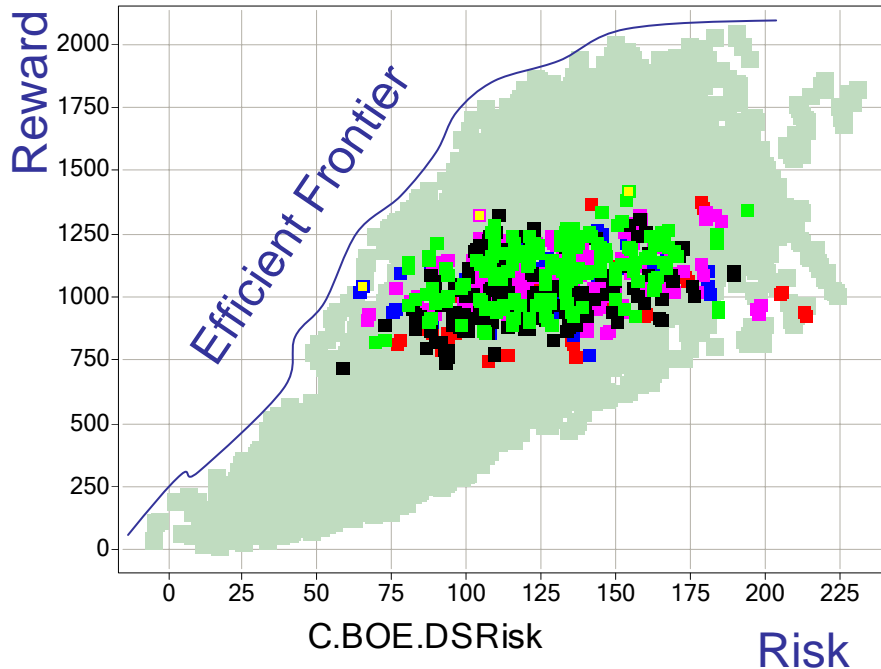


Spotfire Communicates Portfolio Analysis of Investment Opportunities on Efficient Frontiers of Many Measures

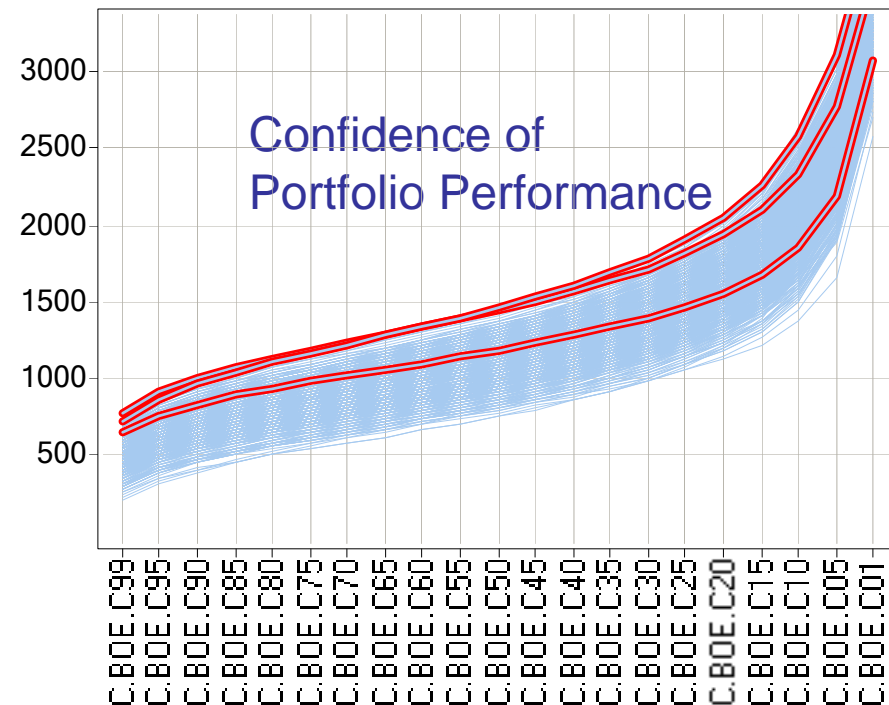
Dr. Stephen M. Rasey, CFO, WiserWays, LLC

Spotfire San Francisco Users Meeting, October 15, 2003

Equivalent Reserves
BOE DSRisk



MMBOE Conf

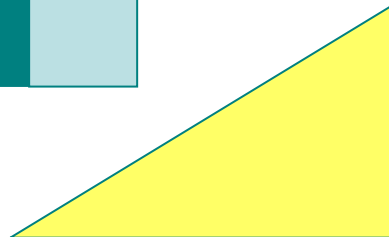
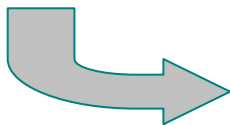
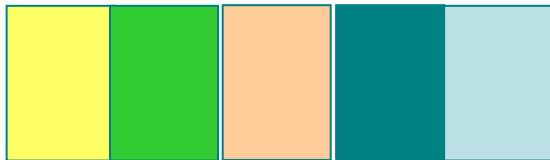


Portfolio Analysis

A search for Efficient *candidate* Portfolios from a collection of *potential Investment Opportunities*.

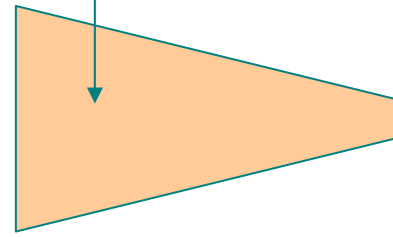
Acceptable Candidate Portfolios must satisfy Business Needs:

