CAPEX and OPEX - ESTIMATE REPORT

Rev.	Date	Description	Prepared	Checked	Approved
1	05/03/2021	Final Issue	M.Balsamini	R.Corradi	G.Catini
0	18/12/2020	Final Issue	M.Balsamini	R.Corradi	G.Catini
A	07/12/2020	Issue for review	M.Balsamini	R.Corradi	G.Catini

TABLE OF CONTENTS

1. INTRODUCTION

1.1 FOREWORD

In the context of negative emissions and decarbonizing industry, carbon capture and storage (CCS) is being discussed as an option for Switzerland. The search for domestic storage sites is ongoing, in the meantime, there could be a possibility of collecting Swiss CO2 and sending it to storage sites under the North Sea, that are planned to open by end of 2024 (Northern Lights project by Equinor, Shell, Total).

In Switzerland, KVA Linth is currently performing a feasibility study for a capture plant with a potential provider, other emitters are also exploring cost and feasibility.

Saipem has been awarded for the feasibility and cost estimate of building a "collection network" (similar to a distribution grid for gas) to connect to Switzerland's largest CO2 emitters on the one hand and to transmission pipelines on the other hand by 2030.

Switzerland has currently 32 large emitters, defined as point sources that emit over 100,000 tons/y of CO2 (see Figure 1.1.1). Together, these 32 large emitters emit about 7 million tons of CO2 per year.

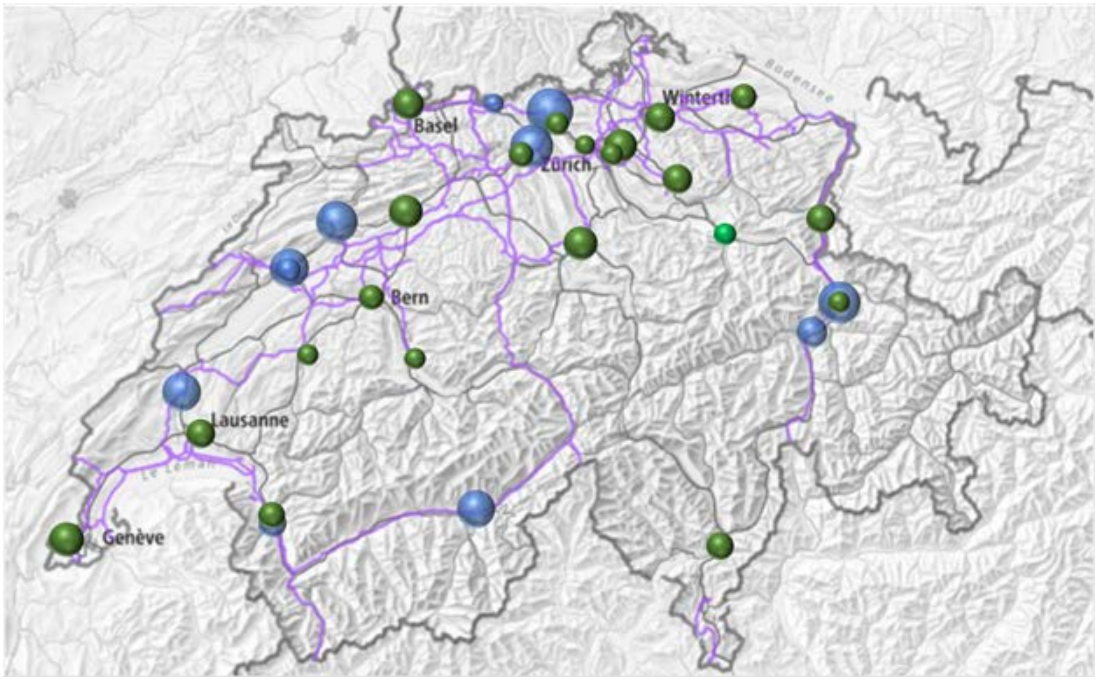

Figure 1.1.1: Large emitters and current natural gas pipeline network in Switzerland

Currently, none of these plants has a capture facility – it is expected that the current study should provide an indication of optimal conditioning parameters (water content and purity) for the CO2.

The CO2 collecting network subject of the present study will transport the captured CO2 stream up to a delivery point, from where a long transmission pipeline will deliver the CO2 to a selected location, for final sequestration.

