Petroleum User Group Conference 2007

Logistics Intelligence Applied to

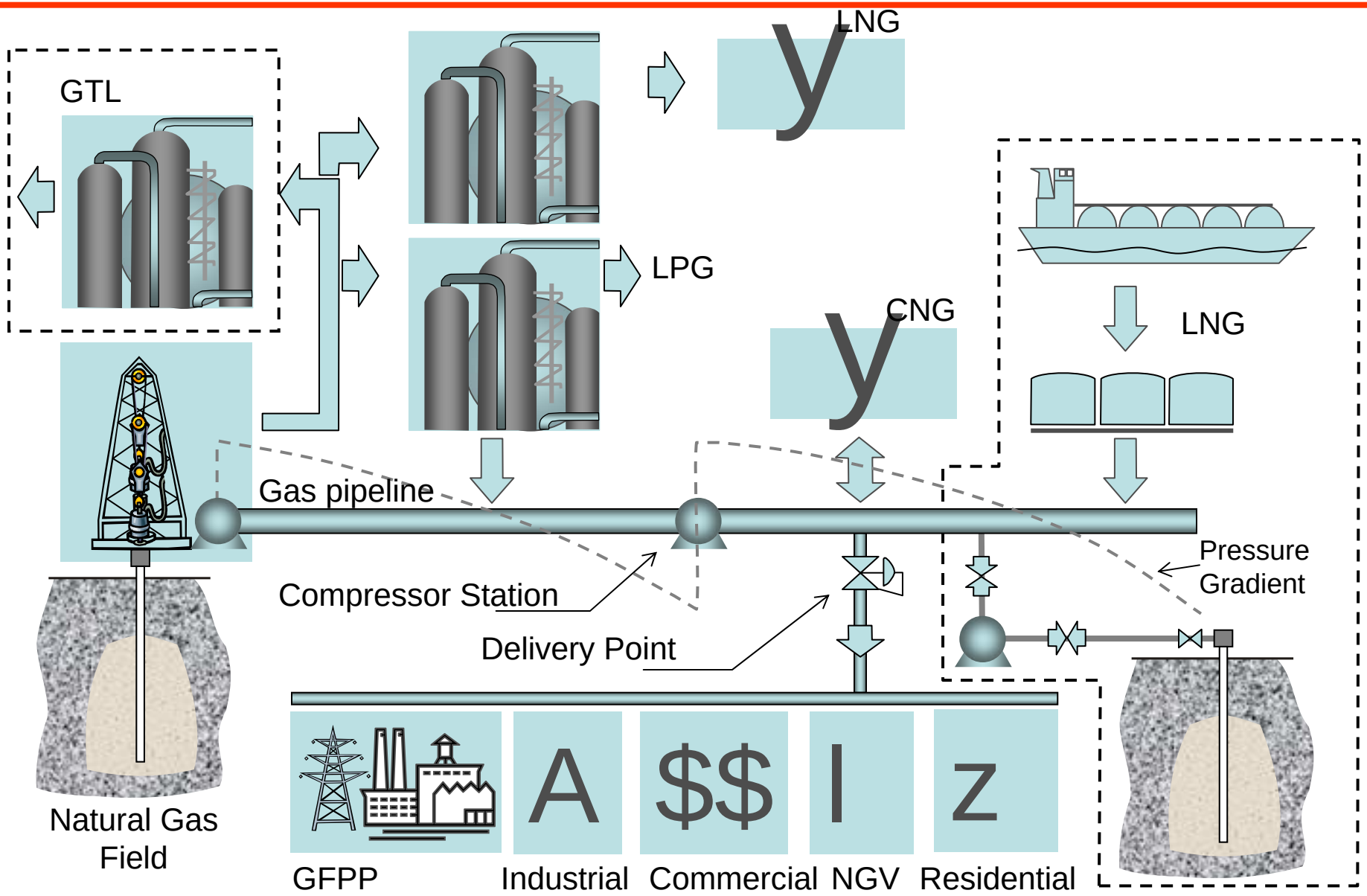
Natural Gas Business

Sidney Pereira dos Santos - Senior Consultant
Renato Cabral - GIS Consultant
Italo Madeira – Mechanical Engineer