Prospect Database



Make Portfolios

+



Apply Constraints

=



A Few Good Portfolios

**RIGS
CAPEX
PERFORMANCE**

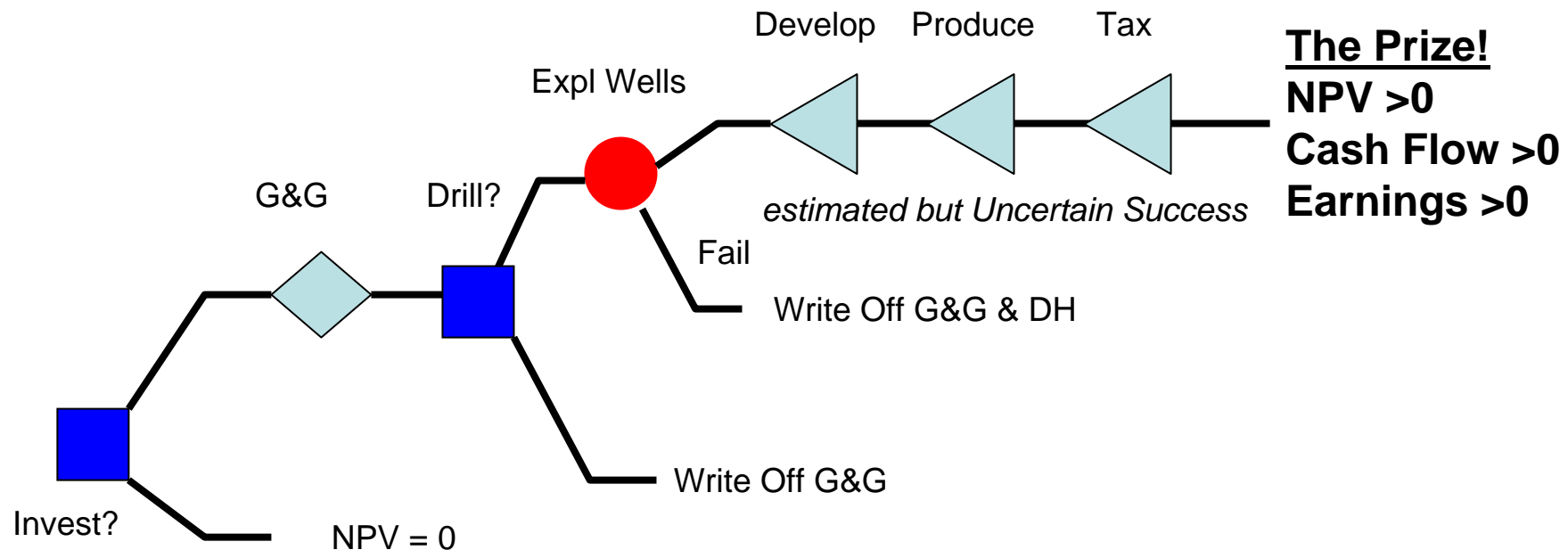
**Minimum
Acceptable
Results**



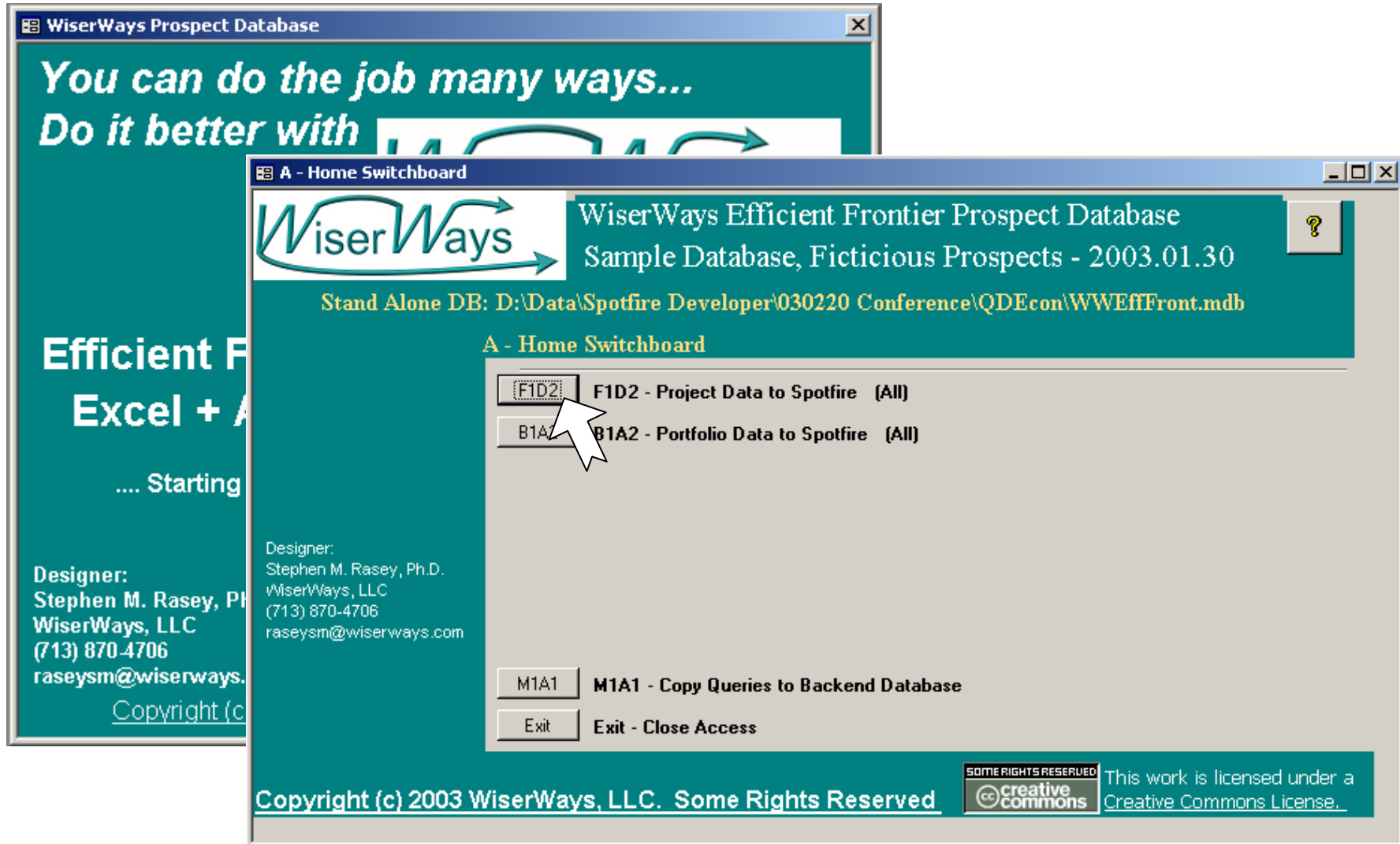
**DECIDE !
ACT !**

Investment Opportunities

- Projects where you have an opportunity to invest capital with estimated, but uncertain, profitable returns in the future.
- Example here: Exploration Projects



Use the Access Database to prepare Queries for Spotfire



WiserWays Prospect Database

*You can do the job many ways...
Do it better with*

Efficient Frontier Prospect Database
Excel + Access

.... Starting

Designer:
Stephen M. Rasey, Ph.D.
WiserWays, LLC
(713) 870-4706
raseysm@wiserways.com

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WiserWays Efficient Frontier Prospect Database
Sample Database, Fictitious Prospects - 2003.01.30

Stand Alone DB: D:\Data\Spotfire Developer\030220 Conference\QDEcon\WWEffFront.mdb

A - Home Switchboard

F1D2 F1D2 - Project Data to Spotfire (All)

B1A2 B1A2 - Portfolio Data to Spotfire (All)

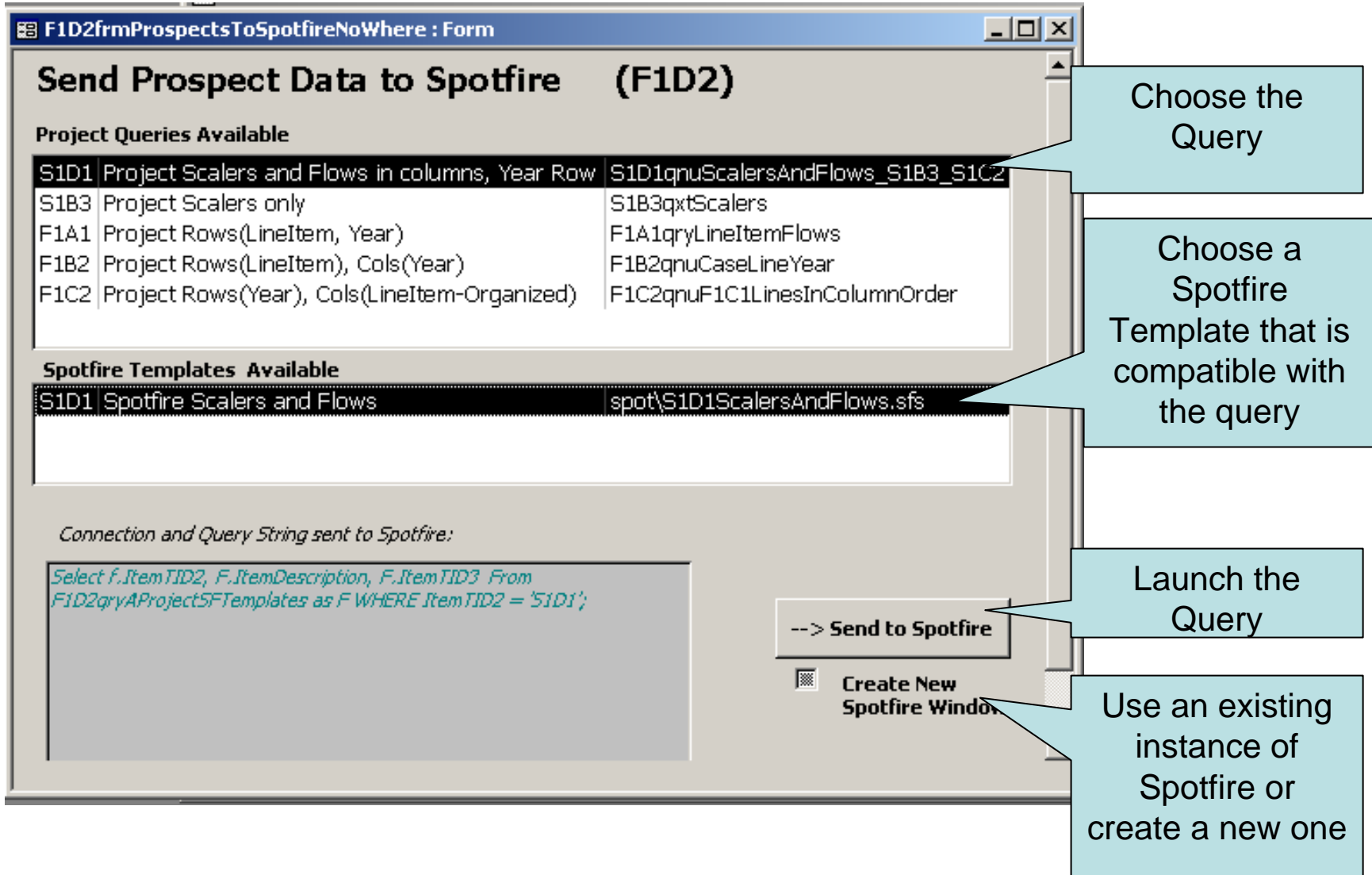
M1A1 M1A1 - Copy Queries to Backend Database

Exit Exit - Close Access

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This work is licensed under a
Creative Commons License.

F1D2 – Choose Canned Queries to send to Spotfire



Send Prospect Data to Spotfire (F1D2)

Project Queries Available

S1D1	Project Scalers and Flows in columns, Year Row	S1D1qnuScalersAndFlows_S1B3_S1C2
S1B3	Project Scalers only	S1B3qxtScalers
F1A1	Project Rows(LineItem, Year)	F1A1qryLineItemFlows
F1B2	Project Rows(LineItem), Cols(Year)	F1B2qnuCaseLineYear
F1C2	Project Rows(Year), Cols(LineItem-Organized)	F1C2qnuF1C1LinesInColumnOrder

Spotfire Templates Available

S1D1	Spotfire Scalers and Flows	spot\S1D1ScalersAndFlows.sfs
------	----------------------------	------------------------------

Connection and Query String sent to Spotfire:

```
Select f.ItemTID2, F.ItemDescription, F.ItemTID3 From
F1D2qryAProjectSFTemplates as F WHERE ItemTID2 = 'S1D1';
```

--> Send to Spotfire

Create New Spotfire Window

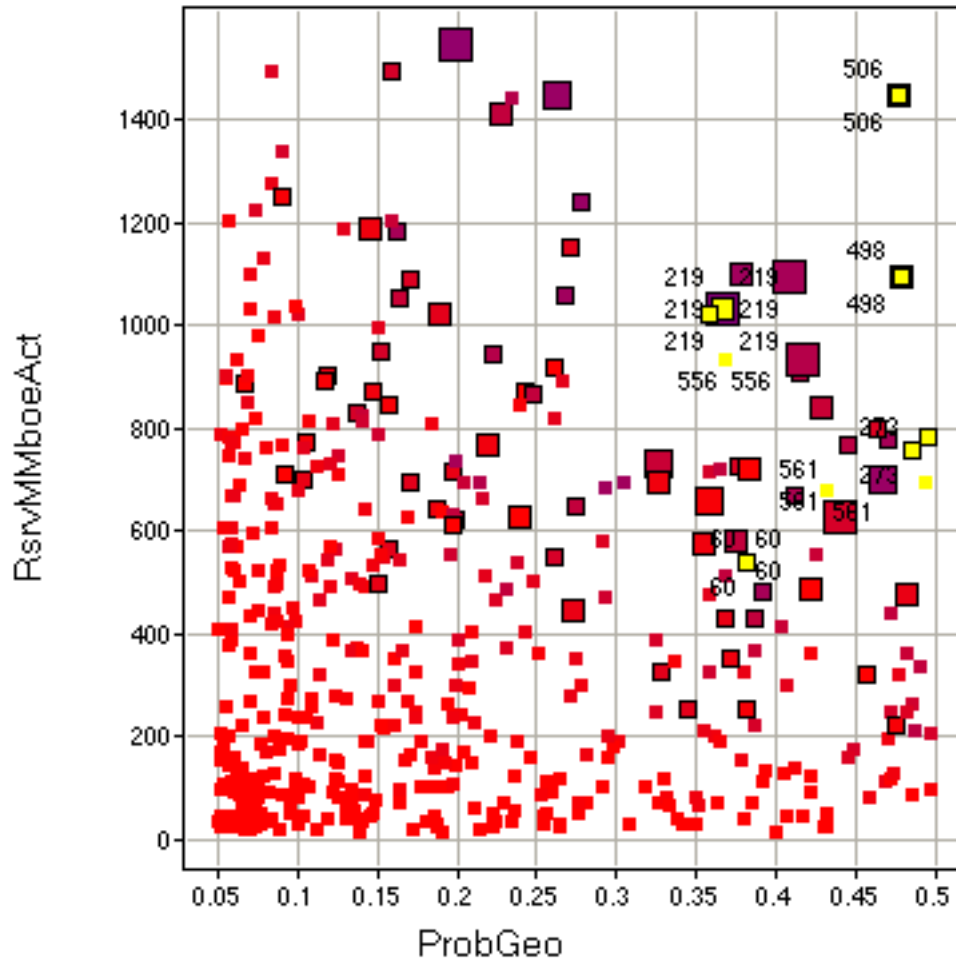
Choose the Query

Choose a Spotfire Template that is compatible with the query

Launch the Query

Use an existing instance of Spotfire or create a new one

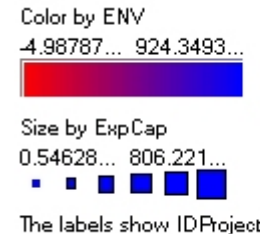
A Prospect Inventory – The most important collection of assets of an Exploration Company



