


# OPEX Cost Estimate

## CO<sub>2</sub> Capture Facility

Kårstø, Norway

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### Attachments

- 1) Operating Cost (OPEX) estimate

## **1.0 General**

The estimate was prepared in accordance with the requirements of the following Contract Documents:

- Exhibit E1.1: Requirements for Cost Estimates and Capture Cost Calculation
- Exhibit E1.2: Cost Breakdown Structure

The Operating Expenditure (OPEX) Cost Estimates has been prepared to an accuracy of +/- 20% as required in the Contract documents.

## **2.0 OPEX Estimate**

### **2.1 General**

The OPEX estimate is provided in attachment number 1.

### **2.2 Data used in developing OPEX**

The following is a summary of the basis of the data used in the OPEX estimate:

- The average use time for utility consumption was estimated at 8105 hours per year. This includes allowances for CCPP outages and the 97% capacity factor for the CCC plant.
- 1: Utility Consumption:
  - Usage rates are based on the base case open-art design
  - Unit prices were provided from Gassnova except for price of condensate which was estimated based on our past experience
- 2: Consumables
  - Usage rates are based on the base case open-art design
  - Unit prices were obtained from Bechtel pricing database
- 3: Staff
  - Staffing levels are as outlined in the Bechtel/██████ document submittal 10112936-PB-O-DOC-0004 (Operating Staff Concept)
- 4: Maintenance cost
  - This was estimated as a percentage of capital costs as is typical for a FEED estimate.

- 5: Spare and Wear Parts
  - o This was estimated as a percentage of equipment costs, except for Absorber packing which was estimated separately based on input from packing suppliers.
- 6: Service cost to Gassco
  - o A cost of 8000,000 NOK/y was input per section 2.0 of Exhibit E1.1
- 7: Special Waste
  - o Usage for activated carbon and reclaimer sludge is based on the base case open-art design. Unit price was based on vendor pricing data.
- 8: Service Agreement with Naturkraft
  - o Cost to be determined by Gassnova per clause E2.2 of Exhibit E1.2
- 9: Taxes
  - o Cost to be determined by Gassnova per clause E2.2 of Exhibit E1.2
- 10: Land leasing cost
  - o Cost to be determined by Gassnova per clause E2.2 of Exhibit E1.2
- 11: Other costs
  - o Administration cost of 10,000,000 NOK/y was input per section 2.0 of Exhibit E1.1

### **3.0 OPEX Sensitivity/Risk Analysis**

The data on the OPEX Sensitivity/risk analysis is included in the CO<sub>2</sub> Capture Cost Calculation (document number: 10112936-PB-G-CRE-0003)

## Base Case: Open Art

	Usage Rate	Average Usage Time	Unit Price	Annual Cost (NOK 000s)
<b>1 Utility consumption</b>				
Electricity	32.0 MW	8,105 h	450 NOK/MWh	116,714
LP Steam	165 t/h	8,105 h	96 NOK/t	128,185
HP Steam	12 t/h	486 h	340 NOK/t	1,984
Natural Gas	708 kg/h	8,105 h	2.06 NOK/kg	11,814
Cooling Water Consumption	17,340 m <sup>3</sup> /h	8,105 h	0.10 NOK/m <sup>3</sup>	14,054
<u>Condensate Consumption</u>	<u>12.0 t/h</u>	<u>8,105 h</u>	<u>15.00 NOK/t</u>	<u>1,459</u>
<b>Utility Consumption</b>				<b>274,211</b>
<b>2 Consumables</b>				
MEA consumption				2,656
MEA lost through absorber	15.6 kg/h	8,105 h	14,310 NOK/t	1,807
MEA consumption from reclaimer	122.0 kg/h	486 h	14,310 NOK/t	849
Soda Ash Cost Consumption	35.0 kg/h	486 h	1,590 NOK/t	27
<u>Nitrogen Gas Cost Consumption</u>	<u>4.45 m<sup>3</sup>/h</u>	<u>8,105 h</u>	<u>5.30 NOK/m<sup>3</sup></u>	<u>191</u>
<b>Consumables Cost</b>				<b>2,874</b>
<b>3 Staff</b>				
Spec Workers	15 people	1 year	775 kNOK/y	11,625
Shift Leaders	5 people	1 year	950 kNOK/y	4,750
Secretaries	1 people	1 year	500 kNOK/y	500
Accounting	9 people	1 year	560 kNOK/y	5,040
<u>Heads of CCC</u>	<u>1 people</u>	<u>1 year</u>	<u>1,200 kNOK/y</u>	<u>1,200</u>
<b>Staff Cost</b>				<b>23,115</b>
<b>4 Maintenance cost</b>				
Maintenance Cost	n/a	1 year	55,893 kNOK/y	55,893
<b>5 Spare and wear parts</b>				
Average Absorber Packing*	n/a	1 year	1,749 kNOK/y	1,749
<u>Spare Parts</u>	<u>n/a</u>	<u>1 year</u>	<u>11,925 kNOK/y</u>	<u>11,925</u>
<b>Spare and wear parts</b>				<b>13,674</b>
<i>*The absorber packing costs will not be the same every year. See the financial model for the estimated repacking schedule</i>				
<b>6 Service cost to GASSCO</b>				
Services from GASSCO	n/a	1 year	8,000 kNOK/y	8,000
<b>7 Special waste</b>				
Activated Carbon	29.8 kg/h	8,105 h	3,000 NOK/t	724
<u>Reclaimer Sludge</u>	<u>171.0 kg/h</u>	<u>486 h</u>	<u>3,000 NOK/t</u>	<u>249</u>
<b>Waste Disposal</b>				<b>973</b>
<b>8 Service Agreement with Naturkraft</b>				
To be determined by Gassnova				0
<b>9 Taxes</b>				
by Gassnova				0
<b>10 Land Leasing cost</b>				
by Gassnova				0
<b>11 Other costs</b>				
Administration	n/a	1 year	10,000 kNOK/y	10,000
<b>12 Total Operating Costs</b>				
<b>Total</b>				<b>388,741</b>