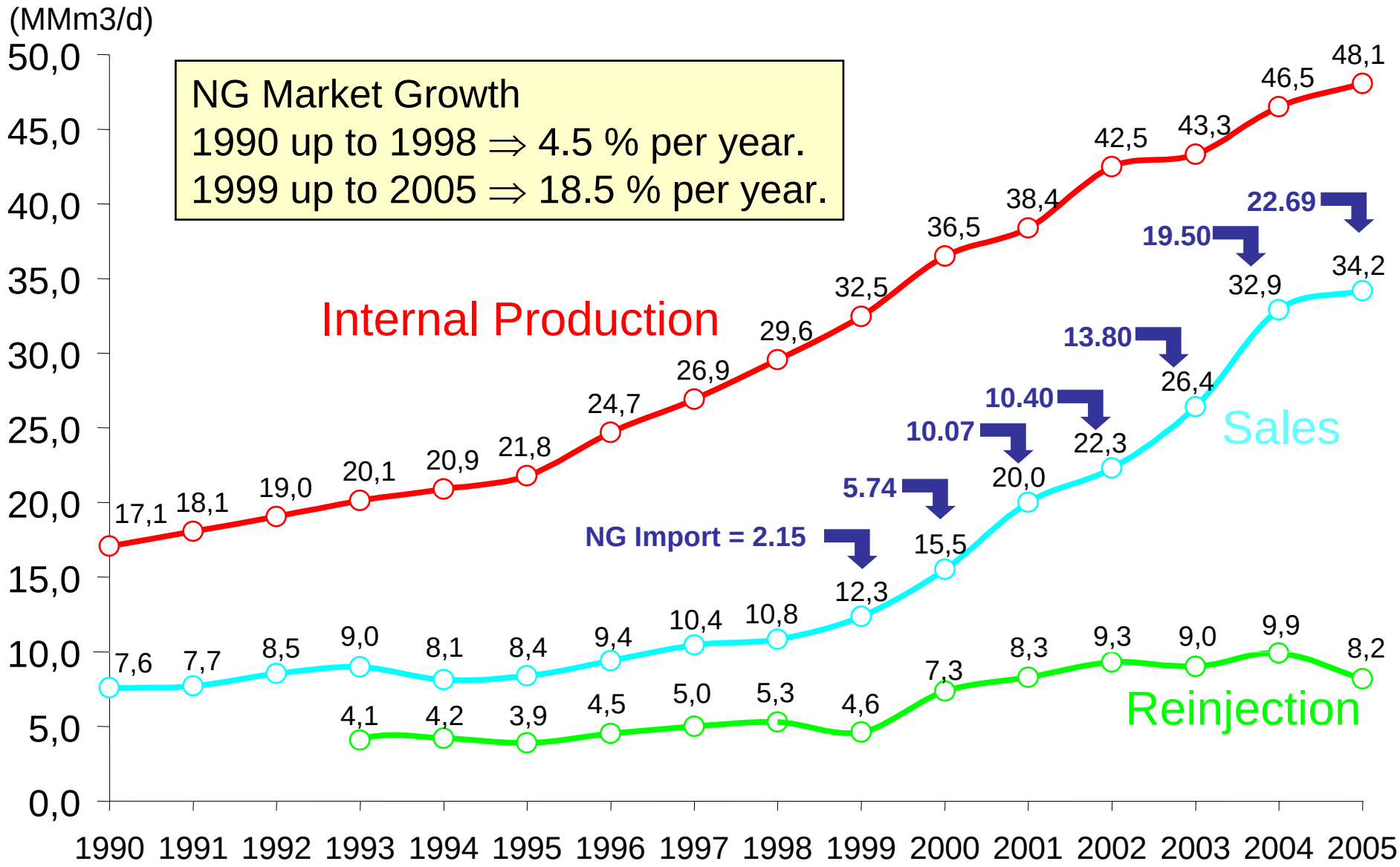
PETROBRAS

February 27th, 2007

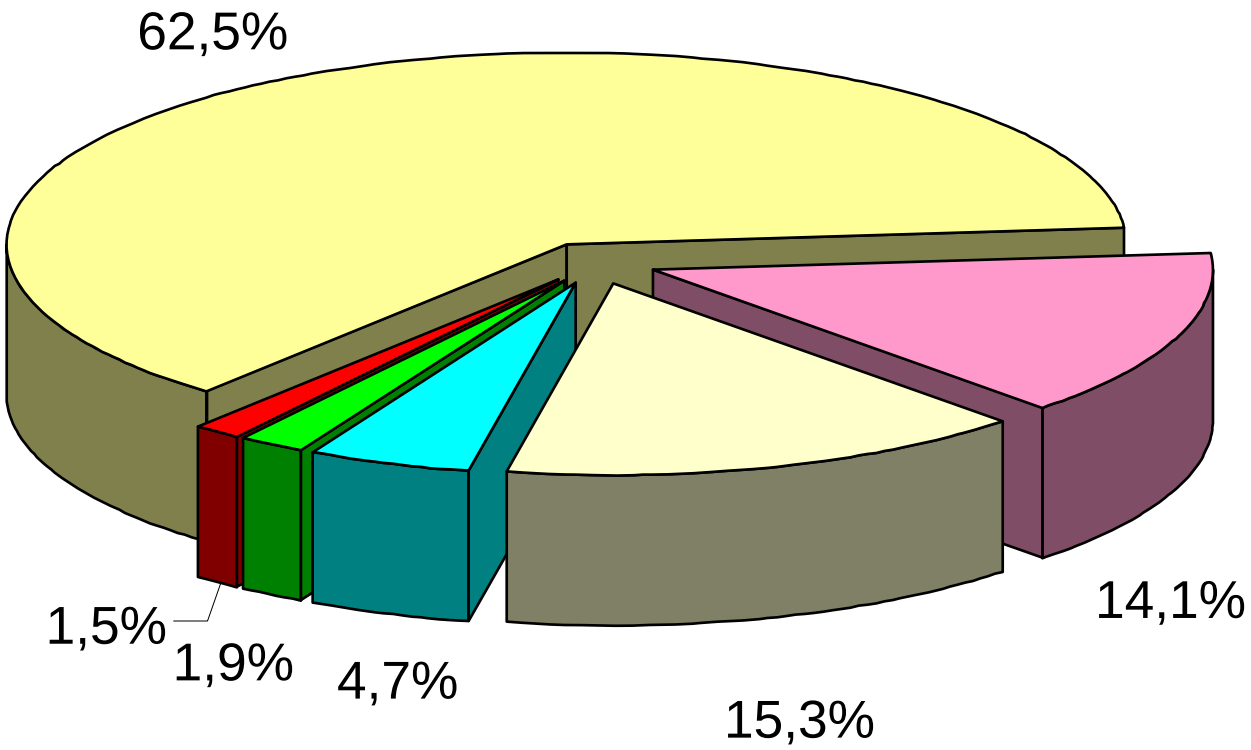
Brazilian Natural Gas Business



Natural Gas Market in Brazil



Natural Gas Market in Brazil – March 2005

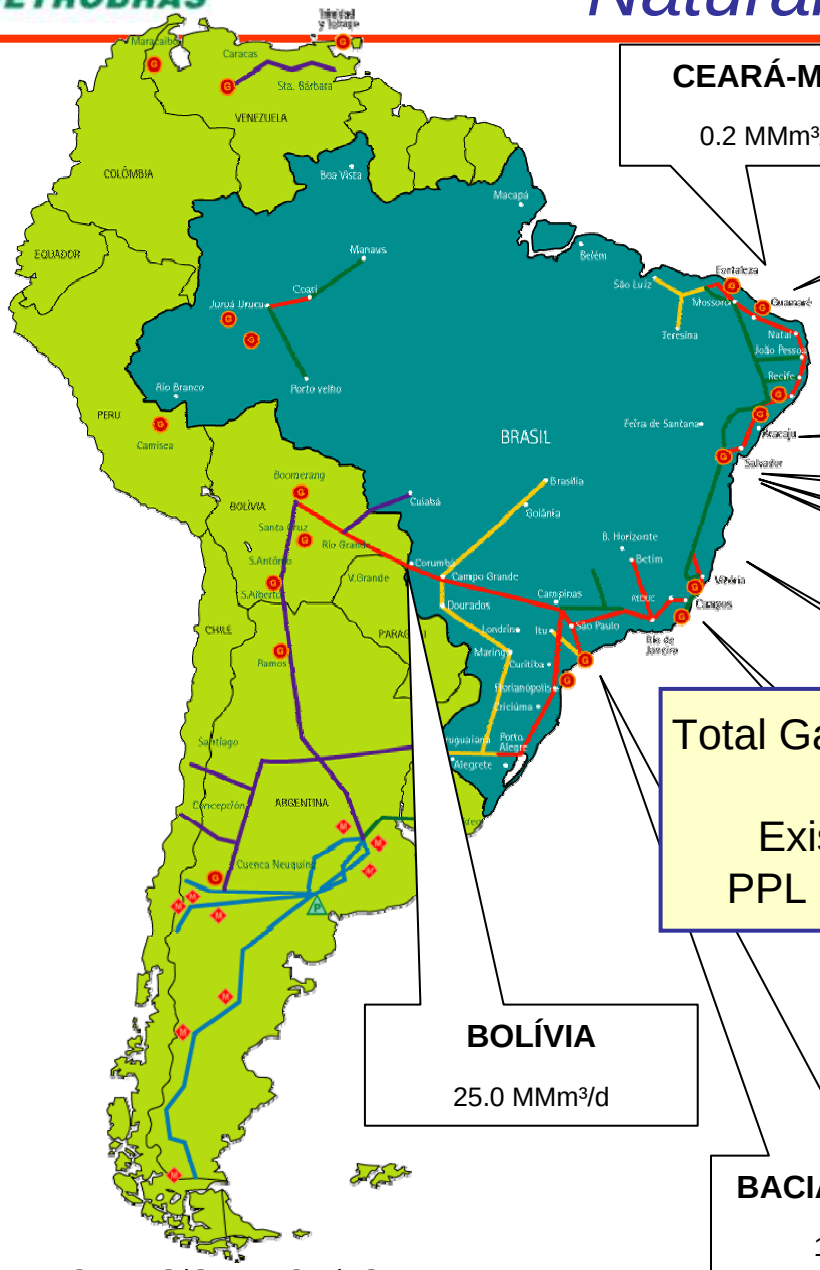


Total = 39.57 MMm3/d

Industrial | Power Generation | NGV | Cogeneration | Residential | Commercial

Source: Brasil Energia, June 2006

Natural Gas Supply



CEARÁ-MAR

0.2 MMm³/d

GUAMARÉ

2.1 MMm³/d

PILAR

1.4 MMm³/d

ATALAIA

1.6 MMm³/d

SÃO FRANCISCO do CONDE (MANATI)