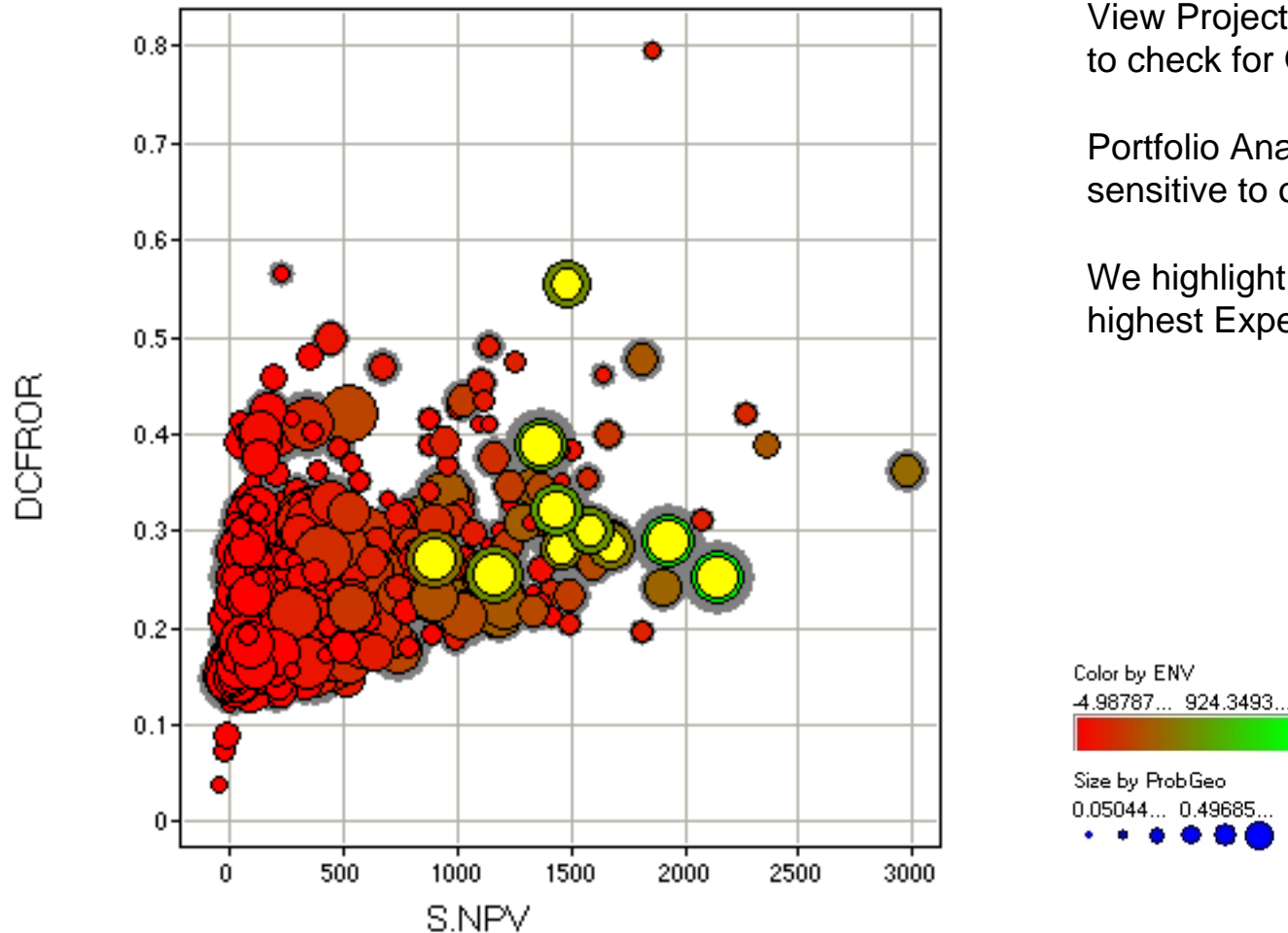
The High ENV (Expected Net Present Value) Projects are, not surprisingly, at high Probabilities of Success.

Note that the color scale is not particularly useful because most of the ENV's are very low.

Size is by Exploration Capex.



ROR vs NPV color:Env Size:Prob

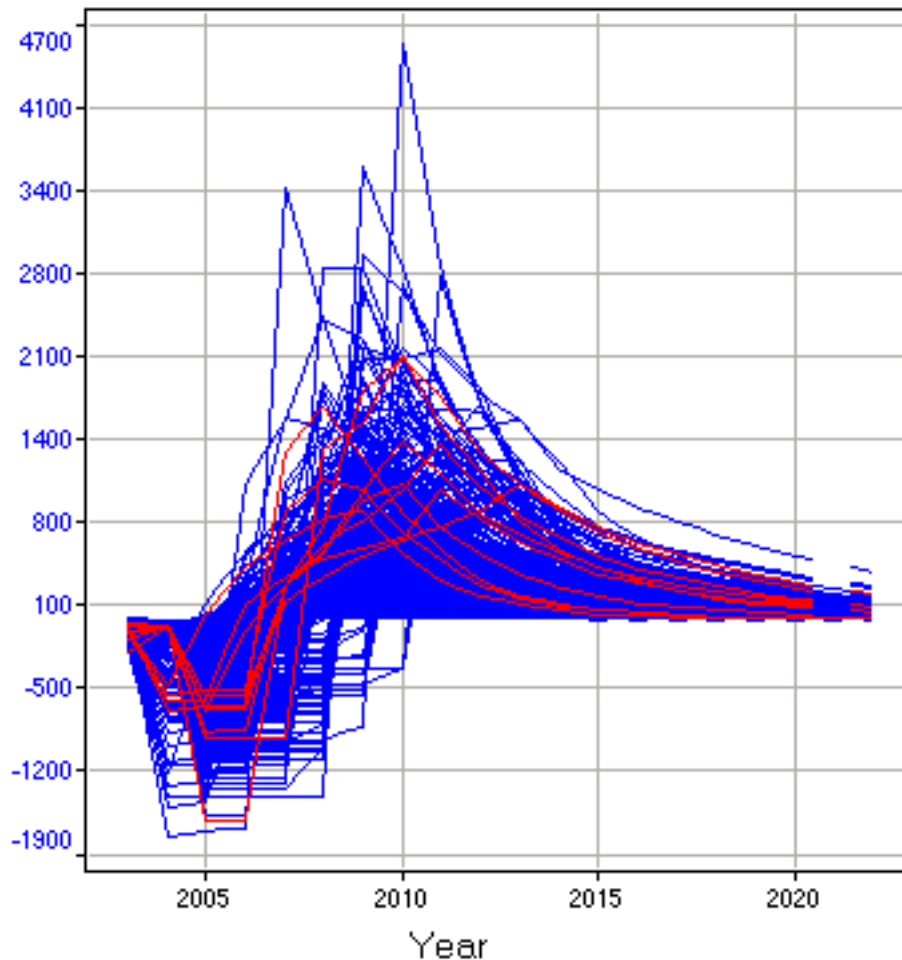


View Project Metrics in the inventory to check for Quality of the input data.

Portfolio Analysis is particularly sensitive to optimistic estimates.

We highlight here 10 project with the highest Expected NPV

If Success Cash Flow After Tax by year



A Line Chart is a much better way to show theFlow data.

All columns use individual scales.

