Energy efficiency improvements at Repsol Química Tarragona complex by using a real time energy optimization system

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REPSOL

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Outline

- Introduction
  - Repsol Química Tarragona Petrochemical Complex
  - Energy system operation challenges
- Project objectives and scope
- Results
- Conclusions

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Repsol Química Tarragona Petrochemical Complex

- The most important petrochemical complex in Spain
- One of the largest in Europe
- Its production includes a variety of chemical compounds such as polyolefins, acrylonitrile, propylene oxide, styrene, polyols and glycols
- It also produces electricity and steam by a set of on-site cogeneration and combined cycle units

Energy system operation challenges

- As many other energy intensive companies one of the main challenges Repsol faces deals with “energy efficiency”
- This is further motivated by a legislature that provides with economic incentives to the electricity exported to the grid based on the efficiency of its production (i.e. equivalent electrical yield)
- Different economic trade-offs such as the ones that exist among the electrical system, steam and fuel networks, lead to many challenges to operate the site at a minimum cost

Project objectives and scope

- Operation of the energy system at a minimum cost while improving the energy efficiency
- Implementation of a real time energy optimizer (Visual MESA)
- Model of the petrochemical complex that accounts for the steam, fuels, electricity and water networks as well as all the indices that are directly related to the energy production cost

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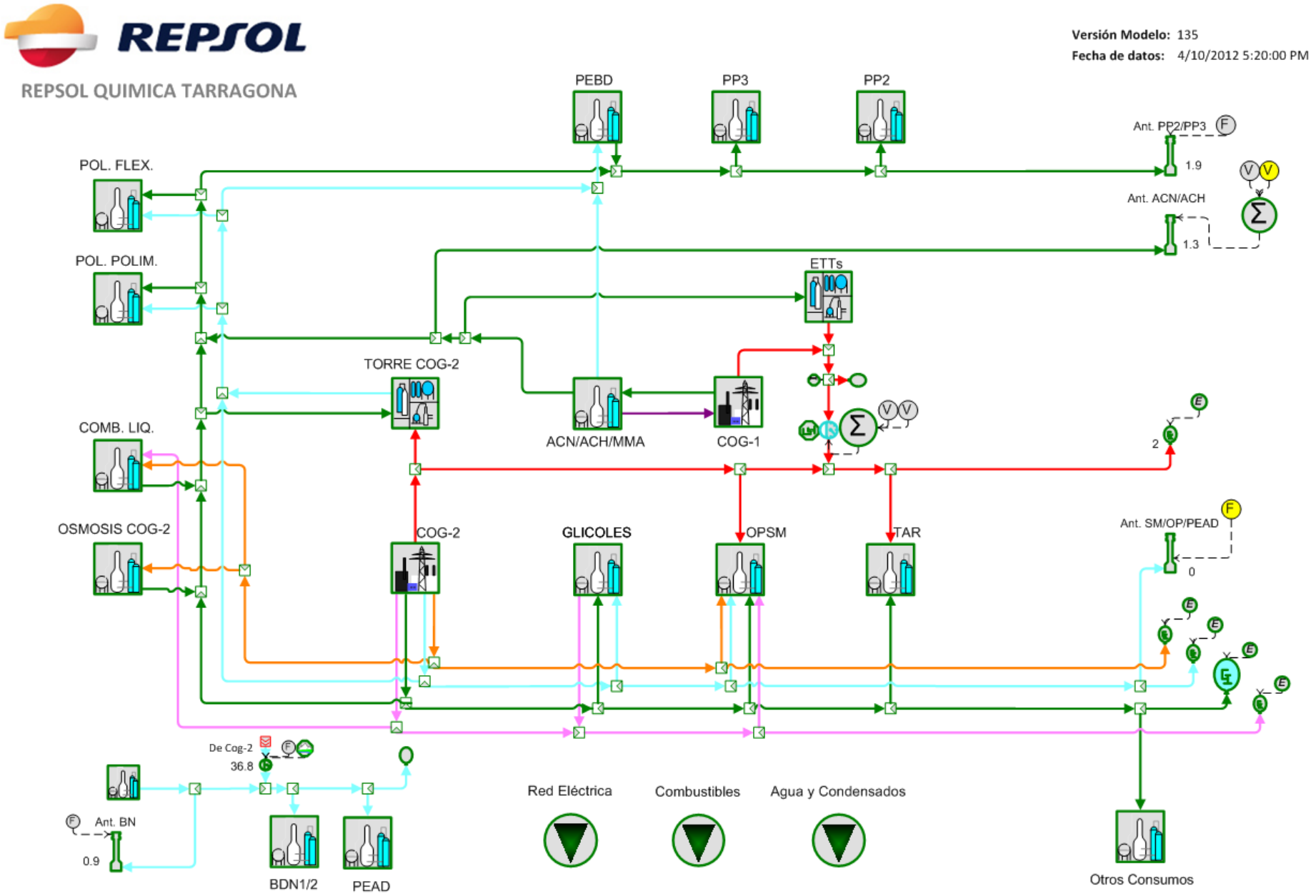
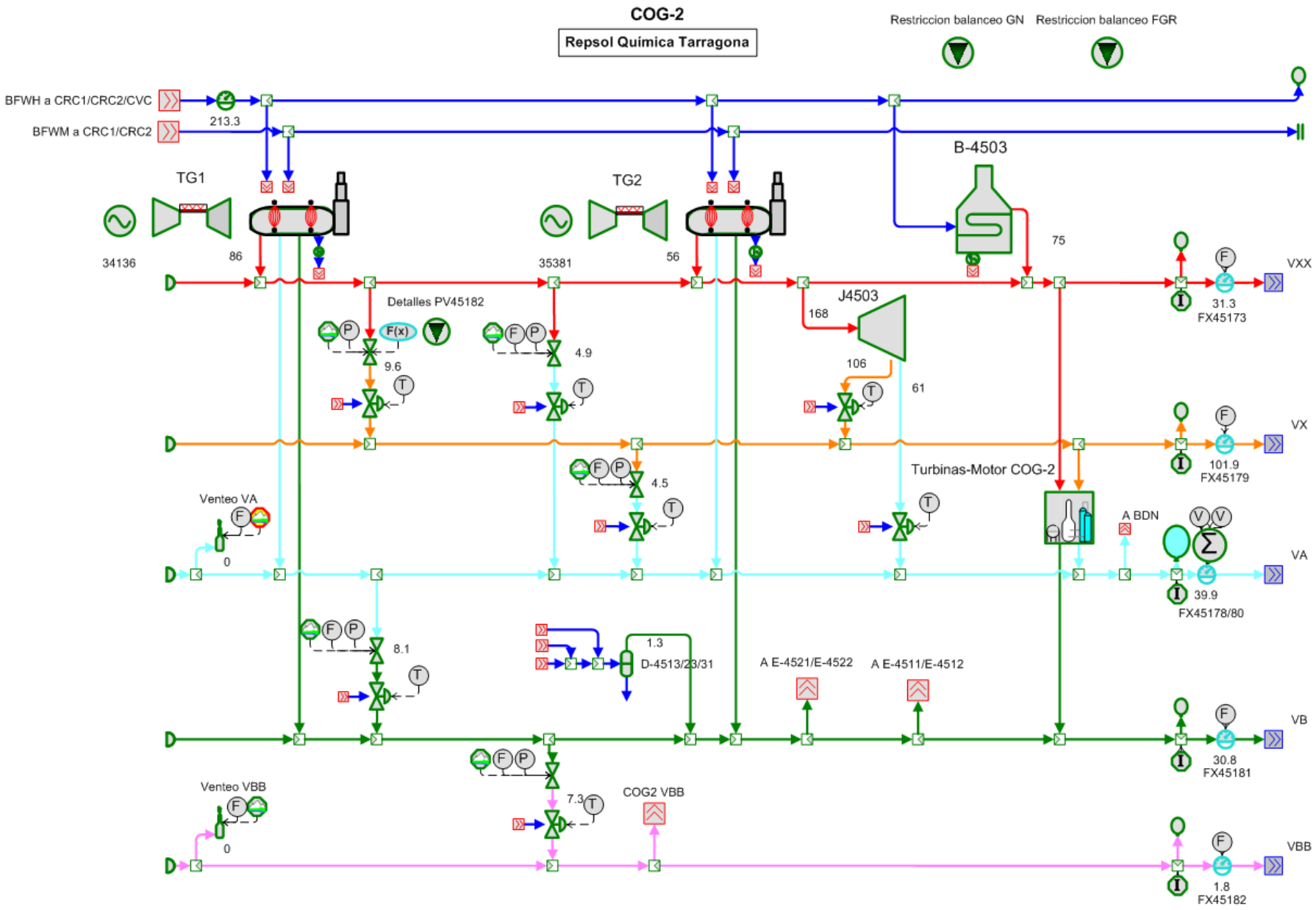
Visual MESA GUI (main view)



