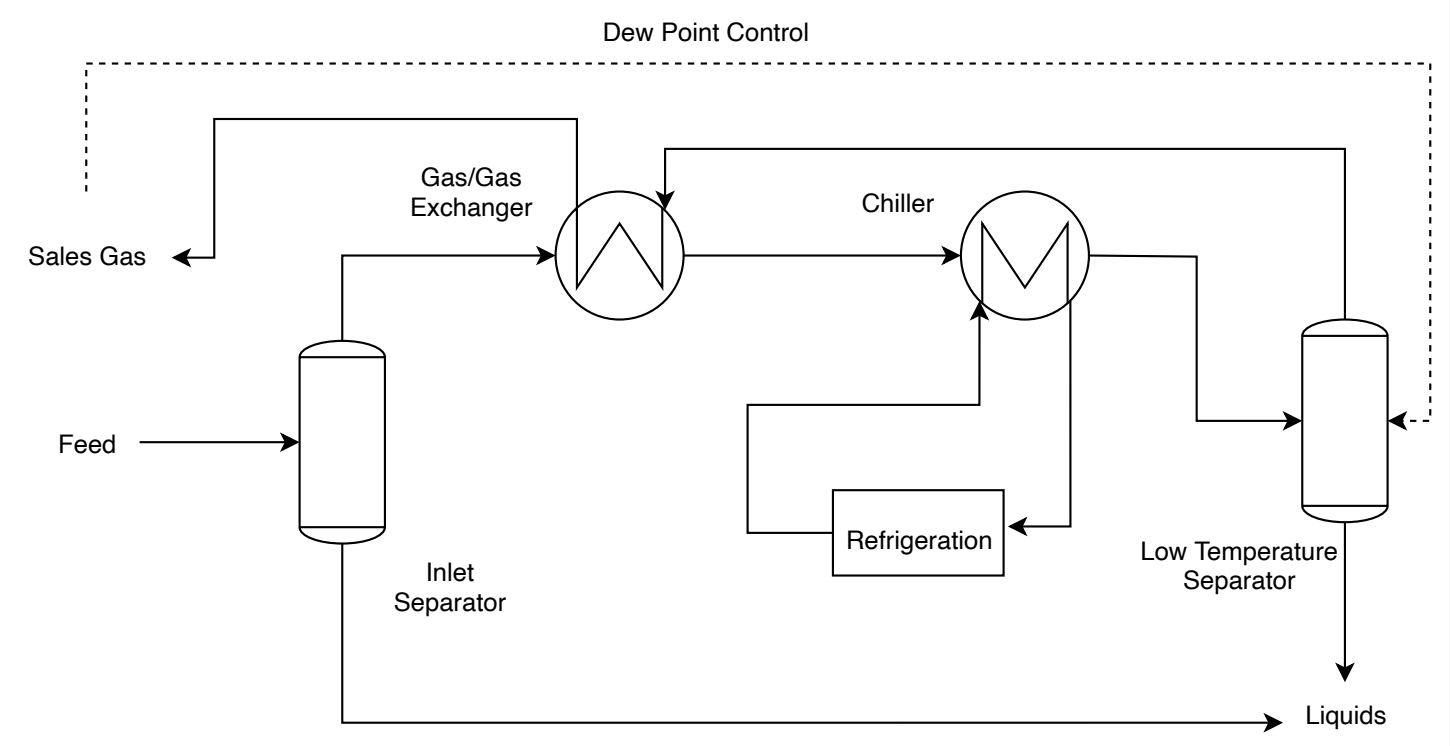
Natural Gas Dew Point Control

Below is a diagram of the front end of a simple hydrocarbon dew point control process for natural gas.



Flowsheet SVG created with drawio and pasted in note

The vapour from a feed stream is passed through a gas to gas exchanger and then a chiller, reducing the temperature to condense out heavier components. The vapour from the low temperature separator is then reheated in the gas to gas exchanger to become the sales gas, while pre-cooling the inlet separator vapour. The dew point of the sales gas is checked against a target value and the temperature of the low temperature separator is adjusted until that target is met.