Two options are possible:

- Transmission towards the North could start in Basel
- Transmission towards South should be assumed to be in Collombey, where an existing oil pipeline leads to Genoa

The transmission pipeline is not part of the current SoW.

It is requested that the new pipeline network to follow the existing natural gas pipelines corridors as much as possible. A specific effort shall be made to clarify possible configurations for the Kanton of Zurich, where different scenarios are possible to connect additional smaller point sources.

1.2 SCOPE

The purpose of the present document is to describe the methodology used for the Estimate for all solution studied in the Pipeline System Hydraulic & Optimization Study Report Doc. No. 000-ZA-E-09001 Rev.A, which are:

Gaseous Phase Transport - Base Case

Gaseous phase transport is with a maximum operating pressure of 35 barg. This is the maximum pressure level ensuring no liquid formation associated to phase change in the pipeline thus allowing single phase stable transport (i.e. purely gas). This solution has the advantage to keep quite low pressures in the system, however large diameters could be required in case of high flowrates. Due to safety reasons, some flowlines crossing urban areas are considered with a MOP = 10 barg (i.e. low pressure flowlines).

Gaseous Phase Transport - Low Pressure Flowlines MOP = 5 barg

This configuration is as per base case above, with the difference that the maximum operating pressure for the low pressure flowlines is 5 barg instead of 10 barg.

Gaseous (No LP flowlines)

This configuration is as per base case above, but considers the possibility to install high pressure flowlines (i.e. MOP = 35 barg) also in urban areas.

Dense Phase Transport.

Dense phase transport is with as maximum operating pressure of 145 barg. Dense phase transport for CO2 is particularly efficient, as the CO2 in dense phase conditions shows the density of a liquid and the viscosity similar to a gas, however this solution involves higher compression requirements. A maximum design pressure of 150 barg is considered being the limit for rating #900: higher operating pressures are technically feasible, however they will have higher compression cost and probably permission issues. In order to keep the CO2 in dense phase, a minimum pressure of 85 barg is to be maintained along the lines

Gaseous phase transport is foreseen in low pressure flowlines (MOP=10 barg) and in some pipeline sections where dense phase transport is deemed not feasible due to safety reasons (in these sections the MOP is fixed to 35 barg).

1.3 DEFINITIONS

The abbreviations when used in this document will have the meanings described here in the following list:

COMPANY/OWNER	VBSA
CONTRACTOR	Saipem S.p.A.
PROJECT	CO2 COLLECTION NETWORK CONCEPTUAL STUDY

1.4 ABBREVIATIONS

API	American Petroleum Institute
ATCI	Actualized Transport Cost Index
CAPEX	Capital Investment Cost
CCS	Carbon Capture and Storage
CS	Compression Station
DF	Design Factor
DP	Design Pressure
d/s	Downstream
HDPE	High Density Polyethylene
ESDV	Emergency Shut Down Valve
HP	High Pressure
KM	Kilometre
KP	Kilometre Post
LP	Low Pressure
MOP	Maximum Operating Pressure
MOT	Maximum Operating Temperature
MM	Million
NPS	Nominal Pipe Size
OD	Outside Diameter
OPEX	Operating Cost
PE	Polyethylene
SCADA	Supervisory Control and Data Acquisition
SMYS	Specified Minimum Yield Strength
WT	Wall Thickness

2. COST ESTIMATIONS

The estimates are based on budgetary costs available at present in Saipem databases from similar project in Oil and Gas field of application executed in Europe zone as well as from available publications.

No formal inquires to vendors and subcontractors have been required for material supply cost, transport and construction.

2.1.1 CAPEX

The Facilities Costs represent the EPC Contractor's Budget Price required to execute the Engineering, Procurement and Supply, Construction, Pre-commissioning and Commissioning operations for the Project.

Land Fee and Transit costs have been added in a separate section as intended to be manage by COMPANY as owner cost.

2.1.2 OPEX - Operating & Maintenance Costs

Operating and maintenance costs have been estimated according to the following assumptions:

- Pipeline Maintenance: 1.50% of total Pipeline CAPEX
- CS Operation & Maintenance: 4.00% of total CS CAPEX
- Energy Cost: 100 €/MWh (a compressor station utilization factor of 90% is assumed)

2.1.3 ACCURACY

The Cost Estimation has the accuracy of the Estimate is a Class 5, in accordance with table here below, and the level of maturity of technical and design information.