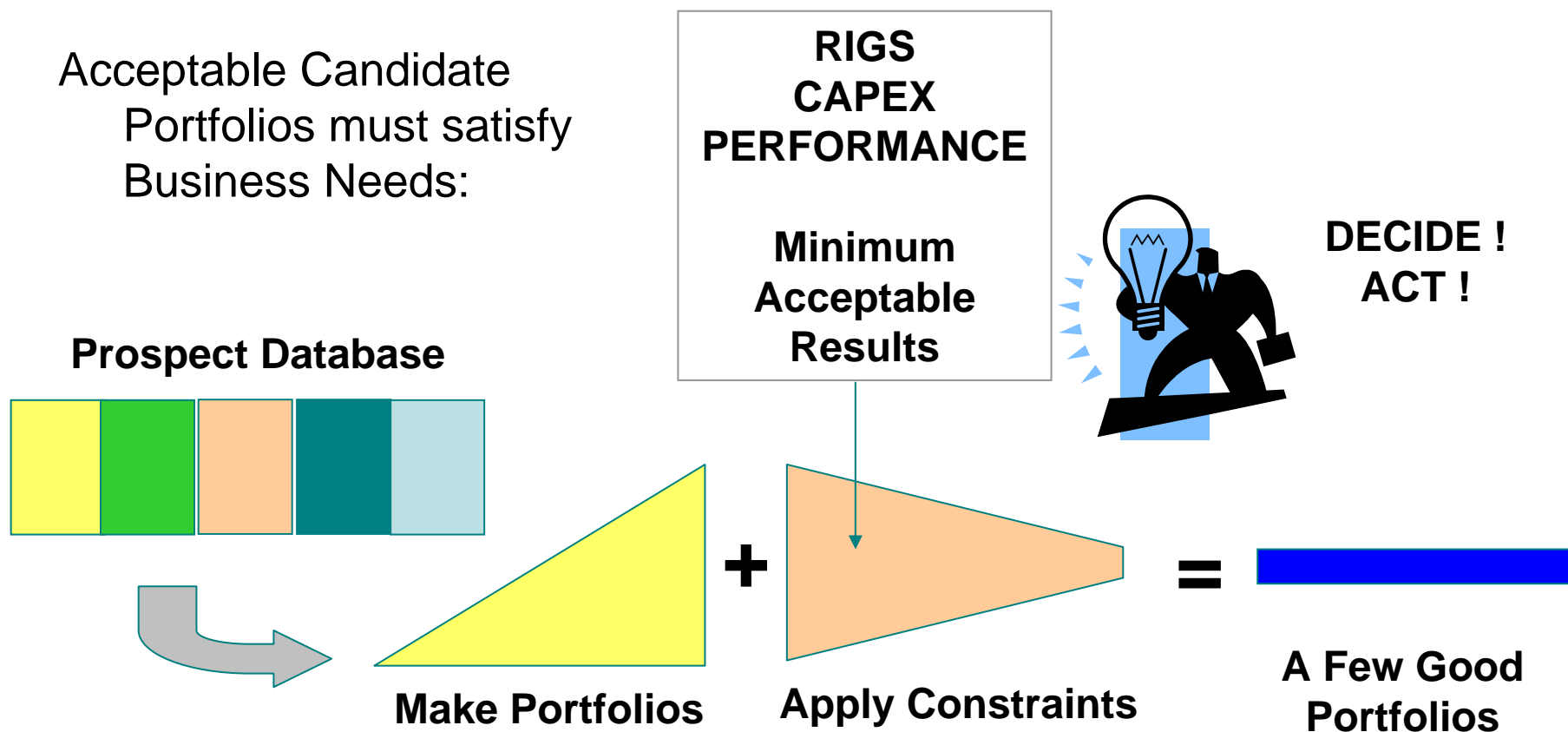
— CashFlow

Markers are connected by IDProject, and ordered by Year.

Portfolio Analysis

A search for Efficient *candidate* Portfolios from a collection of *potential Investment Opportunities*.

Acceptable Candidate Portfolios must satisfy Business Needs:

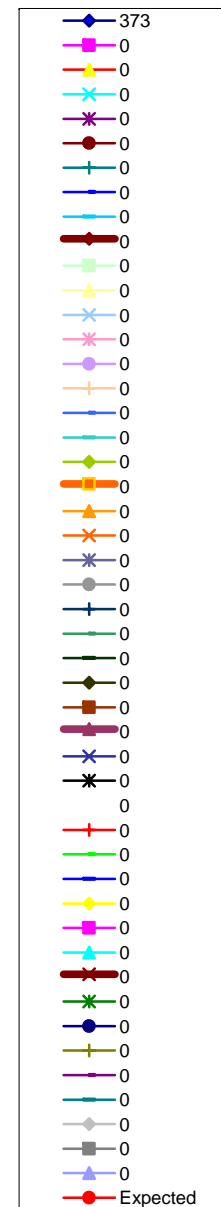
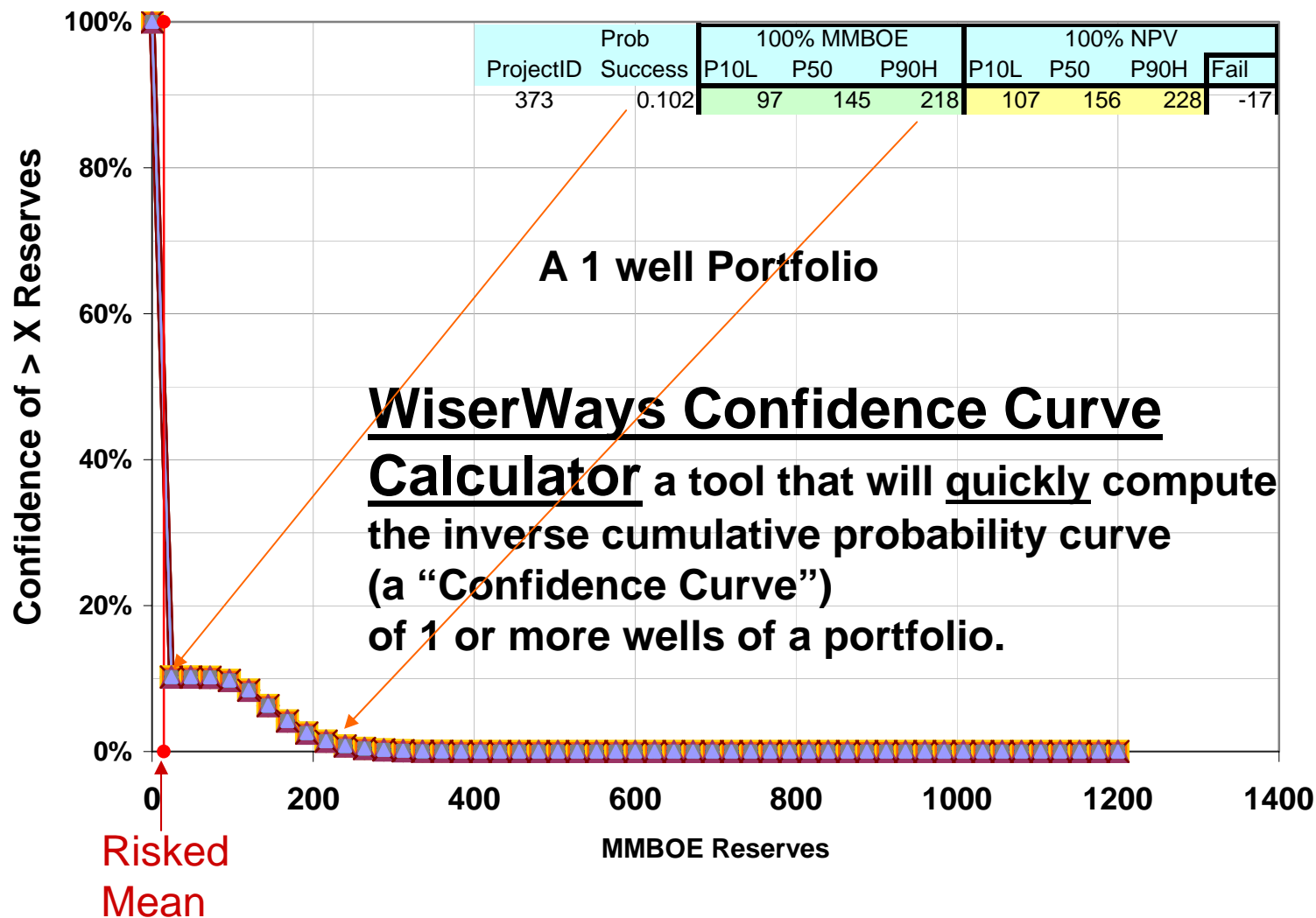


Building a Candidate Portfolio

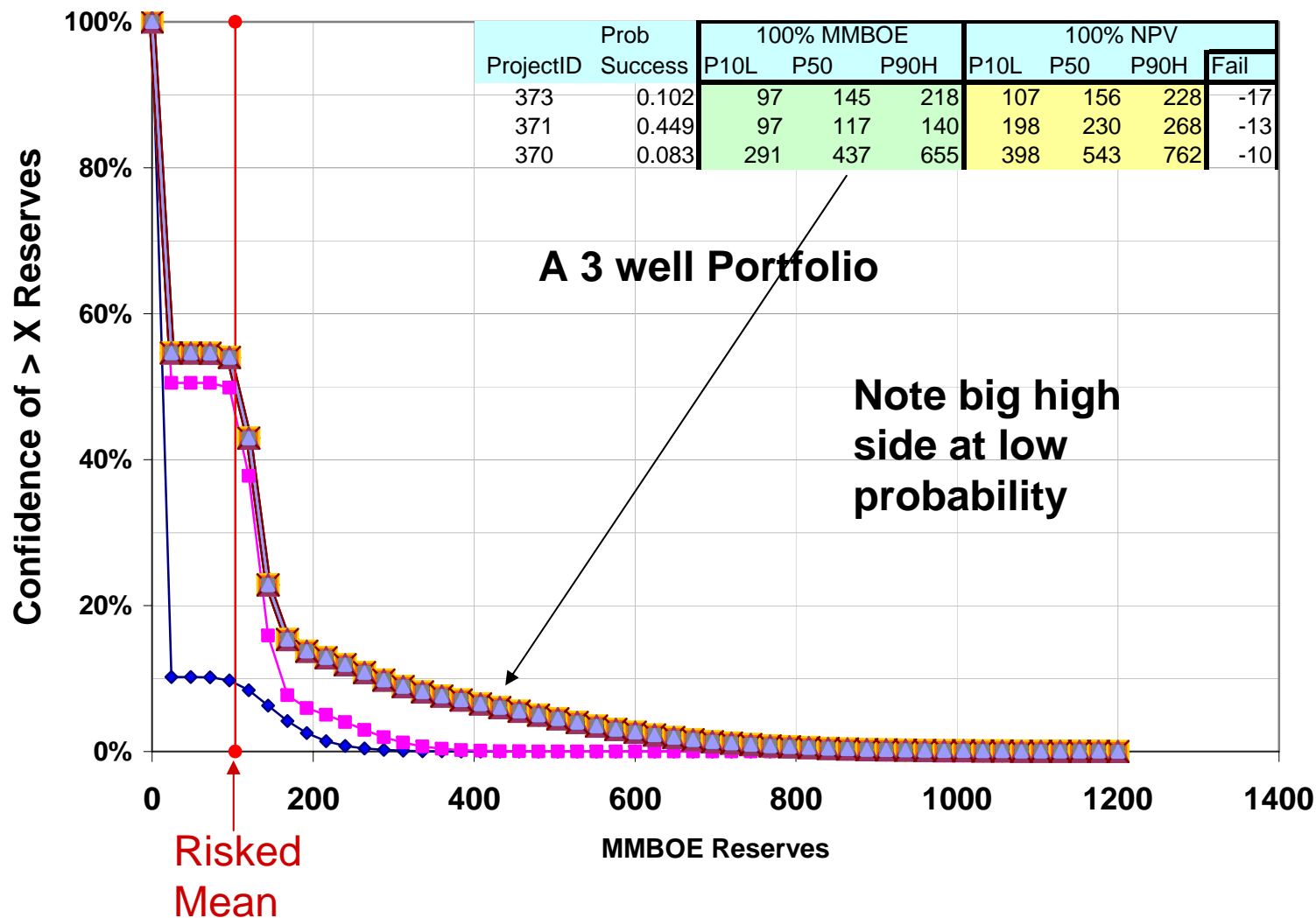
ProjectID	Prob Acquire	Prob Success	100% MMBOE			100% NPV			
			P10L	P50	P90H	P10L	P50	P90H	Fail
359	1	0.102	97	145	218	107	156	228	-17
360	1	0.449	97	117	140	198	230	268	-13
361	1	0.083	291	437	655	398	543	762	-10
362	1	0.457	107	128	154	42	63	89	-45
364	1	0.475	75	90	108	70	85	103	-48
365	1	0.220	237	308	401	261	332	424	-67
366	1	0.056	335	586	1026	160	411	851	-9
368	1	0.125	249	374	561	644	829	1105	-21
369	1	0.209	205	266	346	187	249	329	-36
370	1	0.327	244	293	351	383	444	518	-94
371	1	0.126	76	114	171	110	148	205	-4
373	1	0.200	227	295	383	596	725	892	-21

