THE DETAILS OF COSTING OF THE VARIOUS DECENTRALISED POWER SUPPLY OPTIONS

I. SMALL HYDRO-POWER PLANT

Data Source: Cost computed on the basis of YMC-Stage-II Hydro Electric Station, Yamunanagar (Commissioned on 16-4-2004.)

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Parameters</th>
<th>Derivation #</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>THE CAPITAL COST AT COMMISSIONING</td>
<td>(Rs crore)</td>
<td>92</td>
</tr>
<tr>
<td>2</td>
<td>Lead time</td>
<td>(Years)</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Capacity of the plant</td>
<td>(MW)</td>
<td>14.4</td>
</tr>
<tr>
<td>4</td>
<td>Capital cost adjusted at 2002-03 price level @ 6 % /yr.</td>
<td>(Rs crore)</td>
<td>86</td>
</tr>
<tr>
<td>5</td>
<td>Capital cost per KW of rated capacity in 2002 $</td>
<td>(Rs)</td>
<td>59639</td>
</tr>
<tr>
<td>6</td>
<td>Present value (PV) of capital cost per KW of rated capacity in 2002 $</td>
<td>(Rs)</td>
<td>50721</td>
</tr>
<tr>
<td>7</td>
<td>Discount Rate</td>
<td>(%)</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>Working Life of the plant</td>
<td>(Years)</td>
<td>25</td>
</tr>
<tr>
<td>9</td>
<td>Capital Recovery Factor, @ 12%, 25 yrs.</td>
<td>r/(1-(1+r)^t)</td>
<td>0.1275</td>
</tr>
<tr>
<td>10</td>
<td>O &amp; M Cost</td>
<td>(Rs / KW / Yr.)</td>
<td>596</td>
</tr>
<tr>
<td>11</td>
<td>Capacity Utilization Factor</td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>12</td>
<td>Electricity Generation (8760*.80)</td>
<td>(Kwh/KW/yr.)</td>
<td>7008</td>
</tr>
<tr>
<td>13</td>
<td>Auxiliary Consumption</td>
<td>(%)</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>Auxiliary Consumption factor</td>
<td>1/(1-13/100)</td>
<td>1.01</td>
</tr>
<tr>
<td>15</td>
<td>Net generation at bus bar</td>
<td>(12/14)</td>
<td>6938</td>
</tr>
</tbody>
</table>

Cost calculations in the Base year (2002)

16 PV of an annuity of Rs 1 for 25 years
   \[ \frac{1-(1+r)^t}{r} \] (Rs) 7.84
17 PV of O & M costs for 25 years
   \[ (10*16) \] (Rs / kw) 4678
18 PV of 1 after 4 year
   \[ \frac{1}{(1+r)^t} \] (Rs) 0.64
19 Present value (PV) of O & M Cost in 2002
   \[ (17*18) \] (Rs / kw) 2973
20 Sum of fixed Costs of power or MCC in 2002
   \[ (6+19) \] (Rs / kw) 53694
21 Annualized Life cycle fixed cost or Annualized MCC value
   \[ (9*20) \] (Rs / kw / yr) 6846
22 Annualized Life cycle cost of power or MCC at 80 % Capacity Factor (at bus bar) in 2002
   \[ (31/15) \] (Rs / kw / yr) 6846
23 Life Cycle Cost of Energy or MCOE (at bus bar) in 2002
   \[ (31/15) \] (Rs/kwh) 0.99

Adjusting the (2002) costs to the availability of returns (2006):

33 Life cycle fixed Costs or MCC obtainable when plant
   Begins operation in 2006
   \[ (20/18) \] (Rs) 84468
34 Annualized Life cycle fixed cost or
   Annualized MCC value in 2006
   \[ (9*33) \] (Rs / kw / yr) 10772
35 Annualized Life cycle cost of power or MCC at
   80 % Capacity Factor (at bus bar) in 2006
   \[ (35/15) \] (Rs / kw / yr) 10772
36 LIFE CYCLE COST OF ENERGY or MCOE
   (at bus bar) in 2006
   \[ (35/15) \] Busbar (Rs/kwh) 1.55
The lead time indicates how long it takes to complete a plant. It is assumed that the total cost is evenly distributed to each year of the lead time and the plant would begin to be built in 2002 (no costs are yet sunk), initial expenditure would occur at the beginning of 2002, then the present worth in the year 2002 is thus calculated as:

\[
14910 + \frac{14910}{(1.12)} + \frac{14910}{(1.12)^2} + \frac{14910}{(1.12)^3} = \text{Rs 50721.}
\]

Figures in derivation represent serial nos of parameter's values.

II. BAGASSE BASED CO-GENERATION PROJECT

Data Source: Cost computed on the basis of Detail Project Report (DPR) of M/S Kakatiya Cement, Sugar Industries Ltd. At Peruvancha Village, Kallur Mandal, Khammam District, Andhra Pradesh, Commissioned during 2002-03.