2.0 MMm³/d

CANDEIAS

2.0 MMm³/d

SANTIAGO

2.6 MMm³/d

LAGOA PARDA

1.9 MMm³/d

BACIA DE CAMPOS

14.0 MMm³/d

BACIA DE SANTOS

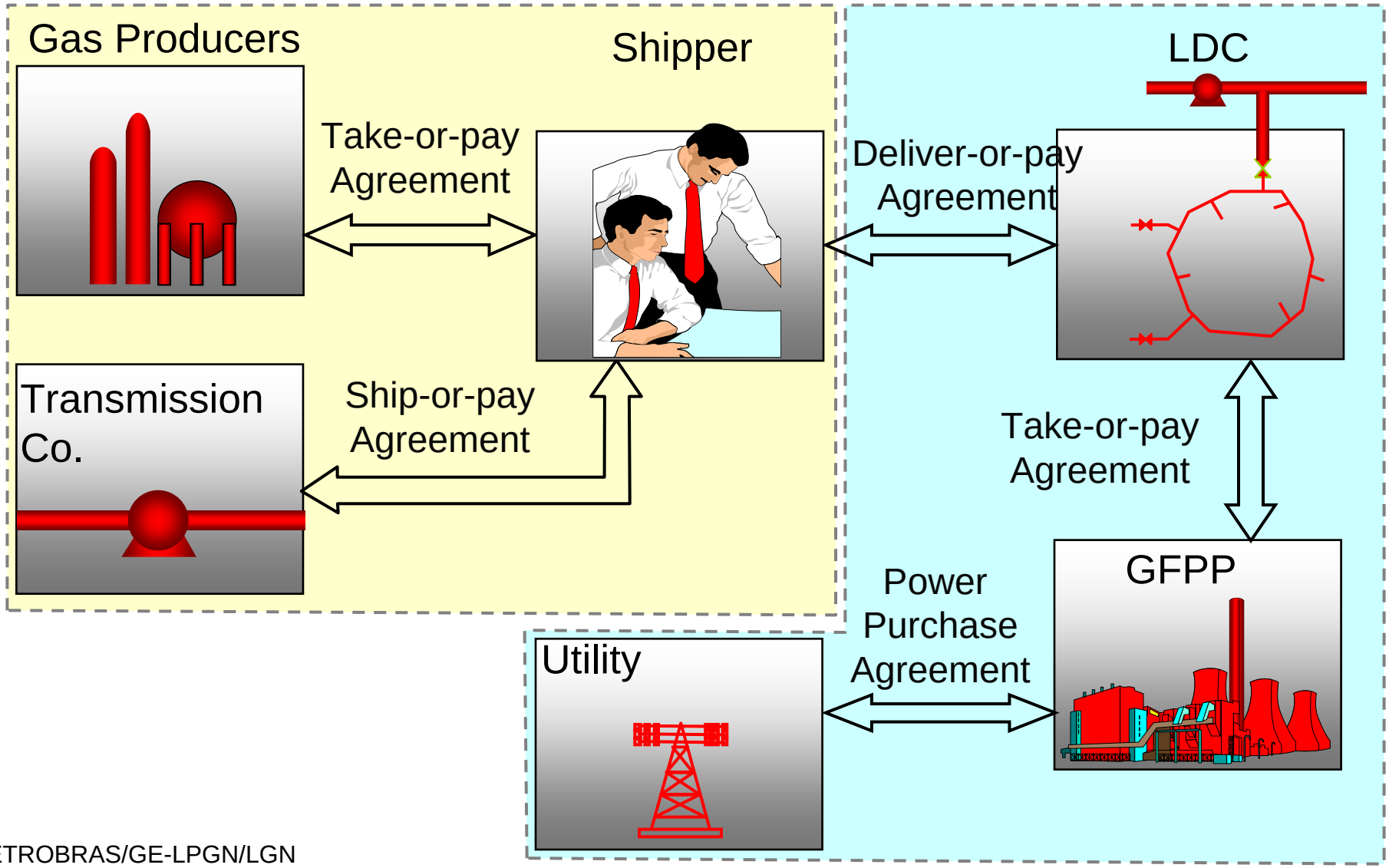
1.1 MMm³/d

BOLÍVIA

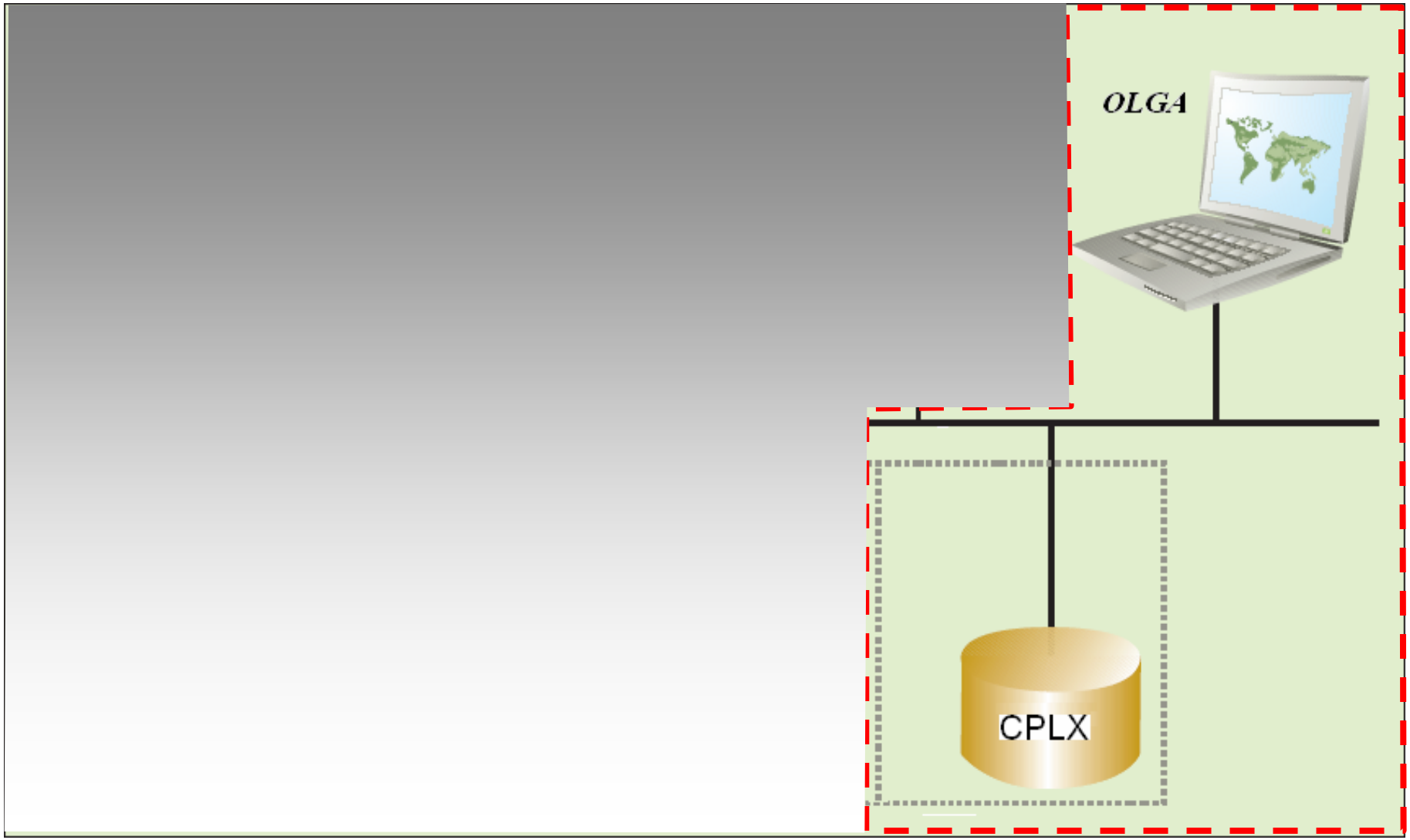
25.0 MMm³/d

Total Gas Supply = 53.9 MMm3/d
(1,903 MMSCFD)
Existing PPL = 5,845 km
PPL Expansion = 3,880 km

Business Chain



Transmission Logistics Management System



Transmission Logistics Management System

OLGA

- Business Modeling
- Linear Programming

Scenario Builder

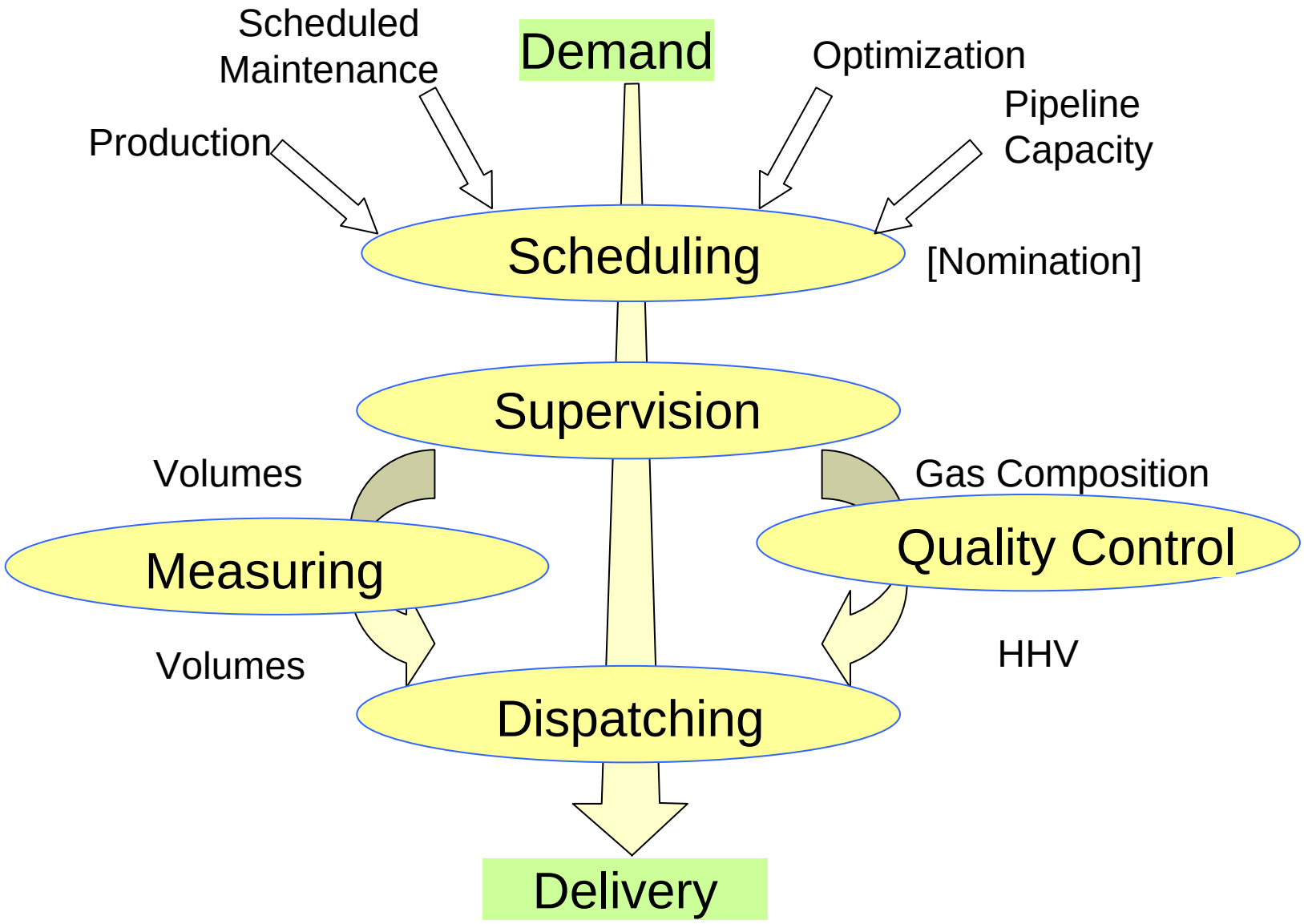
- GIS System
- Pipeline Data Model - APDM
- Pipeline Hydraulic Simulator (SS, TS)
- Easy and friendly Interface

Transmission Logistics Management System

Linear Programming addresses:

- Gas supply shortage
- GFPP dispatch
- Schedule maintenance
- Gas nomination management
- Operation contingencies
- Business model
  - Agreements and liabilities
  - Governmental directives
- Scenario forecasting