The feed conditions are known and given pressure drops for the gas to gas exchanger and chiller all that is needed is an initial estimate for the low temperature separator temperature to define it. A temperature approach between the inlet separator vapour and the sales gas allows the sale gas to be completely determined. With three of the four gas/gas stream known, a heat balance allows the temperature to the chiller to be determined.

A refrigeration model from the ToolBox model is used for the chiller cooling.

Finally the phase envelopes for the feed and sales gas streams are plotted.

DewPtTarget	-5 degC

DewPtSolver

x (solved)	fx
0.18329	5.348364e-5

feed

Label	Unit	B	V	L
q	Fraction	0.54595	1.00000	0.00000
t	degC	15.00	15.00	15.00
p	kPa	3000.00	3000.00	3000.00
f	kmol/h	4980.22	2718.94	2261.28
h	kJ/kmol	9922.51	15352.30	3393.78
s	kJ/kmol-K	63.08	82.79	39.38
dmolar	kmol/m^3	2.31	1.41	9.94
mwt	kg/kmol	37.08251	21.09466	56.30641
x	Methane	0.49296	0.77190	0.15756
x	Ethane	0.14085	0.14840	0.13177
x	Propane	0.07042	0.03922	0.10794
x	Isobutane	0.06338	0.01874	0.11706
x	n-Butane	0.05634	0.01169	0.11003
x	Isopentane	0.04930	5.491377e-3	0.10197
x	n-Pentane	0.04225	3.241380e-3	0.08916
x	n-Hexane	0.03521	9.552718e-4	0.07640
x	n-Heptane	0.02817	2.951034e-4	0.06168
x	n-Octane	0.02113	8.350465e-5	0.04643
dmass	kg/m^3	85.76871	29.78215	559.91590

lts

Label	Unit	B	V	L
q	Fraction	0.95282	1.00000	0.00000
t	degC	-11.83	-11.83	-11.83
p	kPa	2862.10	2862.10	2862.10
f	kmol/h	2718.94	2590.66	128.28
h	kJ/kmol	13451.96	13831.88	5779.33
s	kJ/kmol-K	76.19	77.65	46.66
dmolar	kmol/m^3	1.59	1.52	11.95
mwt	kg/kmol	21.09466	19.91205	44.96056
x	Methane	0.77190	0.80089	0.18670
x	Ethane	0.14840	0.14579	0.20104

x	Propane	0.03922	0.03273	0.17013
x	Isobutane	0.01874	0.01170	0.16076
x	n-Butane	0.01169	6.152121e-3	0.12341
x	Isopentane	5.491377e-3	1.856723e-3	0.07884
x	n-Pentane	3.241380e-3	7.914786e-4	0.05268
x	n-Hexane	9.552718e-4	8.039858e-5	0.01861
x	n-Heptane	2.951034e-4	8.879498e-6	6.071303e-3
x	n-Octane	8.350465e-5	7.900456e-7	1.752744e-3
dmass	kg/m^3	33.50000	30.32007	537.41382