<table>
<thead>
<tr>
<th>Sr. No.</th>
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<th>Derivation #</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>THE CAPITAL COST AT COMMISSIONING</td>
<td></td>
<td>52.67</td>
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<td>2</td>
<td>Lead time @</td>
<td>(Years)</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>Capacity of the plant</td>
<td>(KW)</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Capital cost per KW of rated capacity</td>
<td>(Rs)</td>
<td>30982</td>
</tr>
<tr>
<td>5</td>
<td>Present value (PV) of capital cost per KW of rated capacity in 2002 $</td>
<td>(Rs)</td>
<td>30413</td>
</tr>
<tr>
<td>6</td>
<td>Discount Rate</td>
<td>(%)</td>
<td>12</td>
</tr>
<tr>
<td>7</td>
<td>Working Life of the plant</td>
<td>(Years)</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>Capital Recovery Factor, @ 12%, 20 yrs.</td>
<td>[\frac{n(1-(1+r)^{-n})}{r}]</td>
<td>0.1339</td>
</tr>
<tr>
<td>9</td>
<td>O &amp; M COSTS</td>
<td>(Rs/KW/year)</td>
<td>929</td>
</tr>
<tr>
<td>10</td>
<td>Capacity Utilization Factor (%)</td>
<td>(%)</td>
<td>85</td>
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</tbody>
</table>

**Plant Operation:**

11 1) Cane Crushing season | Days | 170 |
12 2) Off- Season | Days | 160 |

**Electricity Generation:**

13 1) During Cane Crushing season | (Kw/KW) | 3468 |
14 2) During Off- Season | (Kw/KW) | 3264 |
15 Total electricity generation per year | (KWh/KWyr.) | 6732 |
16 Auxiliary Consumption | (%) | 5 |
17 Auxiliary Consumption factor | 1/(1-5/100) | 1.05 |
18 Net generation at busbar | (KWh/KW yr.) | 6395 |

**Variable Costs**

19 1) During Cane Crushing season | Nil |
Note: The project uses bagasse generated from the crushing operation of Sugar mill during season operation.

20 2) During Off- Season | 
Note: The project uses purchased agricultural wastes and industrial wastes such as sugar cane trash, eucalyptus, cotton stalks, Bagasse etc.

<table>
<thead>
<tr>
<th></th>
<th>Amount of fuel required per kwh</th>
<th>(Kg)</th>
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<tr>
<td>21</td>
<td>Amount of fuel required per KW</td>
<td>(14*21)</td>
<td>3264</td>
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<tr>
<td>22</td>
<td>Price of procured fuel</td>
<td>(Rs/Tons)</td>
<td>750</td>
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<tr>
<td>23</td>
<td>Cost of Fuel</td>
<td>(22*23)/103</td>
<td>2448</td>
</tr>
<tr>
<td>24</td>
<td>Total variable cost</td>
<td>(Rs/KW/yr)</td>
<td>2448</td>
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</table>
Cost calculations in the Base year (2002)

26 PV of an annuity of Rs 1 for 20 years
\[ \frac{1-(1+r)^t}{r} \] (Rs) 7.47

27 PV of O & M costs for 20 years
(9*26) (Rs / KW) 6943

28 PV of 1 after 1.5 year
(Rs) 0.84

29 Present value (PV) of O & M Cost in 2002
(27*28) (Rs / KW) 5857

30 Sum of fixed Costs of power or MCC in 2002
(5+29) (Rs / KW) 36270

31 Annualized Life cycle fixed cost or Annualized MCC value
(8*30) (Rs / KW / yr) 4856

32 PV of annual variable costs for 20 years
(25*26) (Rs) 18285

33 PV of variable costs in 2002
(28*32) (Rs) 15427

34 Annualized Life cycle variable cost in 2002
(8*33) (Rs / KW / yr) 2065

35 Unit variable cost or MEC -at Busbar in 2002
(34/18) (Rs/kwh) 0.32

36 Annualized Life cycle cost of power or MCOC at
85 % Capacity Factor (at busbar) in 2002
31+34 or (Rs / KW / yr) 6921

37 Life Cycle Cost of Energy or MCOE
(at busbar) in 2002
(36/18) or (Rs/kwh) 1.08

Adjusting the (2002) costs to the availability of returns (2003):

38 Life cycle fixed Costs or MCC obtainable when plant
begins operation in 2003
(30 /28) (Rs) 42991

39 Annualized Life cycle fixed cost or
Annualized MCC value in 2003
(8*38) (Rs / KW / yr) 5756

40 Life cycle variable cost obtainable in 2003
(25/ 8) (Rs) 18285

41 Annualized Life cycle variable cost in 2003
(41* 8) (Rs / KW / yr) 2448

42 Unit variable cost or MEC (at busbar) in 2003
(41/18) (Rs/kwh) 0.38

43 Annualized Life cycle cost of power or MCOC at
80 % Capacity Factor (at busbar) in 2003
39+41 or (Rs / KW / yr) 8204

44 LIFE CYCLE COST OF ENERGY or MCOE
(At bus bar) in 2003
(39/(15/17)+42) (Rs/kwh) 1.28

The project envisages generation of power to meet captive sugar plant requirements and exports surplus power during both season and off-season to the state grid.