More
↓

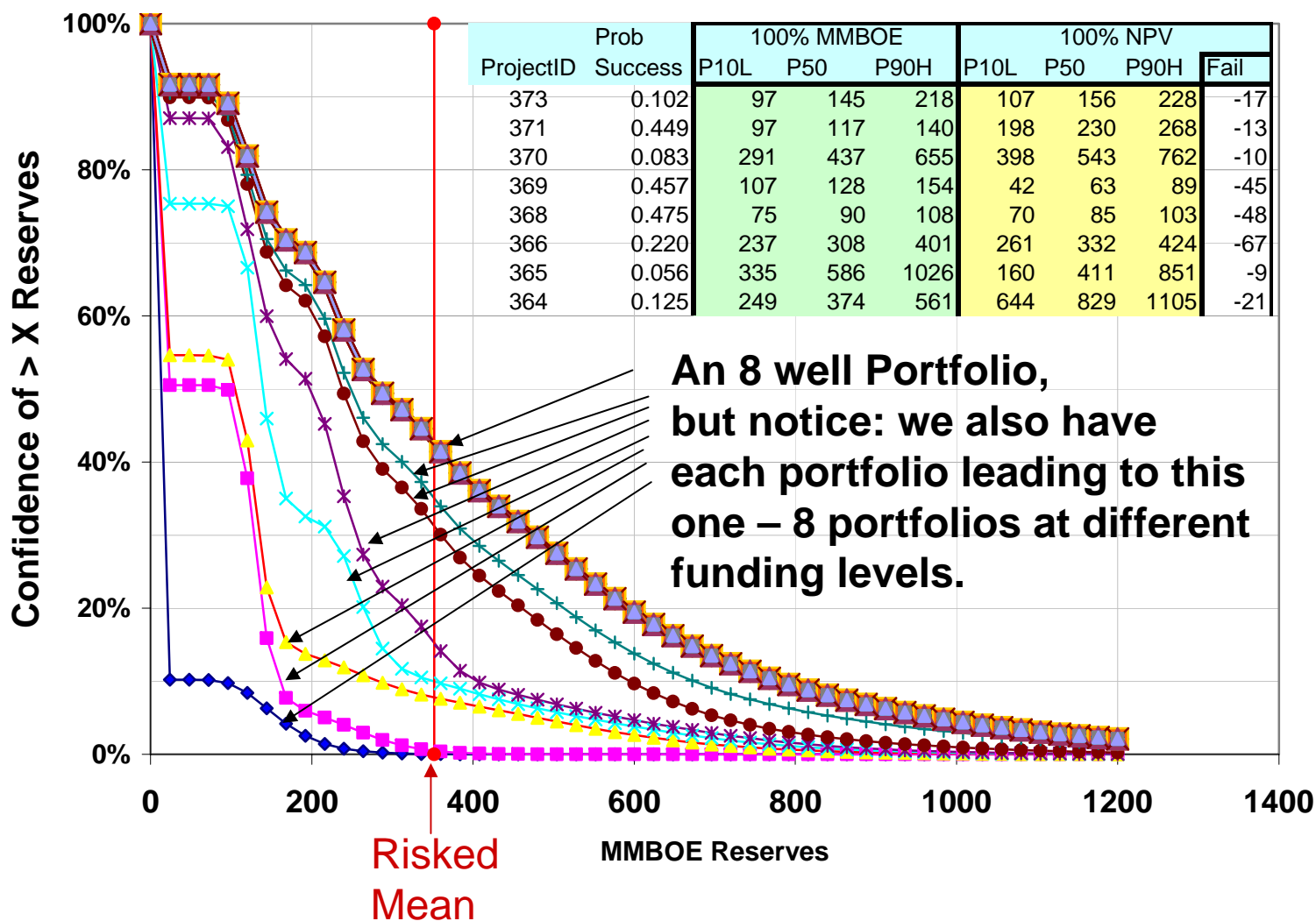
Confidence of At Least X Reserves



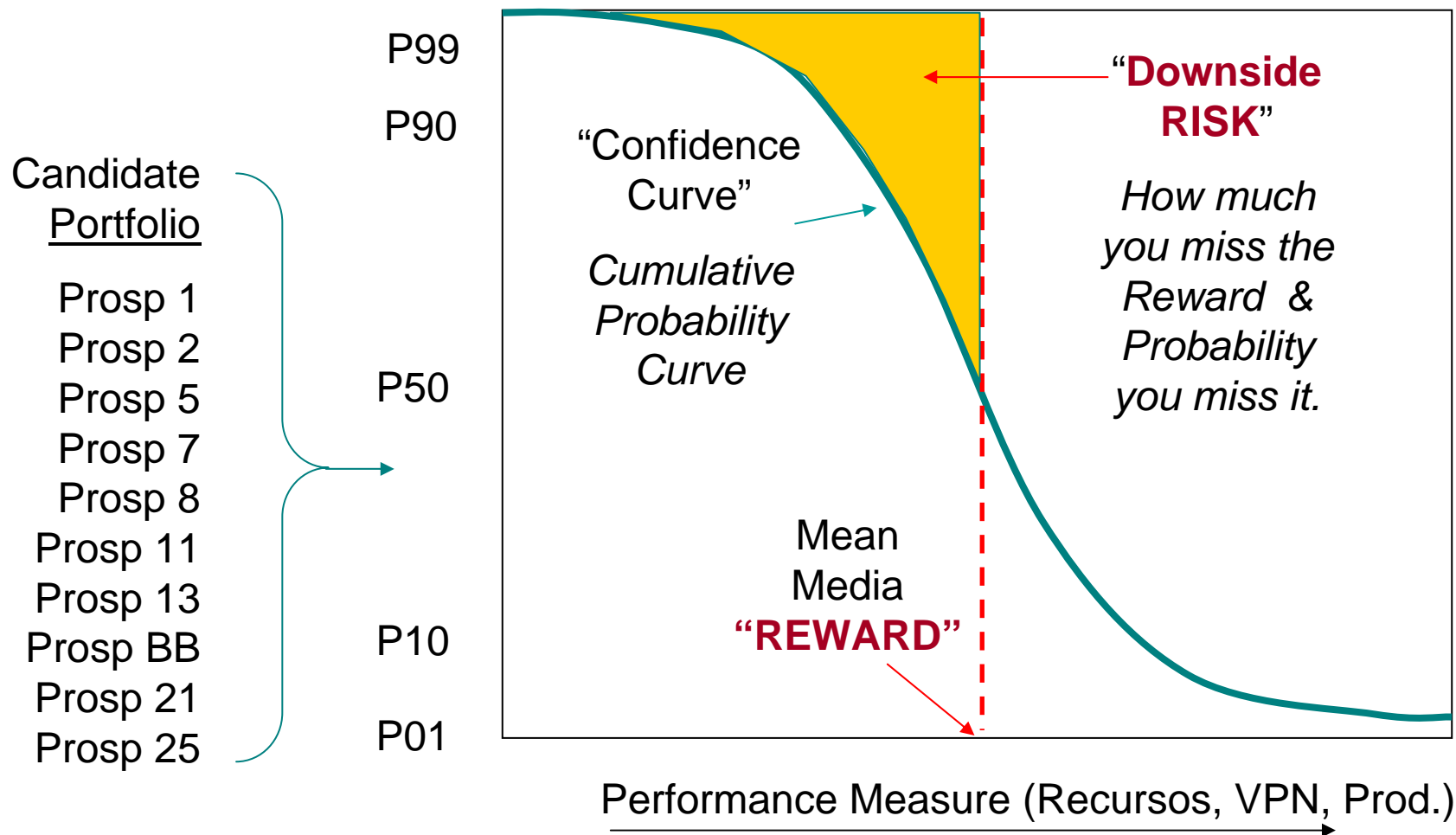
Confidence of At Least X Reserves



Confidence of At Least X Reserves