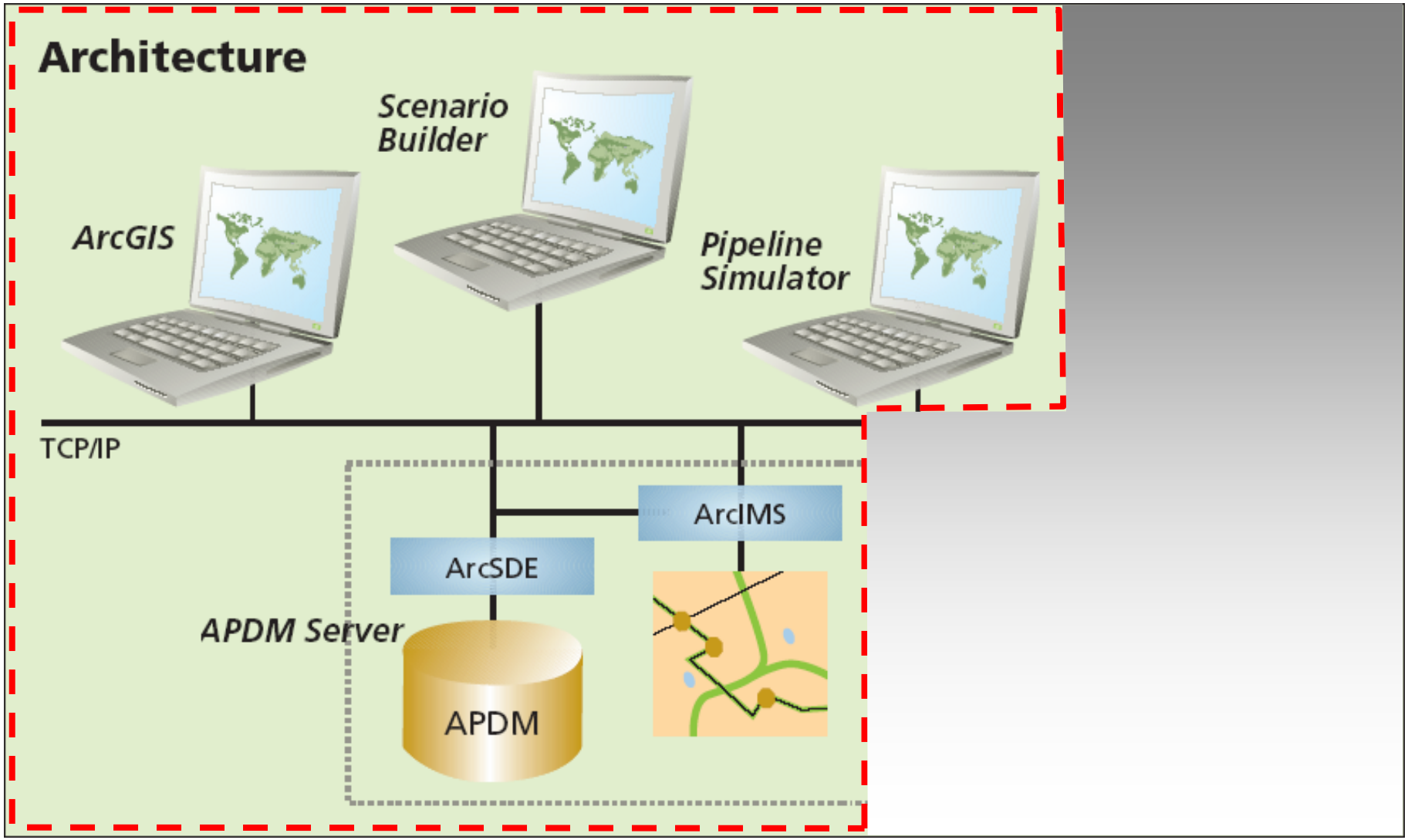
OLGA


Scheduled Maintenance
Demand
Optimization
Pipeline Capacity
Production
Scheduling
[Nomination]
Supervision
Volumes
Gas Composition
Measuring
Quality Control
Volumes
HHV
Dispatching
Delivery

Reporting

- Gas optimized dispatching
- Commercial results
- Liabilities
- Restrictions
- Performance

Transmission Logistics Management System



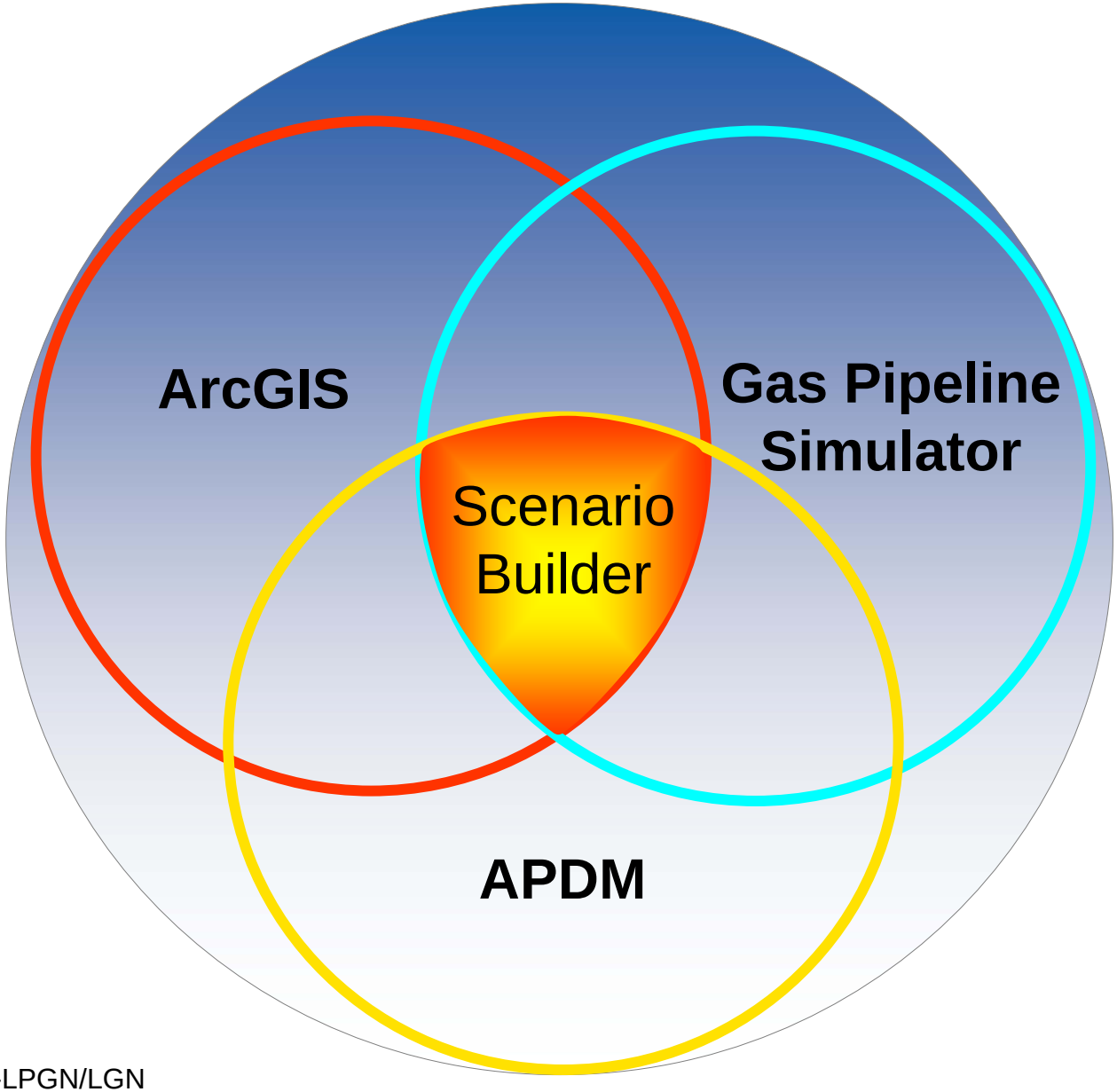
OLGA

- Business Modeling
- Linear Programming

Scenario Builder

- GIS System
- Pipeline Data Model - APDM
- Pipeline Hydraulic Simulator (SS, TS)
- Easy and friendly Interface

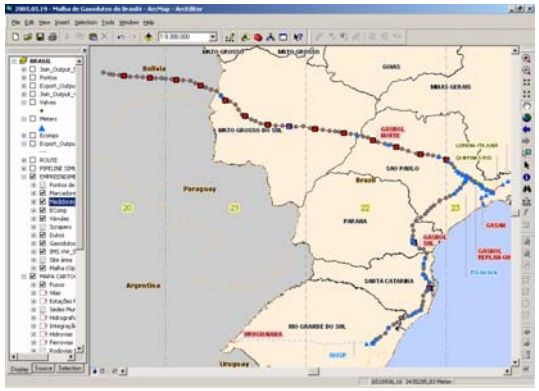
Scenario Builder Functionality



Scenario Builder

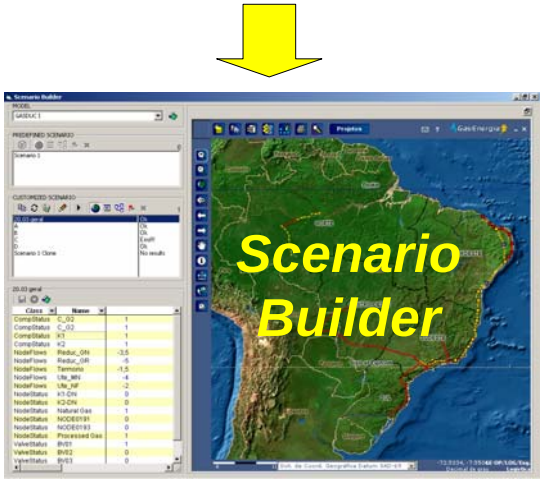
- Thermo-hydraulic Simulation
- Pipeline Expansion Planning
- Scalability
- Flexibility
- Schematic vs Geographic Interface
- Corporate wide
- IT - compliant