$ It is assumed that the total cost is evenly distributed to each year of the lead time and the plant would begin to be built in 2002 (no costs are yet sunk), initial expenditure would occur at the beginning of 2002, then the present worth in the year 2002 is thus calculated as 20655+10327/(1.12) \[ \frac{s}{12} = 30413 \]

# Figures in derivation represents serial no.s of parameter's values

III. BIOMASS GASIFIER BASED POWER PLANT

TECHNOLOGY USED: 100 PERCENT PRODUCER GAS ENGINE COUPLED WITH GASIFIER

Data Source: -Costs computed on the basis of Detail Project Report of M/S Saket Industrial Gases Ltd. URLA Industrial Area, Vill.Achkoli, Raipur, Chhattisgarh.

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Parameters</th>
<th>Derivation #</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>The Capital Cost at commissioning at 2002-03 prices</td>
<td>(Rs Crore)</td>
<td>2.1</td>
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<tr>
<td>2</td>
<td>Lead time</td>
<td>(Years)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Installed Capacity of the plant</td>
<td>(KW)</td>
<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>Capital Cost per KW rated capacity</td>
<td>(1*10^7/ 3) (Rs)</td>
<td>21000</td>
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</table>
5 Discount Rate (%) 12
6 Working Life of the plant (Years) 10
7 Capital Recovery Factor, @ 12%, 10 yrs. \( r \left[ \frac{1}{(1+r)^{10}} \right] \) 0.18
8 O & M COSTS (Rs/ KW / yr) 630
9 Capacity Utilization Factor 0.8
10 Electricity Generation (Kwh / KW/yr) 7008
11 Auxiliary Consumption (%) 5
12 Auxiliary Consumption factor (1/(1-11/100) 1.05
13 Net generation at bus bar (Kwh/KW yr) 6658

Variable Costs

Biomass (Rice Husk):
14 Amount of biomass required per kwh (kg) 2
15 Amount of biomass required per KW (10*14) (Kg) 14016
16 Price of Biomass (Rs/ MT) 650
17 Cost of Biomass (Rs/KW) 9110

Lubricating Oil:
18 Amount of oil required per kwh (ML) 1.06
19 Amount of oil required per KW (ML) 7446
20 Price of Oil (Rs/ L) 80
21 Cost of oil (Rs/KW) 596

22 Total variable cost (Rs / KW /Yr) 9706

Cost calculations in the Base year (2002)

23 PV of an annuity of Rs 1 for 10 years \( \frac{1-(1+r)^{10}}{r} \) (Rs) 5.7
24 PV of O & M costs for 10 years (8*23) 3560 3560
25 PV of 1 after 1year 0.89 (Rs) 0.89
26 Present value (PV) of O & M Cost in 2002 (24*25) (Rs / KW) 3178
27 Sum of fixed Costs of power or MCC in 2002 (4*26) (Rs / KW) 24178
28 Annualized Life cycle fixed cost or Annualized MCC value (7*26) (Rs / KW / yr) 4279
29 PV of annual variable costs for 20 years (22*23) (Rs) 54842
30 PV of variable costs in 2002 (25*29) 48966 48966
31 Annualized Life cycle variable cost in 2002 (7*30) (Rs / KW /yr) 8686
32 Unit variable cost or MEC -at Busbar in 2002 (31/13) (Rs/kwh) 1.30
33 Annualized Life cycle cost of power or MCC at 80 % Capacity Factor (at busbar) in 2002 (28+31) or (Rs / KW/yr) 12945
34 Life Cycle Cost of Energy or MCOE (33/13) or (Rs/kwh) 1.94
(at bus bar) in 2002 (28/(10/12)*32)

Adjusting the (2002) costs to the availability of returns (2003):

35 Life cycle fixed Costs or MCC obtainable when plant Begins operation in 2003 (27/25) (Rs) 27080
36 Annualized Life cycle fixed cost or (7*35) (Rs / KW / yr) 4793
Annualized MCC value in 2003
37 Life cycle variable cost obtainable in 2003 (22/7) (Rs) 54842
38 Annualized Life cycle variable cost in 2003 (37*7) (Rs / KW / yr) 9706
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Formula</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>39</td>
<td>Unit variable cost or MEC (at busbar) in 2003</td>
<td>(38/13) (Rs/kwh)</td>
<td>1.46</td>
</tr>
<tr>
<td>40</td>
<td>Annualized Life cycle cost of power or MCOC at 80% Capacity Factor (at busbar) in 2003</td>
<td>(36+38) or (36+(13*39)) (Rs/KW/yr)</td>
<td>14499</td>
</tr>
<tr>
<td>41</td>
<td>LIFE CYCLE COST OF ENERGY or MCOE (at busbar) in 2003</td>
<td>(40/13) or (36/(10/12)+39) (Rs/kwh)</td>
<td>2.18</td>
</tr>
</tbody>
</table>

# Figures in derivation represents serial nos of parameter's values

😊 Without Central Government Subsidy