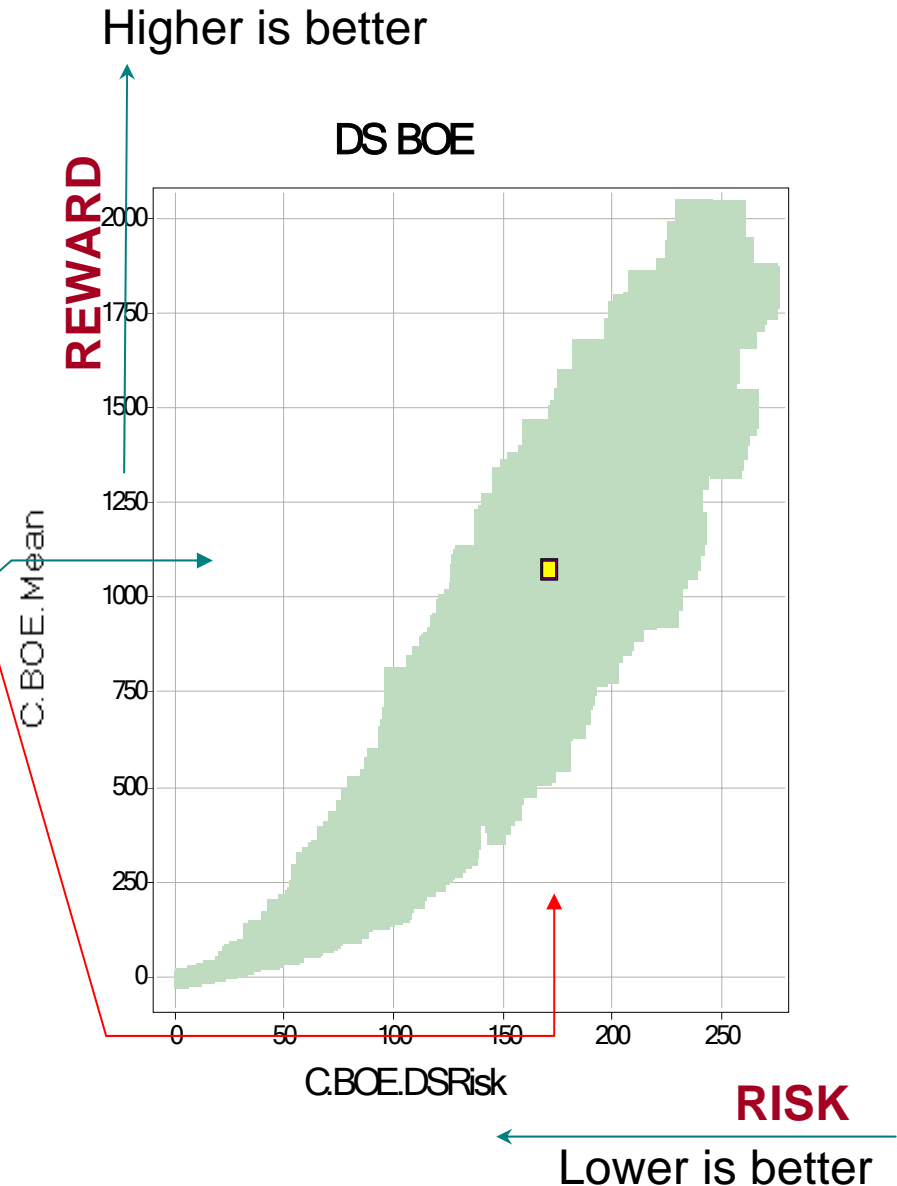
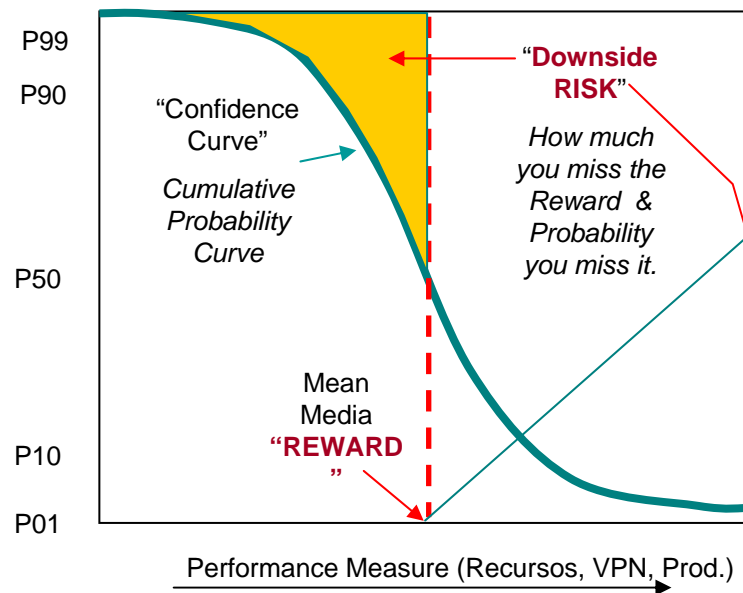


Portfolio Risk and Reward

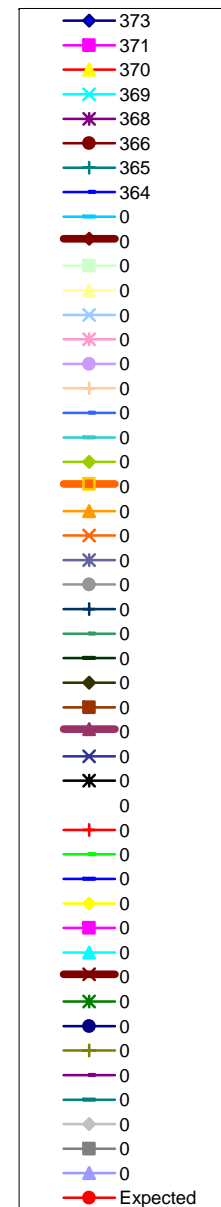
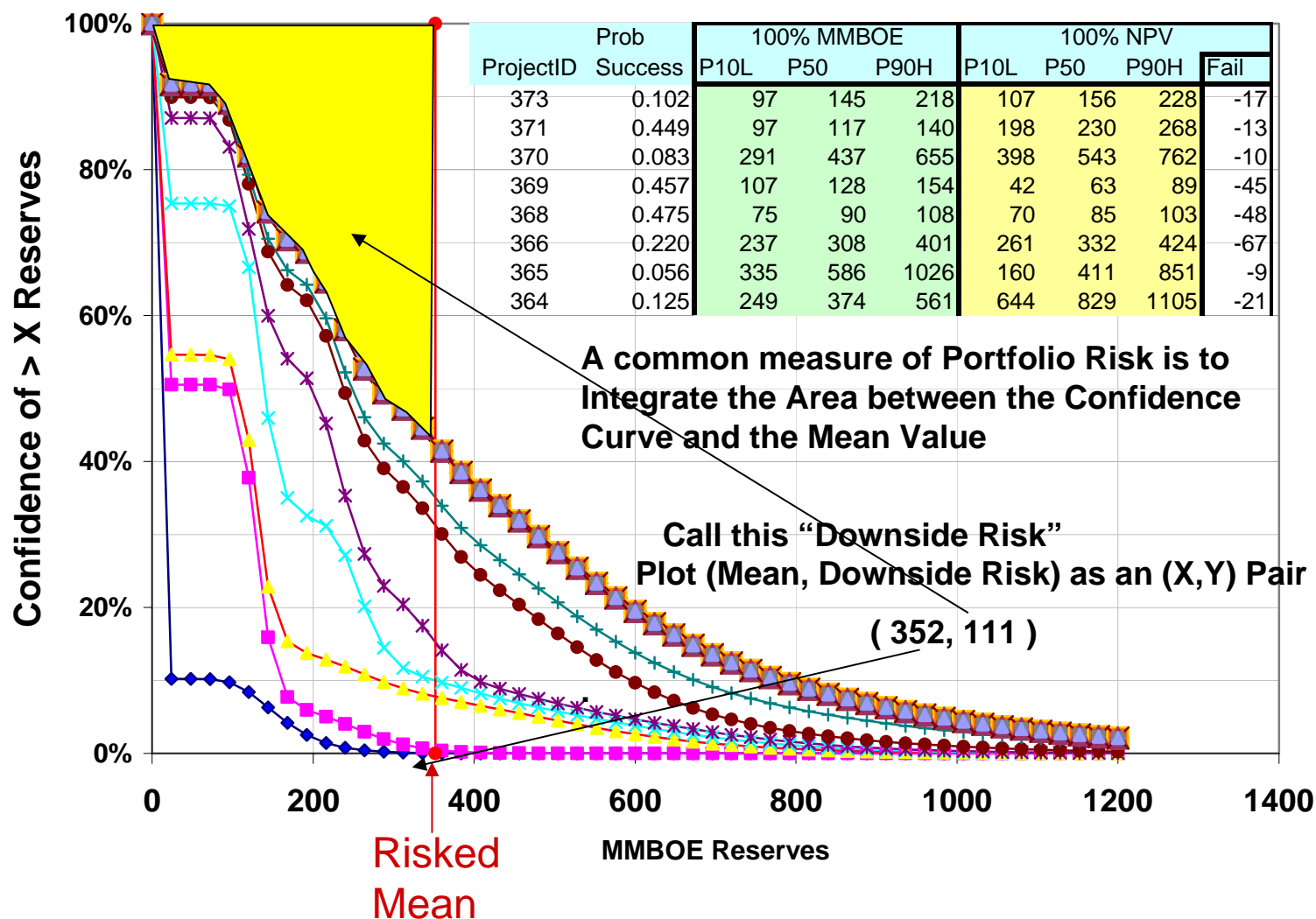


