1	3	1.4	N	0.4%	2.44	30.59	8,412	14.0%	13.31	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 3	6	6	1	3	0	N	0.4%	2.20	18.41	8,412	13.6%	12.39	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 4	6	6	1	3	1.4	N	0.4%	3.04	30.59	8,412	12.8%	12.09	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 5	6	6	0	3	0	N/A	N/A	3.01	2.28	811	24.9%	4.78	6																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 6	6	6	1	3	0	N	0.4%	5.21	20.70	8,412	15.1%	16.47	9																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 7	6	6	1	3	1.4	N	0.4%	6.05	32.87	8,412	15.3%	19.26	9																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 1+5	6	6	0	3	0	N/A	0.4%	3.77	20.67	8,403	17.6%	18.76	8																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 2+5	6	6	1	3	1.4	N	0.4%	5.45	32.87	8,412	15.2%	16.99	9																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 1	6	2	0	1	0	N/A	0%	0.76	13.46	6,152	10.2%	6.58	12																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 2	6	2	3	1	2.8	Y	19%	3.94	33.69	7,444	11.2%	10.30	12																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 3	6	2	3	1	0	Y	19%	2.86	17.10	7,444	10.1%	7.80	12																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 4	6	2	3	1	2.8	Y	19%	4.54	33.69	7,444	10.1%	8.96	12																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 5	6	2	0	1	0	N/A	0%	3.01	2.28	811	24.9%	4.78	6																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 6	6	2	3	1	0	Y	19%	5.87	19.38	7,444	12.0%	11.94	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 7	6	2	3	1	2.8	Y	19%	7.55	35.97	7,444	12.9%	16.13	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 1+5	6	2	0	1	0	N/A	0%	3.77	15.75	6,152	12.6%	10.83	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 2+5	6	2	3	1	2.8	N	19%	6.95	35.97	7,444	12.6%	13.80	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 1	6	1	0	1	0	N/A	0%	0.76	10.57	4,830	5.9%	1.83	17																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 2	6	1	4	1	4.2	Y	22%	5.31	38.73	6,915	10.4%	9.89	12																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 3	6	1	4	1	0	Y	22%	3.39	16.44	6,915	8.0%	5.11	15																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 4	6	1	4	1	4.2	Y	22%	5.91	38.73	6,915	9.3%	8.43	13																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 5	6	1	0	1	0	N/A	0%	3.01	2.28	811	24.9%	4.78	6																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 6	6	1	4	1	0	Y	22%	6.40	18.73	6,915	10.2%	9.28	12																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 7	6	1	4	1	4.2	Y	22%	8.92	41.01	6,915	12.1%	15.60	11																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 1+5	6	1	0	1	0	N/A	0%	3.77	12.85	4,830	9.2%	6.18	13																																																																																																																																																																																																																																																																																																																																																																																																																									
Method 2+5	6	1	4	1	4.2	Y	22%	8.32	41.01	6,915	12%	13	10																																																																																																																																																																																																																																																																																																																																																																																																																									
Attachments																																																																																																																																																																																																																																																																																																																																																																																																																																						
Verbal Clarifications (Consultants)																																																																																																																																																																																																																																																																																																																																																																																																																																						