One of the power plants model view



Optimization variables

- Fuels to fired boilers
  - Natural Gas
  - Residual fuel gas
  - Liquid fuels
- Gas turbine loads
- Turbogenerators management (loads and extractions)
- Pump swaps (electrical motors/steam turbines pairs and groups)
- Steam importation/exportation from/to external plant
- Steam letdowns and vents / condensing
- Electricity exportation / importation
- Natural gas importation

74 optimization variables

49 constraints

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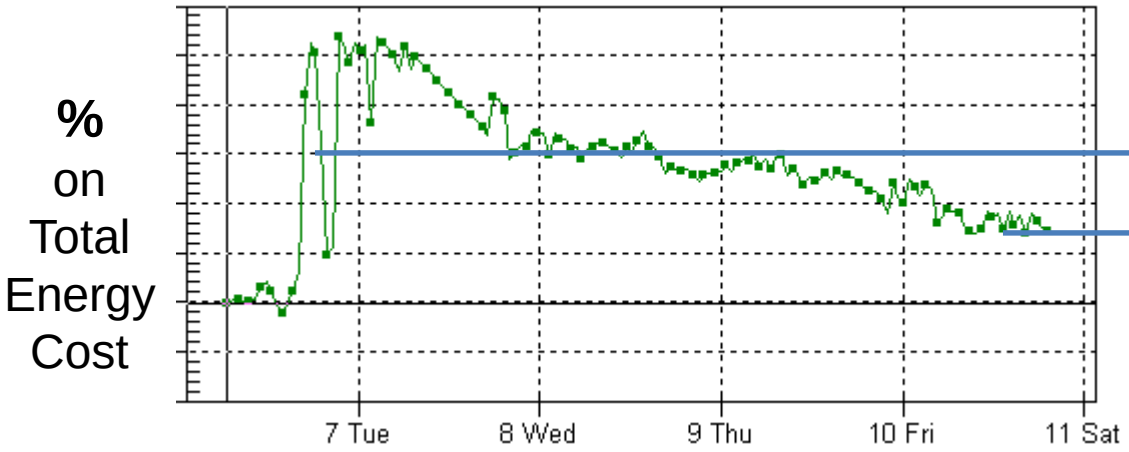
Results

Real time optimization

- Typical operators direct actions (daily basis)
  - Natural Gas and Residual fuel gas to heat recovery boilers postcombustion
  - Liquid fuel and Natural Gas to fired boilers
  - Steam importation/exportation from/to an external plant
  - Pump swaps
  - Some manual steam letdowns
  - Gas Turbine loads
- And as a consequence (i.e. by control system)
  - Steam vents
  - Steam extraction at turbogenerator
  - Fuel gas flaring
  - Natural Gas importation
  - Electricity importation / exportation

Example of cost reduction



Around 8% of energy cost reduction achieved

Example of Operations report with a set of recommendations

Lista de recomendaciones

Cogeneración 1		
	Aumentar Carga a TG:	6 MW
Cogeneración 2		
	Disminuir GN a B-4502:	-753 Nm3/h
	Disminuir GN a B-4503:	-2346 Nm3/h
	Aumentar FOP a B-4503:	1905 kg/h
	Disminuir VBB a E-5910:	-20 t/h
	Disminuir PC45182B:	-2,0 %
	Disminuir PC45184:	-23,2 %
	Disminuir PC45185:	-55,1 %
Energías ACN		
	Disminuir PIC_296:	-2,8 %