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low(L), and high(H) ranges[a]
Class 5	0% to 2%	Conceptual planning	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Screening options	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Funding authorization	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Project control	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Fixed price bid check estimate	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of technology, availability of applicable reference cost data and many other risks affect the range markedly. The +/- Values represent typical percentage variation of actual costs from the cost estimate after application of contingency [3] (typically at a 50% level of confidence) for given scope.

3. BASIC DATA

3.1 HOME OFFICE SERVICES

Home Office Services cost including Project Management, basic and detail Engineering, Procurement activities, subcontracts engineering studies can be considered.

- Pipeline Engineering: 4 % of total Pipeline Section
- Station Engineering: 9 % of total Station Section

3.2 MATERIALI SUPPLY ESTIMATION COST

3.2.1 Pipeline Materials Costs

- Line Pipes (material only): 1.8€/kg (ISO3183 L450MB - API5L X65 steel grade is considered, no significant savings are expected if using lower steel grades, typically used in low pressure gas lines)
- Internal Lining: N/A
- External Coating: 23 €/m^2 (3mm PE)
- Cathodic Protection: 2.4 €/m
- Valves, Scraper Traps, etc.: 6% of line pipe material
- SCADA/Telecommunication: 21 €/m

3.2.2 Compression Station Materials Costs

Material of Compression Station has been estimated starting from internal database for similar project for Oil & Gas.

In the below table 1, the cost of 1 compression unit is reported for the 4 possible compression configurations and for different classes, each one corresponding to a different maximum flowrate.
The installed power of each compression unit is reported in Table 2.

Table 1: Compressor Unit Cost

	Max rate	Compression from 0 to 20 bar (gas phase)	Compression from 0 to 40 bar (gas phase)	Compression from 10 to 140 bar (dense phase)	Compression from 0 to 140 bar (dense phase)
	ktons/y	*MM€*	*MM€*	*MM€*	*MM€*
Class 1	200	2.1	3.1	2.6	4.1
Class 2	300	2.4	3.6	3.0	4.8
Class 3	400	2.7	4.0	3.4	5.4
Class 4	500	3.0	4.5	3.8	6.1

Table 2: Compressor Unit Installed Power

	Max rate	Compression from 0 to 20 bar (gas phase)	Compression from 0 to 40 bar (gas phase)	Compression from 10 to 140 bar (dense phase)	Compression from 0 to 140 bar (dense phase)
	ktons/y	*MW*	*MW*	*MW*	*MW*
Class 1	200	1.4	2.1	1.5	2.7
Class 2	300	2.4	3.5	2.5	4.6
Class 3	400	3.3	4.9	3.5	6.4
Class 4	500	4.2	6.4	4.5	8.2

Here below the remaining compression station supply costs are listed:

- Dehydration Unit: 0.4 million €
- Appurtenances (piping, utilities, instrumentation, etc.) 150% of compressor unit (gas phase)
  200% of compressor unit (dense phase)
- Rotating parts: 30% of Gas Compressor Trains
  (15 years expected lifetime)
- Electric Sub-station cost: 1.5 million € (1+0 spare philosophy)
  5 million € (2+1 spare philosophy)

3.2.3 Compression Stations at Delivery Points Material Costs

In the below Table 3, the cost of 1 compression unit is reported for the export stations at Basel and Collombey, with compression from gas or dense phase. In all cases a spare philosophy of 3+1 is considered. No dehydration unit is foreseen at the export stations, since the CO2 coming from the gathering network is already dehydrated.

Table 3: Compressor Unit Installed Power

	Compressor Unit Max Rate	Compressor Unit Power	Compressor Unit Cost
	ktons/y	*MW*	*MM€*
Basel Export CS from gas phase (10 to 145 bar)	2510	24.8	11.7
Collombey Export CS from gas phase (10 to 145 bar)	1800	17.8	9.0
Basel Export CS from dense phase (100 to 145 bar)	2510	1.25	1.6
Collombey Export CS from dense phase (100 to 145 bar)	1800	1.25	1.6

The following investment costs are considered in case of compression from gas phase (10 to 145 bar):

- Appurtenances (piping, utilities, instrumentation, etc.) — 50 MM€ in Collombey CS; 60 MM€ in Basel CS
- Rotating parts: — 30% of Gas Compressor Trains (15 years expected lifetime)
- Electric Sub-station cost: — 28 MM€