We Plot the Portfolio as ONE POINT

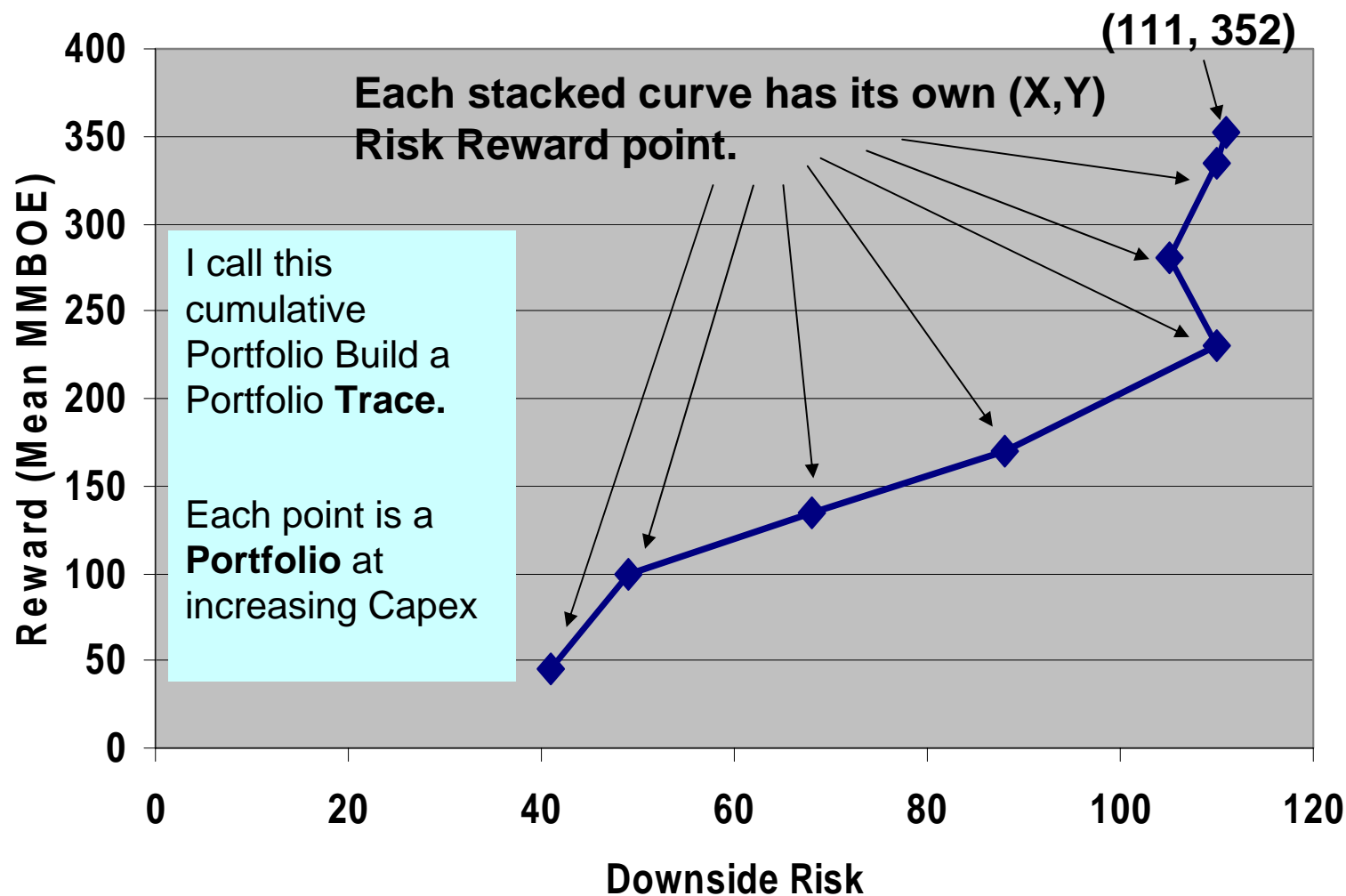
(Risk, Reward)



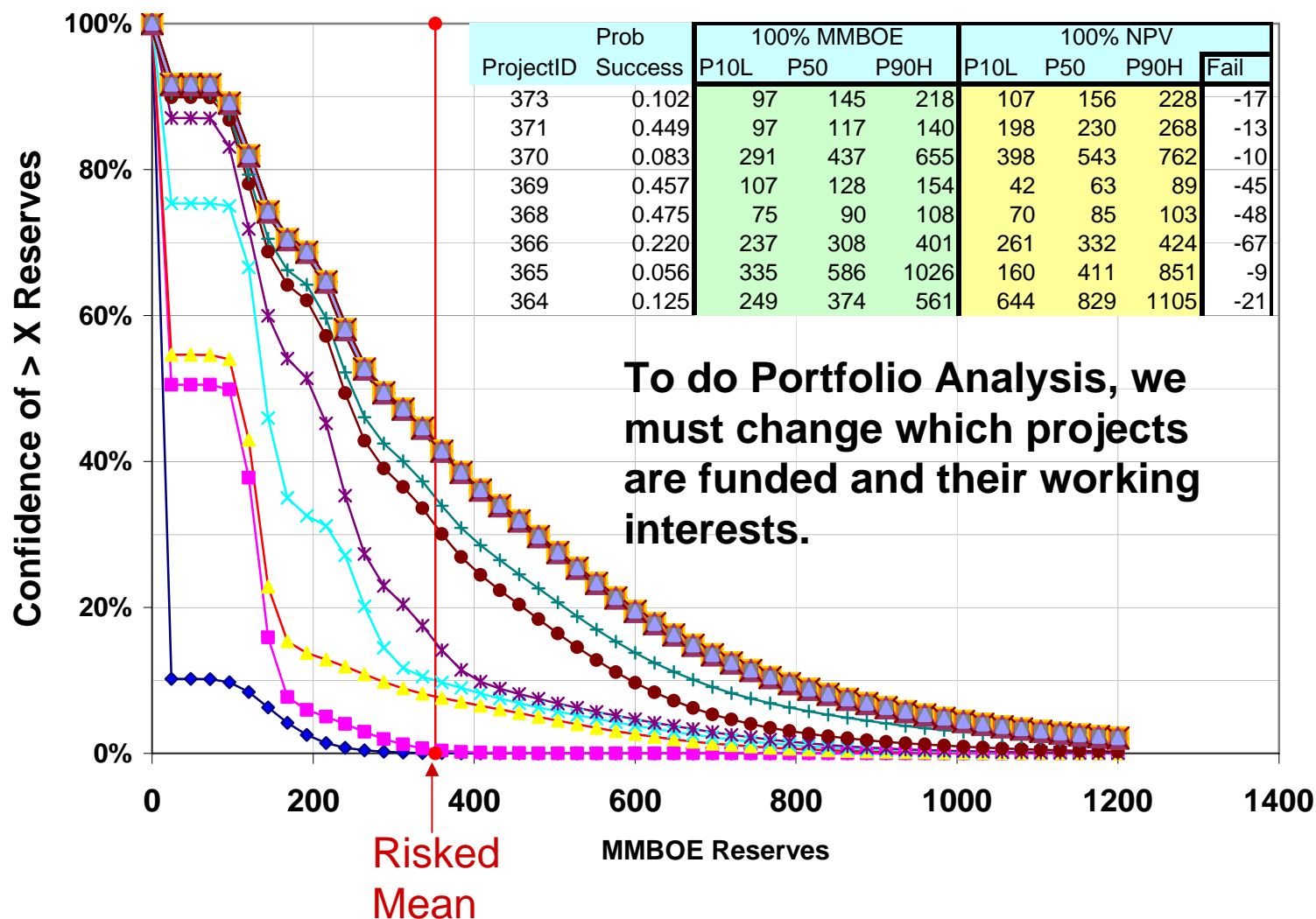
Confidence of At Least X Reserves



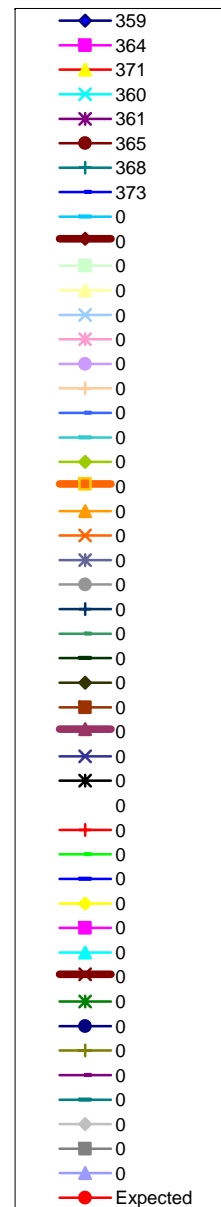
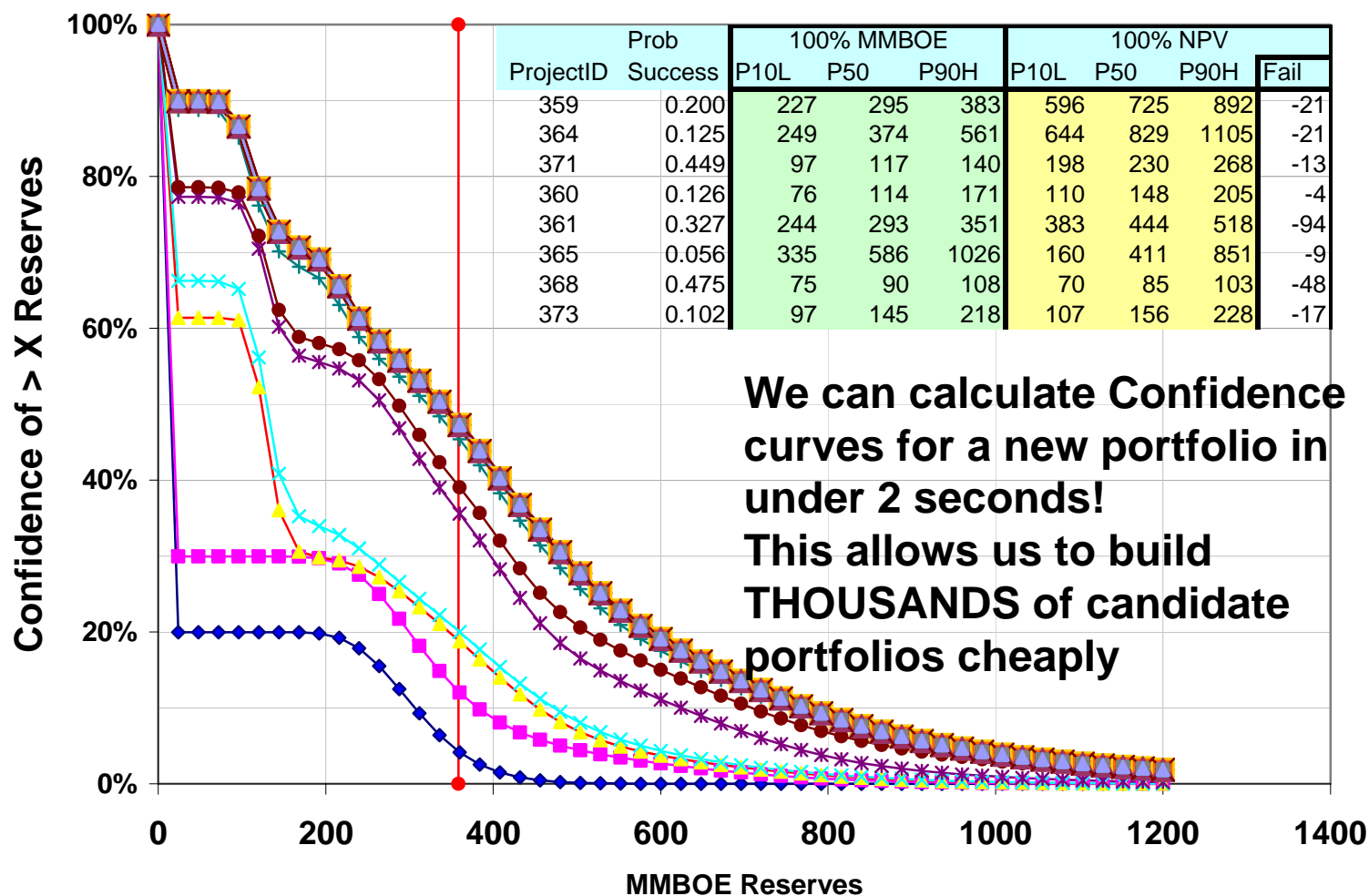
Risk Reward Plot for an 8 well Portfolio Trace