Gas Turbine load increase

Fuels to boilers management

Steam condensing reduction

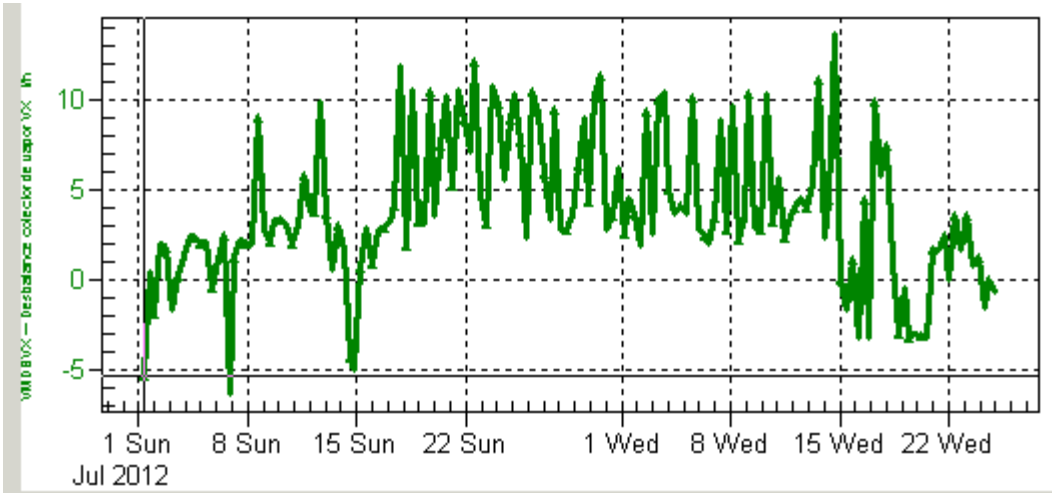
Steam letdown reduction

Pump swaps

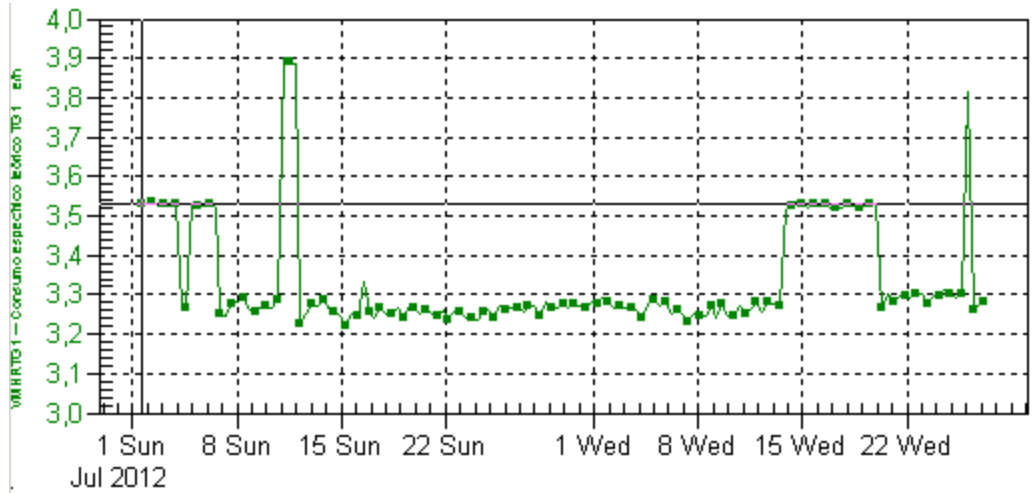
Turbinas y motores Cambios: 2

Área	Equipo	Nombre	Potencia mecánica (kW)	Niveles de presión	Estado actual	Estado óptimo
Cogeneración 2	Turbina	GT-4552B	59	VX a VB	Marcha	Parada
Cogeneración 2	Motor	GM-4552A	59		Parada	Marcha
OPSM	Turbina	GT-5332B	719	VXX a VA	Marcha	En calentamiento
OPSM	Motor	GM-5332A	719		Parada	Marcha

Energy system monitoring and auditing



Steam header imbalance



Gas Turbine theoretical heat rate

What-if case studies

- Evaluation of the impact on energy system of Start-stop of:
  - Equipment *
  - Process units
- Multiple case studies
  - Scheduling of gas turbines loads based on:
    - Electricity prices
    - Planning of process units operation
    - Forecasted ambient conditions

(*) Furthermore, the option to allow start/stop equipment was enabled for some units (small fired boilers, postcombustion at heat recovery steam generators, turbogenerators) so such Start-Stop can be recommended as part of real time optimization on daily basis