The following investment costs are considered in case of compression from dense phase (100 to 145 bar):

- Appurtenances (piping, utilities, instrumentation, etc.) — 200% of compressor unit
- Rotating parts: — 30% of Gas Compressor Trains (15 years expected lifetime)
- Electric Sub-station cost: — 5 MM€

3.3 CONSTRUCTION AND INSTALLATION ESTIMATION COST

3.3.1 Pipeline Construction Costs

Pipeline Laying and Assembling cost: 55 €/inch/m in hilly terrain (most of the system)
90 €/inch/m in mountain/challenging areas (Lonza and Giubiasco flowlines)

The above Costs should be intended as inclusive of Installation of Cathodic Protection, Block Valve Station , Scraper Traps, SCADA, and telecommunication system.

Pipeline Construction Cost should be intended as inclusive of SITE MANAGEMENT and SUPERVISION (QA, HSE ect.)

3.3.2 Compressor Station Construction Costs

In accordance with the level of accuracy of estimation and in line with our experience and our cost database, construction cost of Compressor Station has been estimated as:

- 35% of Construction plus Material Supply for compressor stations of the gathering network;
- 100% of Construction plus Material Supply for the compressor stations at delivery points.

Construction Cost should be intended as inclusive of SITE MANAGEMENT and SUPERVISION (QA, HSE ect.)

3.4 COMMISSIONING

Commissioning works have been estimated in accordance with the following percentage:

- Pipeline Commissioning: 0.5 % of total Pipeline material + construction cost
- Station Commissioning: 1.5 % of Station material + construction cost

3.5 GENEVA LAKE (OFFSHORE) PIPELINE COSTS

Parameters used for a budgetary cost estimate of the Geneva Lake offshore section are reported here below.

- Line Pipes (material only): 1.8€/kg
- Buckle Arrestors: 10% of line pipe cost
- External Coating: 26 €/m^2
- Anodes Cost: 6300 €/ton (1% of line pipe material)
- Concrete Cost: 735 €/ton (concrete thickness = 6 cm - assumed)
- Installation time (S-lay rate): 7.5 km/day + 4 days for startup + 7 days for pull-in
- Laying cost: 500,000 €/day
- Engineering + Survey Cost: 5 million €
- Precomm. + Testing Cost: 5 million €
- Intervention Cost: 10% of Total Cost
- Mob/Demob Cost: 37.5 million €

4. OTHER TRANSPORT SYSTEM COMPONENTS

4.1 METERING AND PIGGING STATIONS

Metering stations can be installed at compression facilities, including filters and metering lines, in a suitable arrangement to measure the flow as per actual state of-the-art.

Please note that these system components are not included in the present CAPEX/OPEX Estimation

4.2 TECHINCAL ALLOWANCE

The Estimate is inclusive of the technical allowance to cover all technical uncertainties related to material supply and construction.

- ALLOWANCEs: 15 % of total investment cost

4.3 ESCALATION

The present Capex has been developed on today's cost, based on current cost data and the escalation not included.

4.4 EXCLUSION

The present cost estimate does not include, due to unavailable information at this stage of the project, the following costs:

- Financing Costs;
- Custom Duties, Taxes and VAT;
- Any other OWNER Cost except Land Fee and Transit costs;
- Currency Risks;
- Escalation/market conditions;
- Any costs associated to specific Company's terms and conditions;
- All Weather stand-by cost for Offshore Pipeline Section.

4.5 CAPEX AND OPEX BREAKDOWN STRUCTUREs

The calculations for CAPEX and OPEX costs are reported here below for the four different scenarios listed in Appendix 1.2 Scope of these present documentation.