Scenario Builder



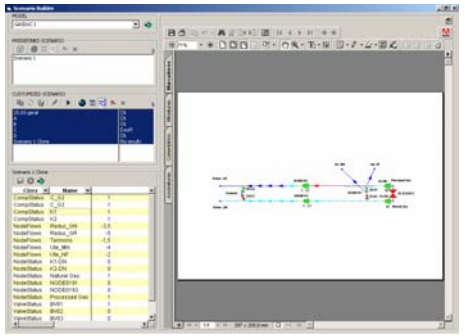
GIS + APDM

Pipeline Simulator Models

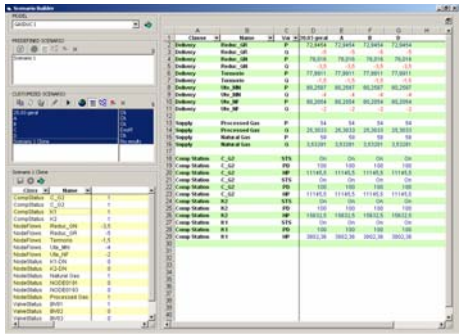


Geographic Interface

Schematic Interface

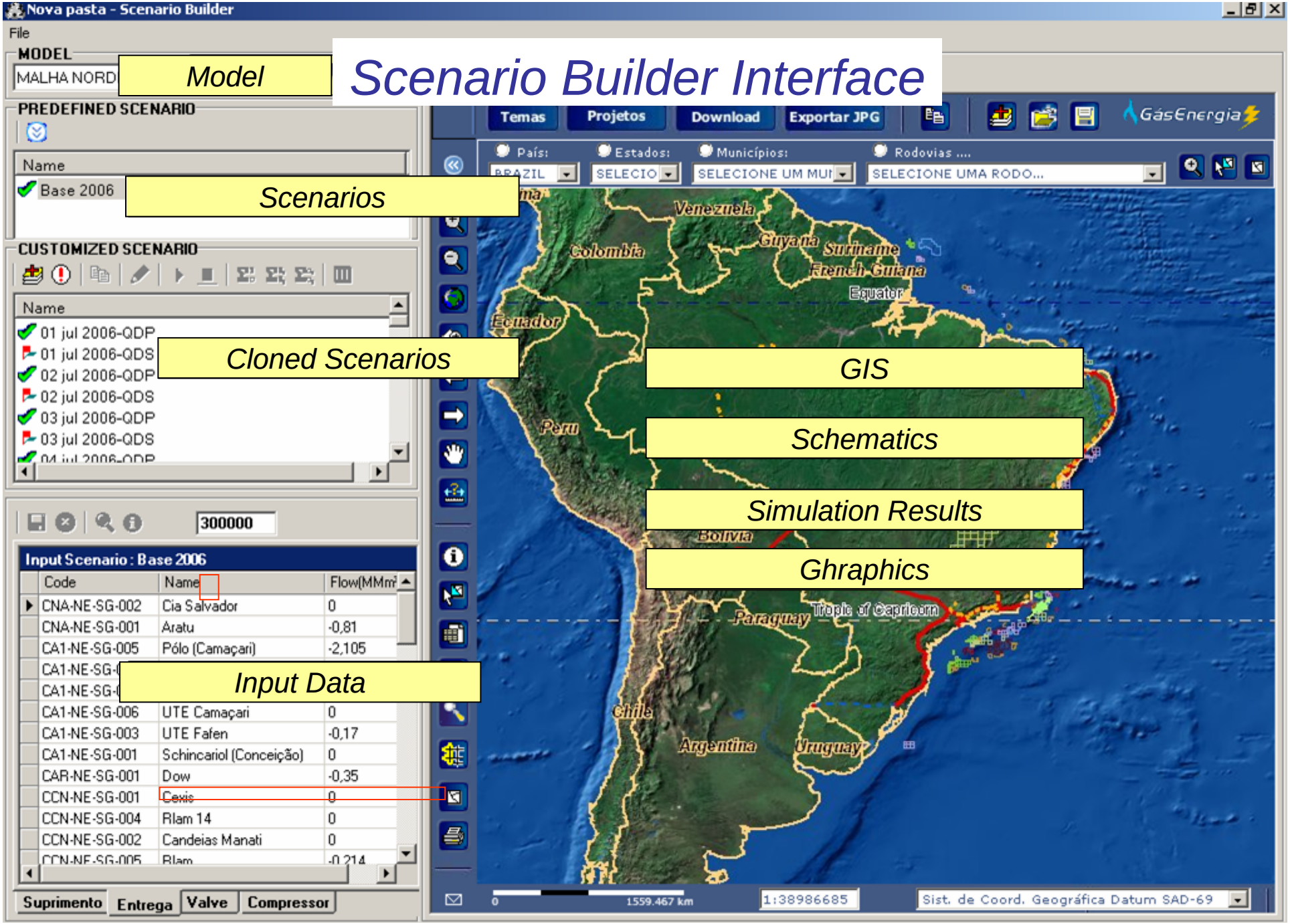


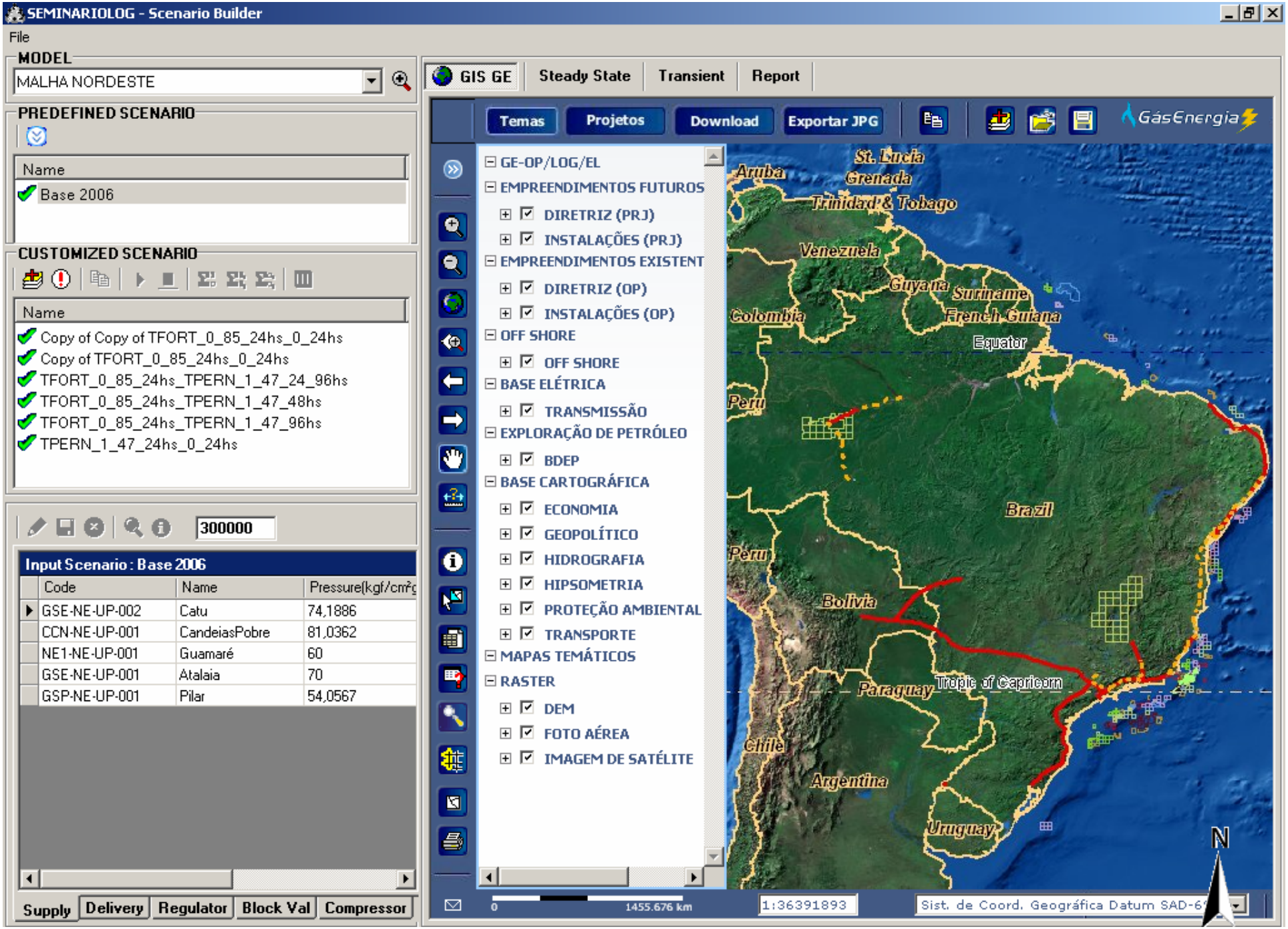
Spreadsheet Interface



Scenarios Reports

Scenario Builder Interface




SEMINARIOLOG - Scenario Builder
File
MODEL
MALHA NORDESTE
PREDEFINED SCENARIO
Name
Base 2006
CUSTOMIZED SCENARIO
Name
Copy of Copy of TFORT_0_85_24hs_0_24hs
Copy of TFORT_0_85_24hs_0_24hs
TFORT_0_85_24hs_TPERN_1_47_24_96hs
TFORT_0_85_24hs_TPERN_1_47_48hs
TFORT_0_85_24hs_TPERN_1_47_96hs
TPERN_1_47_24hs_0_24hs
300000
Input Scenario : Base 2006
Code
Name
Pressure(kgf/cm²g
GSE-NE-UP-002
Catu
74,1886
CCN-NE-UP-001
CandeiasPobre
81,0362
NE1-NE-UP-001
Guamaré
60
GSE-NE-UP-001
Atalaia
70
GSP-NE-UP-001
Pilar
54,0567
Supply
Delivery
Regulator
Block Val
Compressor
GIS GE
Steady State
Transient
Report
Temas
Projetos
Download
Exportar JPG
GásEnergia
GE-OP/LOG/EL
EMPREENDIMENTOS FUTUROS
DIRETRIZ (PRJ)
INSTALAÇÕES (PRJ)
EMPREENDIMENTOS EXISTENT
DIRETRIZ (OP)
INSTALAÇÕES (OP)
OFF SHORE
OFF SHORE
BASE ELÉTRICA
TRANSMISSÃO
EXPLORAÇÃO DE PETRÓLEO
BDEP
BASE CARTOGRÁFICA
ECONOMIA
GEOPOLÍTICO
HIDROGRAFIA
HIPSOMETRIA
PROTEÇÃO AMBIENTAL
TRANSPORTE
MAPAS TEMÁTICOS
RASTER
DEM
FOTO AÉREA
IMAGEM DE SATÉLITE
St. Lucia
Aruba
Grenada
Trinidad & Tobago
Venezuela
Guyana
Suriname
French Guiana
Colombia
Equator