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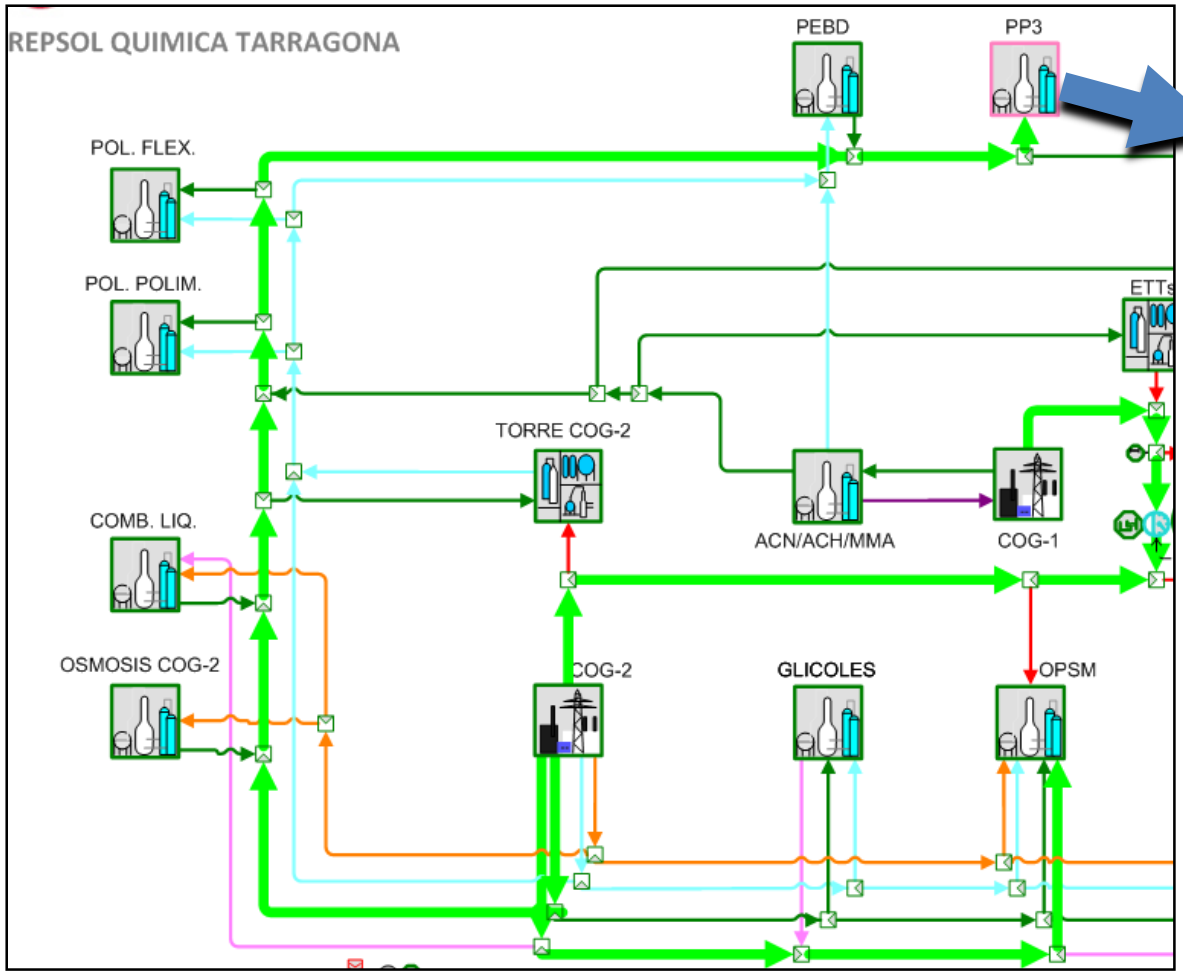
What-if cases studies analysis
Delta view example



Process unit shutdown

Highlighted the lines with flow changes

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Conclusions

- Visual MESA implemented at Repsol Química Tarragona petrochemical complex
- As a result of the project, a better knowledge of utilities system interactions has been acquired, understanding all decision variables and the associated constraints which sometimes are hidden
- Ability to react on-line to capture business opportunities to reduce energy costs and improve energy system efficiency, getting significant energy savings

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