Gaseous Phase Transport - Base Case

Gaseous - Base case	Pipeline (MM€)		Compressor Stations (MM€)	
Engineering	**52.2**		**71.8**	
East	21.4		44.7	
West	30.9		27.1	
Material Supply	**242.9**		**466.5**	
Pipeline			**-**	
Pipeline East	103.4		-	
Pipeline West	139.5		-	
CS				
CS East			290.3	
CS West			176.2	
Construction Comm & Supervision	**1,159.8**		**261.9**	
East	430.6		156.3	
West *	722.7		94.9	
Commissioning East	2.7		6.7	
Commissioning West	3.9		4.1	
Cost	**1,454.9**		**800.2**	
Fee and Transit	62.7		-	
Allowances	251.9		141.2	
Total Cost (CAPEX)	**1,769.5**		**941.4**	

* Offshore Section(30", 16 KM) included

Total OPERATING COST	**26.5**	**111.3**

Gaseous Phase Transport - Low Pressure Flowlines MOP = 5 barg

Gaseous - LP flowlines MOP=5bar	Pipeline (MM€)		Compressor Stations (MM€)	
Engineering	**52.9**		**71.8**	
East	21.7		44.7	
West	31.2		27.1	
Material Supply	**245.3**		**466.5**	
Pipeline			**-**	
Pipeline East	104.8		-	
Pipeline West	140.6		-	
CS				
CS East			290.3	
CS West			176.2	
Construction Comm & Supervision	**1,173.7**		**261.9**	
East	436.9		156.3	
West *	730.3		94.9	
Commissioning East	2.7		6.7	
Commissioning West	3.9		4.1	
Cost	**1,471.9**		**800.2**	
Fee and Transit	63.5		-	
Allowances	255.0		141.2	
Total Cost (CAPEX)	**1,790.4**		**941.4**	

* Offshore Section(30", 16 KM) included

Total OPERATING COST	**26.9**	**115.0**

Gaseous (No LP flowlines)

Gaseous No LP flowlines	Pipeline (MM€)		Compressor Stations (MM€)	
Engineering	**51.9**		**58.2**	
East	21.1		34.8	
West	30.7		23.4	
Material Supply	**241.5**		**378.2**	
Pipeline			**-**	
Pipeline East	102.5		-	
Pipeline West	139.1		-	
CS				
CS East			226.0	
CS West			152.2	
Construction Comm & Supervision	**1,152.4**		**212.4**	
East	425.9		121.7	
West *	720.0		82.0	
Commissioning East	2.6		5.2	
Commissioning West	3.8		3.5	
Cost	**1,445.8**		**648.8**	
Fee and Transit	62.3		-	
Allowances	250.2		114.5	
Total Cost (CAPEX)	**1,758.3**		**763.2**	

* Offshore Section(30", 16 KM) included

Total OPERATING COST	**26.4**	**95.6**

Dense Phase Transport.

Dense Phase Transport	Pipeline (MM€)	Compressor Stations (MM€)
Engineering	**36.0**	**111.4**
East	13.6	65.4
West	22.4	46.0
Material Supply	**196.9**	**724.3**
Pipeline		-
Pipeline East	75.5	-
Pipeline West	121.4	-
CS		
CS East		425.2
CS West		299.2
Construction Comm & Supervision	**781.0**	**406.7**
East	264.1	228.9
West *	512.4	161.1
Commissioning East	1.7	9.8
Commissioning West	2.8	6.9
Cost	**1,014.0**	**1,242.5**
Fee and Transit	43.2	-
Allowances	173.7	219.3
Total Cost (CAPEX)	**1,230.9**	**1,461.7**

* Offshore Section(16", 16 KM) included

Total OPERATING COST	**18.5**	**174.9**

Export CS at Delivery Points

Export CS at Delivery Points from Gas Phase	Compressor Stations (MM€)	
Engineering	**33.2**	
Basel CS	18.2	
Collombey CS	15.0	
Material Supply	**248.8**	
Basel CS	134.8	
Collombey CS	114.0	
Construction Comm & Supervision	**87.8**	
Basel CS	46.8	
Collombey CS	36.0	
Commissioning Basel CS	2.7	
Commissioning Collombey CS	2.3	
Cost	**369.7**	
Allowances	65.2	
Total Cost (CAPEX)	**435.0**	
Total OPERATING COST	**59.2**	

Export CS at Delivery Points from Dense Phase	Compressor Stations (MM€)	
Engineering	**6.2**	
Basel CS	3.1	
Collombey CS	3.1	
Material Supply	**48.7**	
Basel CS	24.4	
Collombey CS	24.4	
Construction Comm & Supervision	**13.8**	
Basel CS	6.5	
Collombey CS	6.5	
Commissioning Basel CS	0.5	
Commissioning Collombey CS	0.5	
Cost	**68.7**	
Allowances	12.1	
Total Cost (CAPEX)	**80.8**	
Total OPERATING COST	**5.2**	