Peru
Brazil
Peru
Bolivia
Paraguay
Tropic of Capricorn
Chile
Argentina
Uruguay
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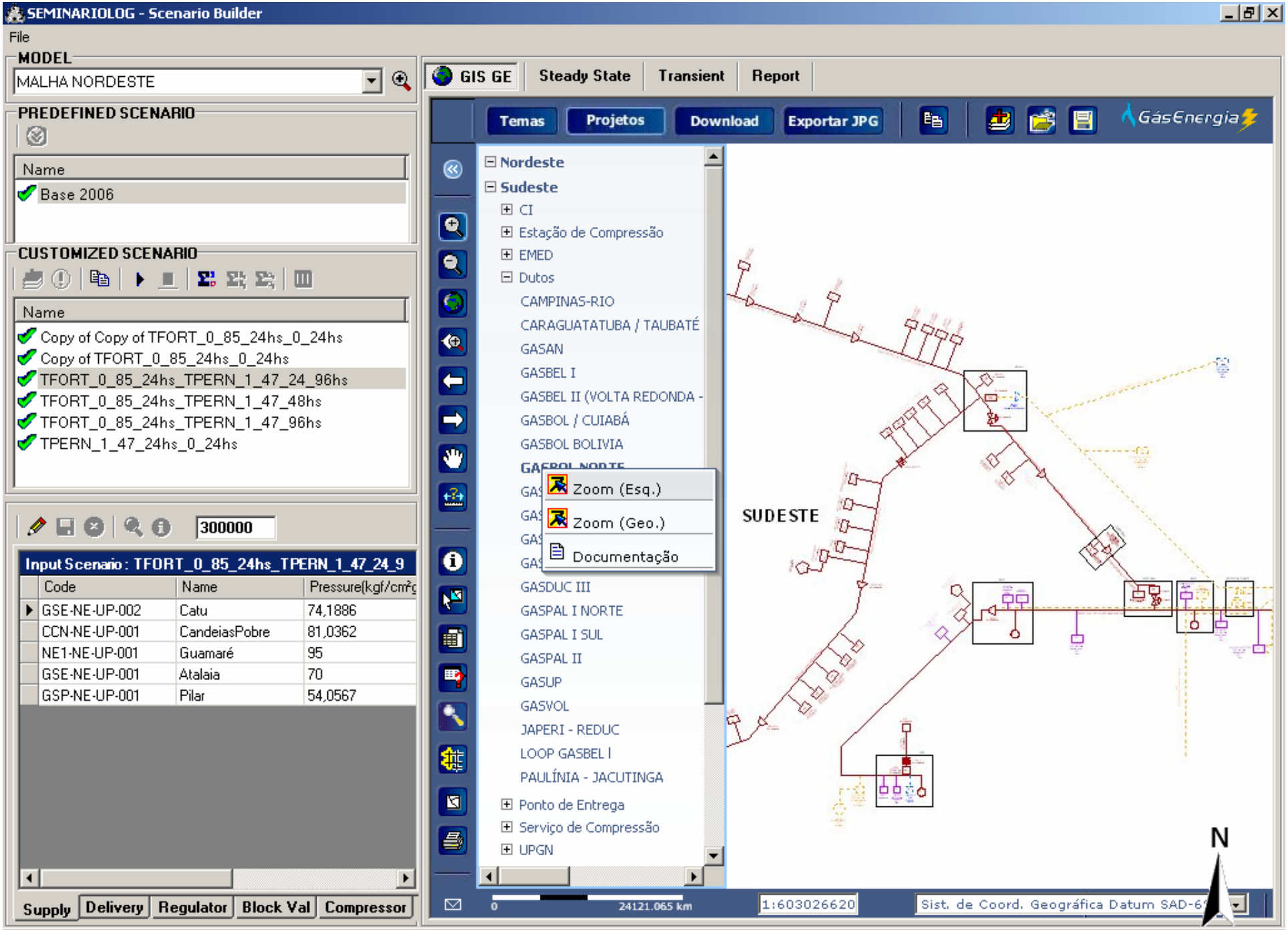
Sist. de Coord. Geográfica Datum SAD-6


SEMINARIOLOG - Scenario Builder
File
MODEL
MALHA NORDESTE
PREDEFINED SCENARIO
Name
Base 2006
CUSTOMIZED SCENARIO
Name
Copy of Copy of TFORT_0_85_24hs_0_24hs
Copy of TFORT_0_85_24hs_0_24hs
TFORT_0_85_24hs_TPERN_1_47_24_96hs
TFORT_0_85_24hs_TPERN_1_47_48hs
TFORT_0_85_24hs_TPERN_1_47_96hs
TPERN_1_47_24hs_0_24hs
300000
Input Scenario : TFORT_0_85_24hs_TPERN_1_47_24_9
Code
Name
Pressure(kgf/cm²g
GSE-NE-UP-002
Catu
74,1886
CCN-NE-UP-001
CandeiasPobre
81,0362
NE1-NE-UP-001
Guamaré
95
GSE-NE-UP-001
Atalaia
70
GSP-NE-UP-001
Pilar
54,0567
Supply
Delivery
Regulator
Block Val
Compressor
GIS GE
Steady State
Transient
Report
Temas
Projetos
Download
Exportar JPG
GásEnergia
Nordeste
Sudeste
CI
Estação de Compressão
EMED
Dutos
CAMPINAS-RIO
CARAGUATATUBA / TAUBATÉ
GASAN
GASBEL I
GASBEL II (VOLTA REDONDA -
GASBOL / CUIABÁ
GASBOL BOLIVIA
Zoom (Esq.)
Zoom (Geo.)
Documentação
GASDUC III
GASPAL I NORTE
GASPAL I SUL
GASPAL II
GASUP
GASVOL
JAPERI - REDUC
LOOP GASBEL I
PAULÍNIA - JACUTINGA
Ponto de Entrega
Serviço de Compressão
UPGN
SUDESTE
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0
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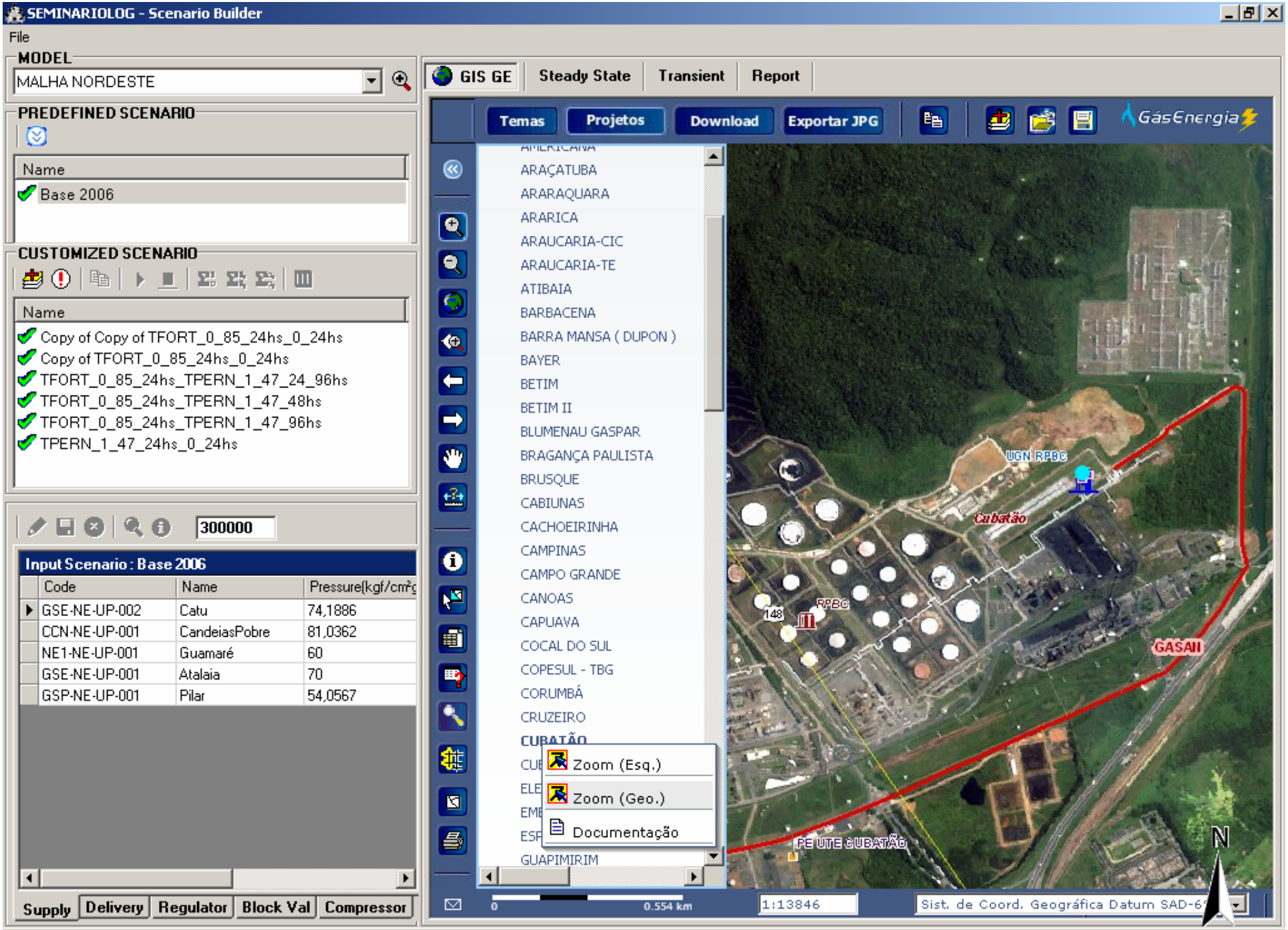
Sist. de Coord. Geográfica Datum SAD-6