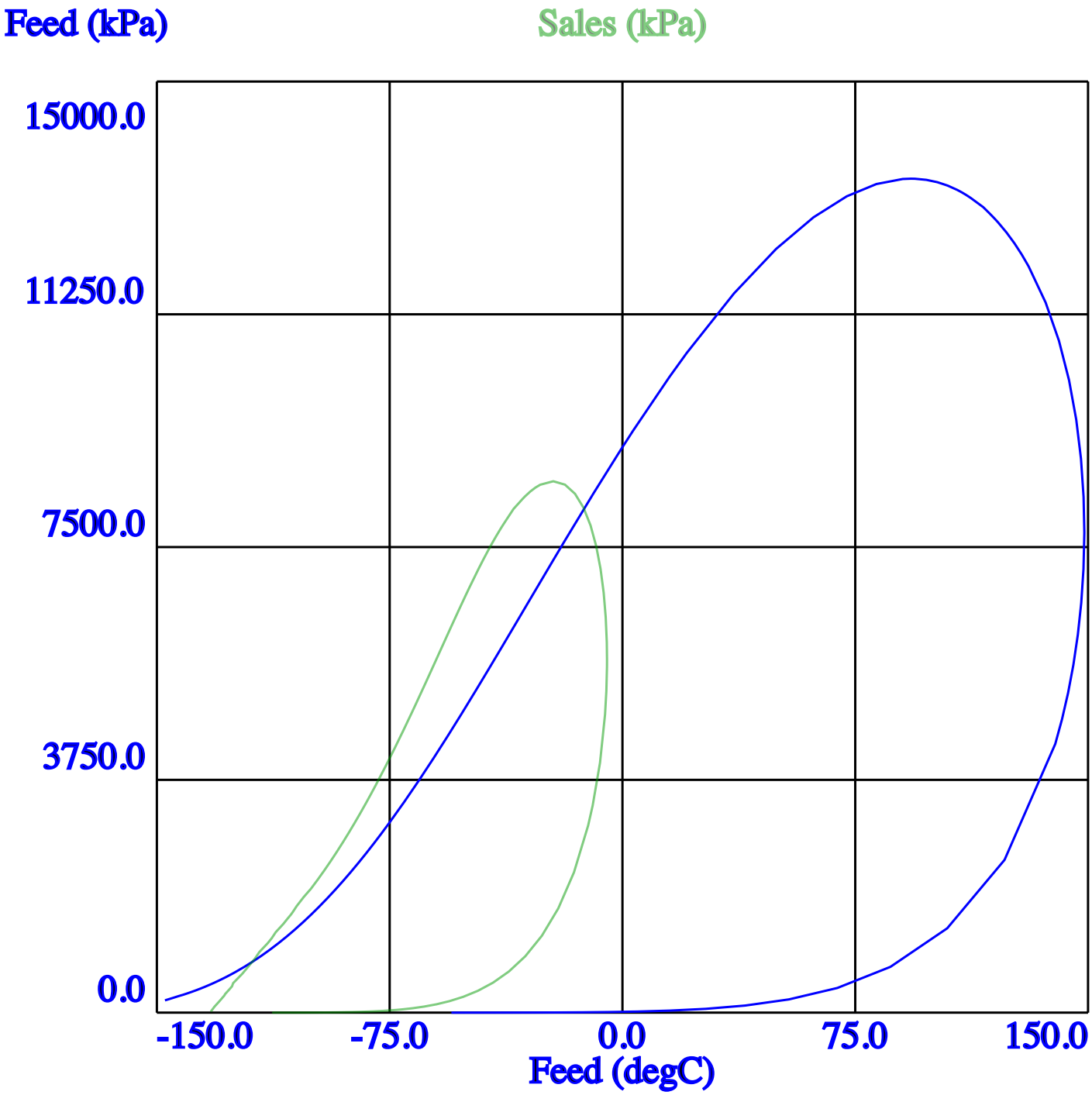
SalesGas

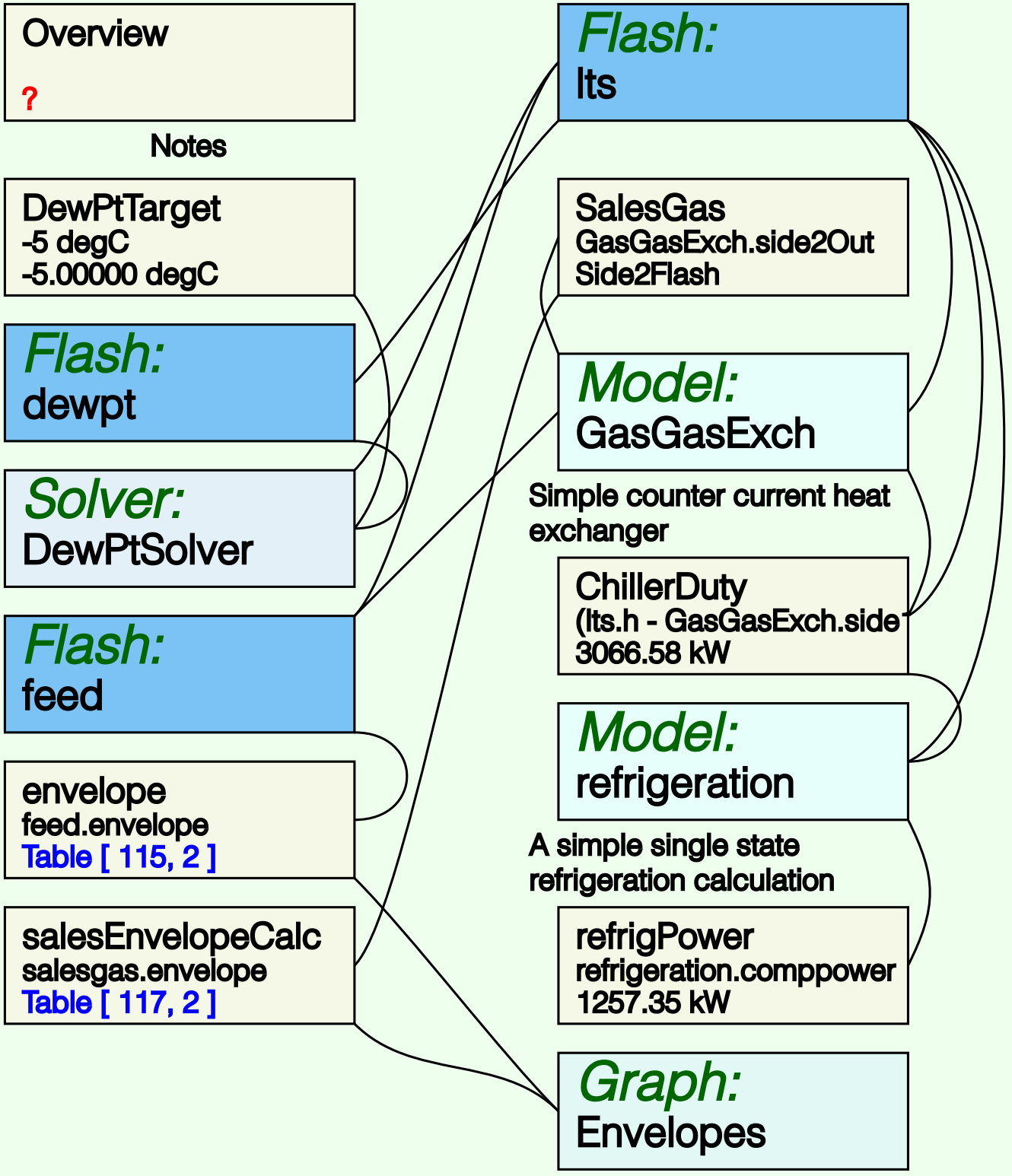
Label	Unit	B
q	Fraction	-1.00000
t	degC	10.00
p	kPa	2852.10
f	kmol/h	2590.66
h	kJ/kmol	14852.23
s	kJ/kmol-K	81.43
dmolar	kmol/m^3	1.35
mwt	kg/kmol	19.91205
x	Methane	0.80089
x	Ethane	0.14579
x	Propane	0.03273
x	Isobutane	0.01170
x	n-Butane	6.152121e-3
x	Isopentane	1.856723e-3
x	n-Pentane	7.914786e-4
x	n-Hexane	8.039858e-5
x	n-Heptane	8.879498e-6
x	n-Octane	7.900456e-7
dmass	kg/m^3	26.80915

ChillerDuty	3066.58 kW

refrigPower	1257.35 kW

Envelopes


Feed (kPa)
Sales (kPa)
15000.0
11250.0
7500.0
3750.0
0.0
-150.0
-75.0
0.0
75.0
150.0
Feed (degC)


Overview
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Notes
DewPtTarget
-5 degC
-5.00000 degC
Flash:
dewpt
Solver:
DewPtSolver
Flash:
feed
envelope
feed.envelope
Table [115, 2]
salesEnvelopeCalc
salesgas.envelope
Table [117, 2]
Flash:
lts
SalesGas
GasGasExch.side2Out
Side2Flash
Model:
GasGasExch
Simple counter current heat exchanger
ChillerDuty
(lts.h - GasGasExch.side
3066.58 kW
Model:
refrigeration
A simple single state refrigeration calculation
refrigPower
refrigeration.comppower
1257.35 kW
Graph:
Envelopes