SEMINARIOLOG - Scenario Builder
File
MODEL
MALHA NORDESTE
PREDEFINED SCENARIO
Name
Base 2006
CUSTOMIZED SCENARIO
Name
Copy of Copy of TFORT_0_85_24hs_0_24hs
Copy of TFORT_0_85_24hs_0_24hs
TFORT_0_85_24hs_TPERN_1_47_24_96hs
TFORT_0_85_24hs_TPERN_1_47_48hs
TFORT_0_85_24hs_TPERN_1_47_96hs
TPERN_1_47_24hs_0_24hs
300000
Input Scenario : Base 2006
Code
Name
Pressure(kgf/cm²g
GSE-NE-UP-002
Catu
74,1886
CCN-NE-UP-001
CandeiasPobre
81,0362
NE1-NE-UP-001
Guamaré
60
GSE-NE-UP-001
Atalaia
70
GSP-NE-UP-001
Pilar
54,0567
Supply
Delivery
Regulator
Block Val
Compressor
GIS GE
Steady State
Transient
Report
Temas
Projetos
Download
Exportar JPG
GásEnergia
ARAÇATUBA
ARARAQUARA
ARARICA
ARAUCARIA-CIC
ARAUCARIA-TE
ATIBAIA
BARBACENA
BARRA MANSA (DUPON)
BAYER
BETIM
BETIM II
BLUMENAU GASPAR
BRAGANÇA PAULISTA
BRUSQUE
CABIUNAS
CACHOEIRINHA
CAMPINAS
CAMPO GRANDE
CANOAS
CAPUAVA
COCAL DO SUL
COPESUL - TBG
CORUMBÁ
CRUZEIRO
CUBATÃO
GUAPIMIRIM
Zoom (Esq.)
Zoom (Geo.)
Documentação
UGN RPBC
Cubatão
RPBC
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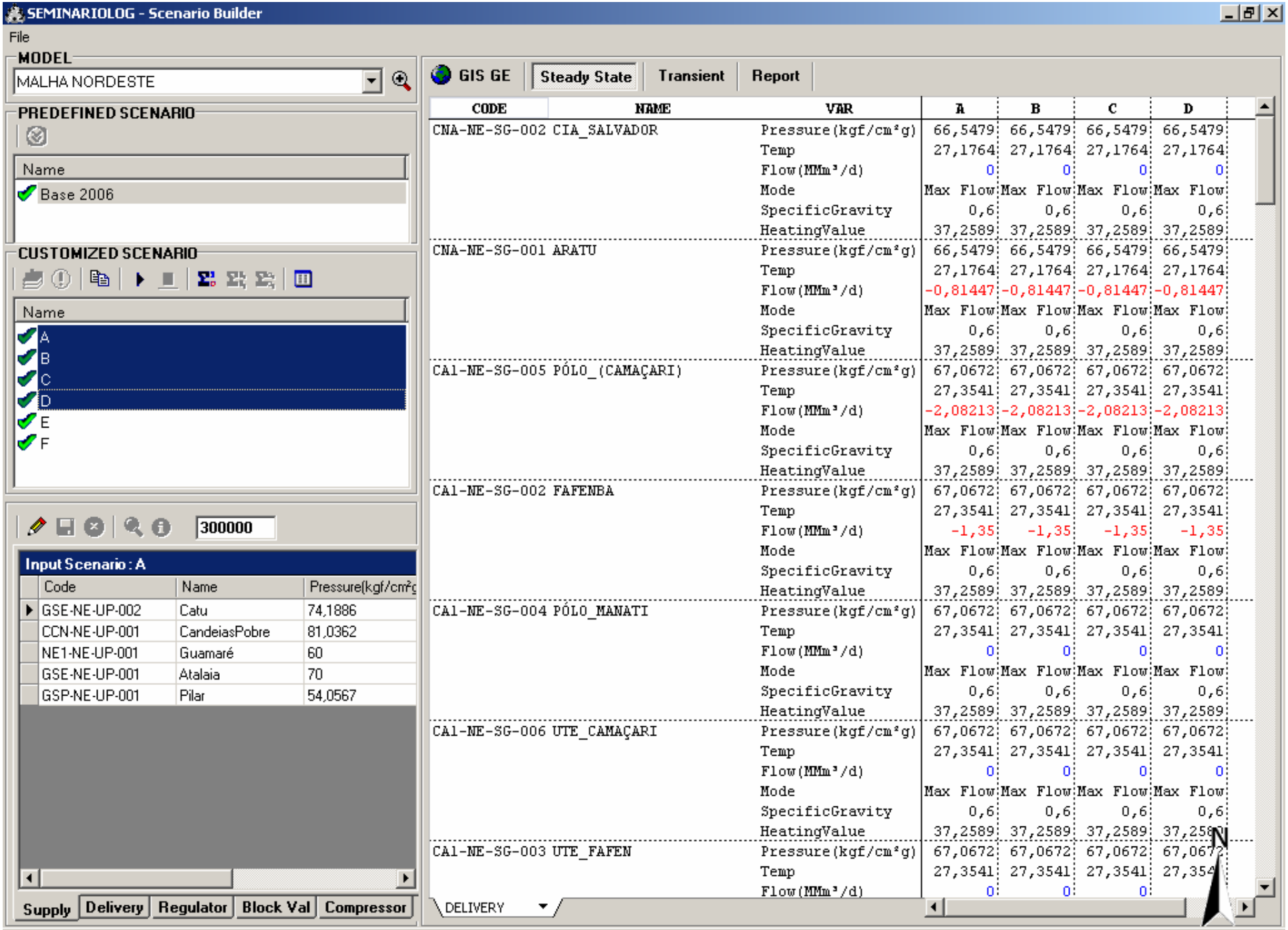
GASAN
PE UTE CUBATÃO
N
0
0.554 km
1:13846
Sist. de Coord. Geográfica Datum SAD-6


SEMINARIOLOG - Scenario Builder
File
MODEL
MALHA NORDESTE
PREDEFINED SCENARIO
Name
Base 2006
CUSTOMIZED SCENARIO
Name
A
B
C
D
E
F
300000
Input Scenario : A
Code
Name
Pressure(kgf/cm²g
GSE-NE-UP-002
Catu
74,1886
CCN-NE-UP-001
CandeiasPobre
81,0362
NE1-NE-UP-001
Guamaré
60
GSE-NE-UP-001
Atalaia
70
GSP-NE-UP-001
Pilar
54,0567
Supply
Delivery
Regulator
Block Val
Compressor
GIS GE
Steady State
Transient
Report
CODE
NAME
VAR
A
B
C
D
CNA-NE-SG-002 CIA_SALVADOR
Pressure(kgf/cm²g)
66,5479
Temp
27,1764
Flow(MMm³/d)
0
Mode
Max Flow
SpecificGravity
0,6
HeatingValue
37,2589
CNA-NE-SG-001 ARATU
Pressure(kgf/cm²g)
66,5479
Temp
27,1764
Flow(MMm³/d)
-0,81447
Mode
Max Flow
SpecificGravity
0,6
HeatingValue
37,2589
CA1-NE-SG-005 PÓLO_(CAMAÇARI)
Pressure(kgf/cm²g)
67,0672
Temp
27,3541
Flow(MMm³/d)
-2,08213
Mode
Max Flow
SpecificGravity
0,6
HeatingValue
37,2589
CA1-NE-SG-002 FAFENBA
Pressure(kgf/cm²g)
67,0672
Temp
27,3541
Flow(MMm³/d)
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Mode
Max Flow
SpecificGravity
0,6
HeatingValue
37,2589
CA1-NE-SG-004 PÓLO_MANATI
Pressure(kgf/cm²g)
67,0672
Temp
27,3541
Flow(MMm³/d)
0
Mode
Max Flow
SpecificGravity
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HeatingValue
37,2589
CA1-NE-SG-006 UTE_CAMAÇARI
Pressure(kgf/cm²g)
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Temp
27,3541
Flow(MMm³/d)
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Mode
Max Flow
SpecificGravity
0,6
HeatingValue
37,2589
CA1-NE-SG-003 UTE_FAFEN
Pressure(kgf/cm²g)
67,0672
Temp
27,3541
Flow(MMm³/d)
0
DELIVERY
N

SEMINARIOLOG - Scenario Builder

File

MODEL

MALHA NORDESTE

PREDEFINED SCENARIO

Name
Base 2006

CUSTOMIZED SCENARIO

Name
A
B
C
D
E
F

300000

Input Scenario : D

Code	Name	Pressure(kgf/cm²g
GSE-NE-UP-002	Catu	74,1886
CCN-NE-UP-001	CandeiasPobre	81,0362
NE1-NE-UP-001	Guamaré	95
GSE-NE-UP-001	Atalaia	70
GSP-NE-UP-001	Pilar	54,0567

Supply | Delivery | Regulator | Block Val | Compressor

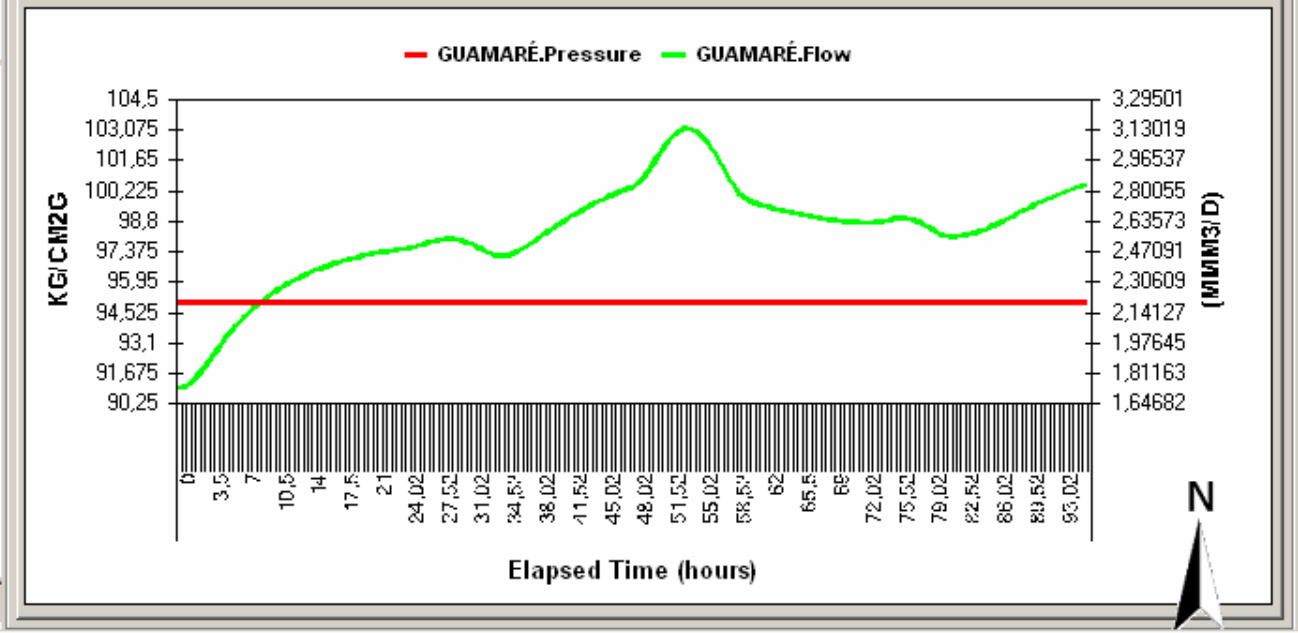
GIS GE | Steady State | Transient | Report

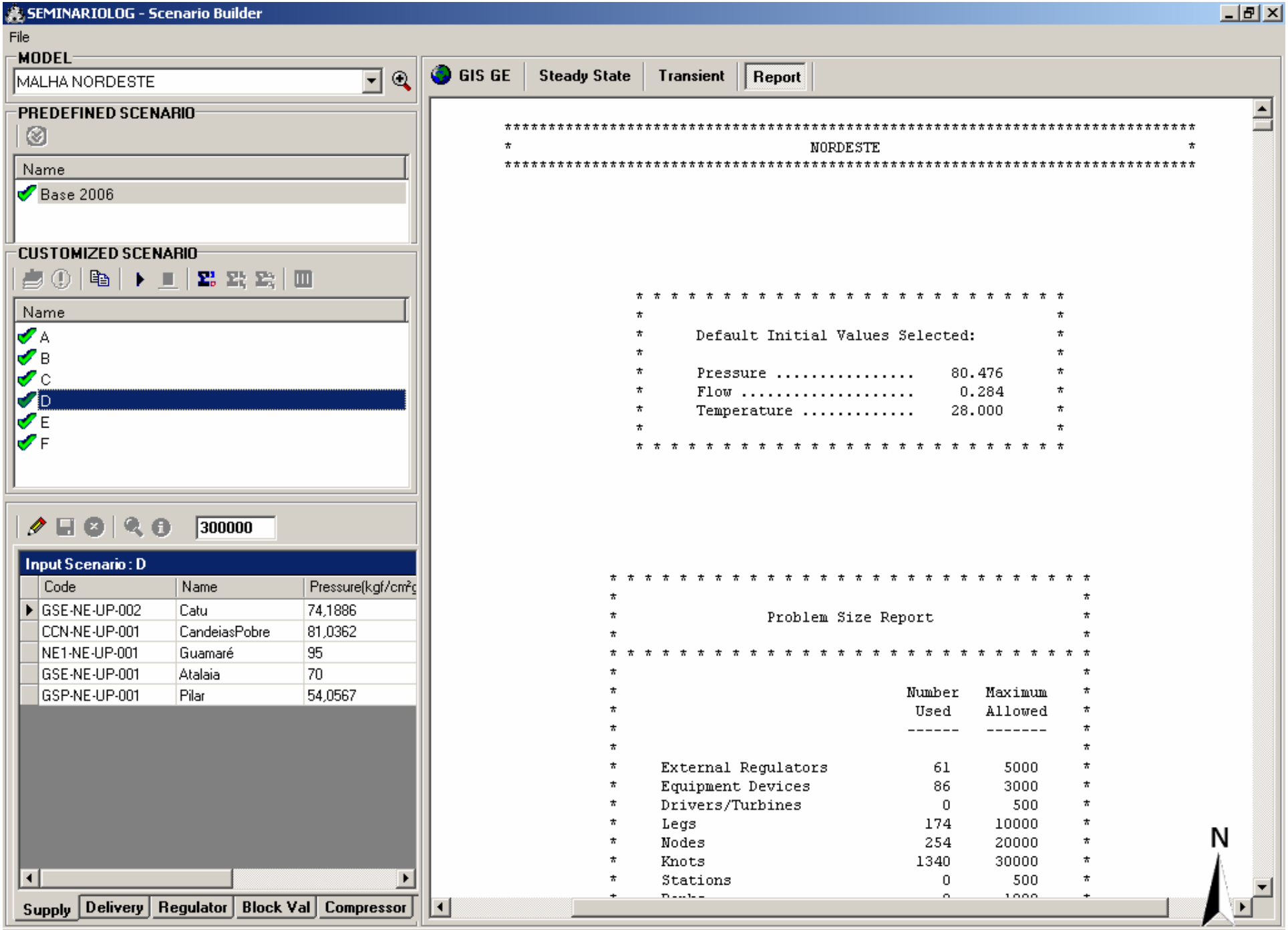
INPUT | OUTPUT

D

Code	Name	Field	Unit	Set Point	Count	Min	Max	Sum
CCN-NE-UP-001	CANDEIASPOBRE	Pressure	KG/CM2G	67,6309	195	62,5398	67,6309	127(
CCN-NE-UP-001	CANDEIASPOBRE	Temp.	(DEG C)	25	195	25	25	487
CCN-NE-UP-001	CANDEIASPOBRE	Flow	(MMM3/D)	1,87875	195	1,87875	1,87875	366,
CCN-NE-UP-001	CANDEIASPOBRE	Specific Gravity	(null)	0,6	195	0,6	0,6	117
CCN-NE-UP-001	CANDEIASPOBRE	Heating Value	(MJ/M3)	37,2589	195	37,2589	37,2589	726
CCN-NE-UP-001	CANDEIASPOBRE	Percent Carbon Dioxide	(null)	0	195	0	0	0
NE1-NE-UP-001	GUAMARÉ	Pressure	KG/CM2G	95	195	95	95	185
NE1-NE-UP-001	GUAMARÉ	Temp.	(DEG C)	25	195	25	25	487
NE1-NE-UP-001	GUAMARÉ	Flow	(MMM3/D)	1,73349	195	1,73349	3,1381	502,
NE1-NE-UP-001	GUAMARÉ	Specific Gravity	(null)	0,6	195	0,6	0,6	117
NE1-NE-UP-001	GUAMARÉ	Heating Value	(MJ/M3)	37,2589	195	37,2589	37,2589	726
NE1-NE-UP-001	GUAMARÉ	Percent Carbon Dioxide	(null)	0	195	0	0	0
GSE-NE-UP-001	ATALAIA	Pressure	KG/CM2G	70	195	64,7888	70	121

Supply | Delivery | Block Val. | Regulator | Compressor




SEMINARIOLOG - Scenario Builder
File
MODEL
MALHA NORDESTE
PREDEFINED SCENARIO
Name
Base 2006
CUSTOMIZED SCENARIO
Name
A
B
C
D
E
F
300000
Input Scenario : D
Code
Name
Pressure(kgf/cm²g
GSE-NE-UP-002
Catu
74,1886
CCN-NE-UP-001
CandeiasPobre
81,0362
NE1-NE-UP-001
Guamaré
95
GSE-NE-UP-001
Atalaia
70
GSP-NE-UP-001
Pilar
54,0567
Supply
Delivery
Regulator
Block Val
Compressor
GIS GE
Steady State
Transient
Report
NORDESTE
Default Initial Values Selected:
Pressure 80.476
Flow 0.284
Temperature 28.000
Problem Size Report
Number Used
Maximum Allowed
External Regulators 61 5000
Equipment Devices 86 3000
Drivers/Turbines 0 500
Legs 174 10000
Nodes 254 20000
Knots 1340 30000
Stations 0 500
N

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Logistics Intelligence Applied to

Natural Gas Business

Sidney Pereira dos Santos - Senior Consultant
Renato Cabral - GIS Consultant
Italo Madeira – Mechanical Engineer

PETROBRAS

February 27th, 2007