Confidence of At Least X Reserves



Confidence of At Least X Reserves



WiserWays MultiField Confidence Curve Calculator

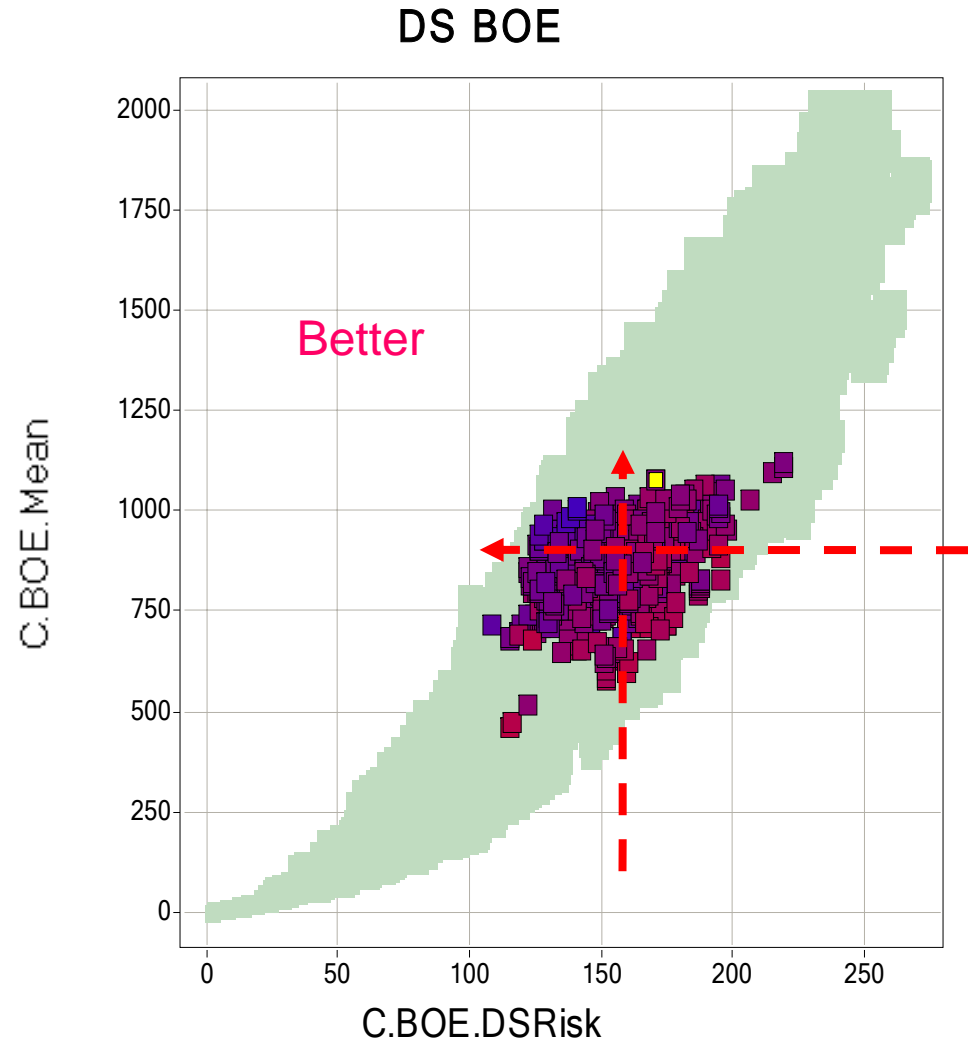
- The largest version can handle
 - a 5000 Project inventory,
 - Up to 150 funded at any one portfolio
 - Up to 3 discrete working interest per project
 - Customized weighted project selection based upon good heuristics.
- Each trace calculates has up to 150 Portfolio points.
- Each Portfolio point has FIVE confidence curves at isotiles (every 5%) for MMBOE and NPV written to the database.
- Process time: 10 seconds per trace including writing to the Database. -- 15 Portfolios per second. (2.4Ghz Pentium IV)
- Confidence Curves calculated directly without simulation
- Available for sale from WiserWays.

WiserWays MultiField Confidence Curve Calculator Superior to Monte Carlo Simulation

- **Calculation speed is 20 seconds.** Monte Carlo simulation could take 200 to 2000 seconds.
- **Repeatable.** No random numbers used.
- Output of Monte Carlo simulation always have a statistical uncertainty in the result.
MultiField has **no such error.**
- MultiField automatically writes results to a database.
Most Monte Carlo applications use manual processes to write to separate spreadsheets.
- Input Distributions are not limited to Log-Normal assumptions.

Definitions

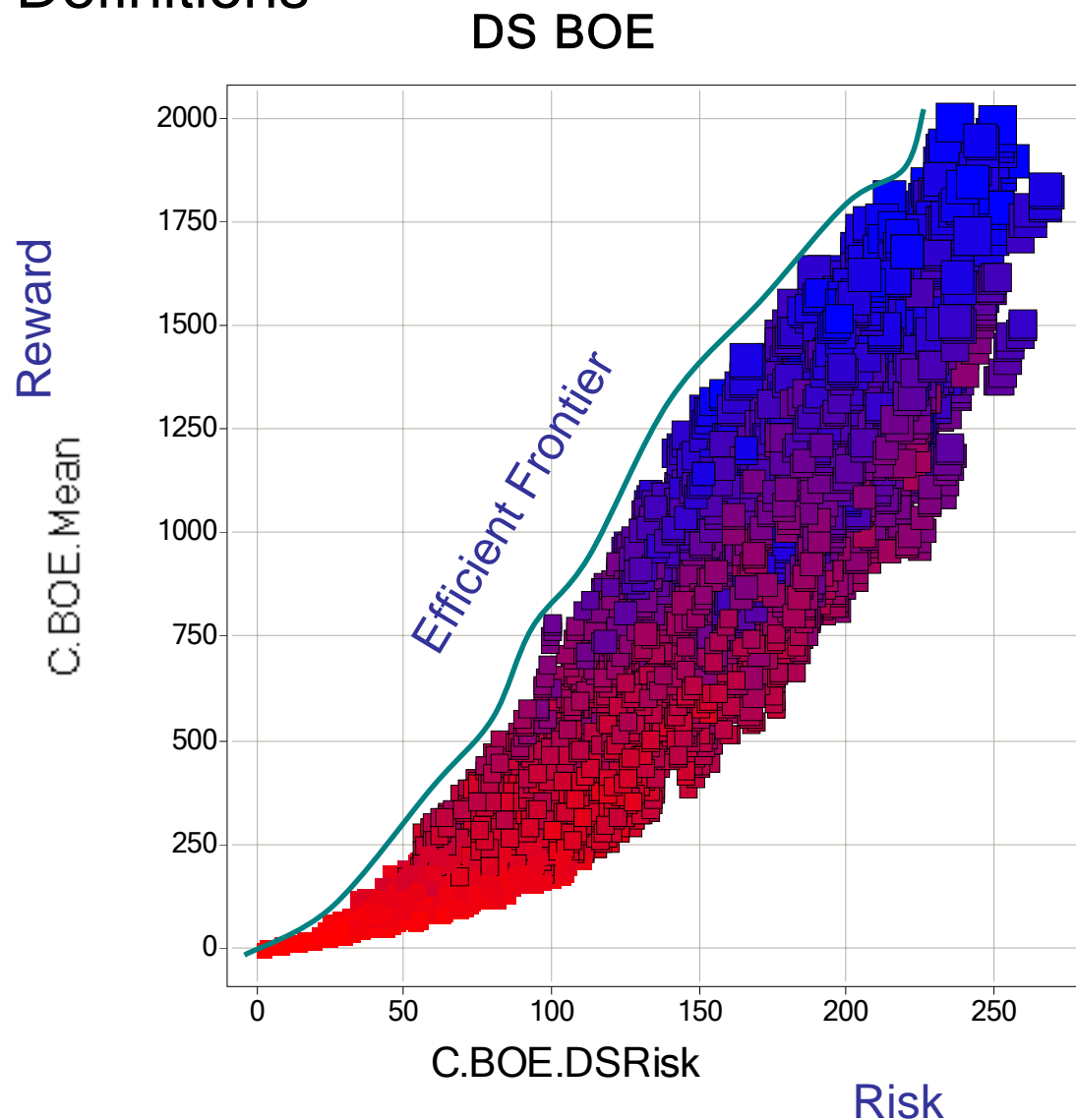
- Efficient Portfolio: A portfolio that provides the greatest expected return for a given level of risk.
- Which is Lowest Risk for a given expected return.



Definitions

- **Efficient Frontier:**
The line on a risk-reward graph comprised of all efficient portfolios.

This is the Frontier for all portfolios regardless of Capex Level.

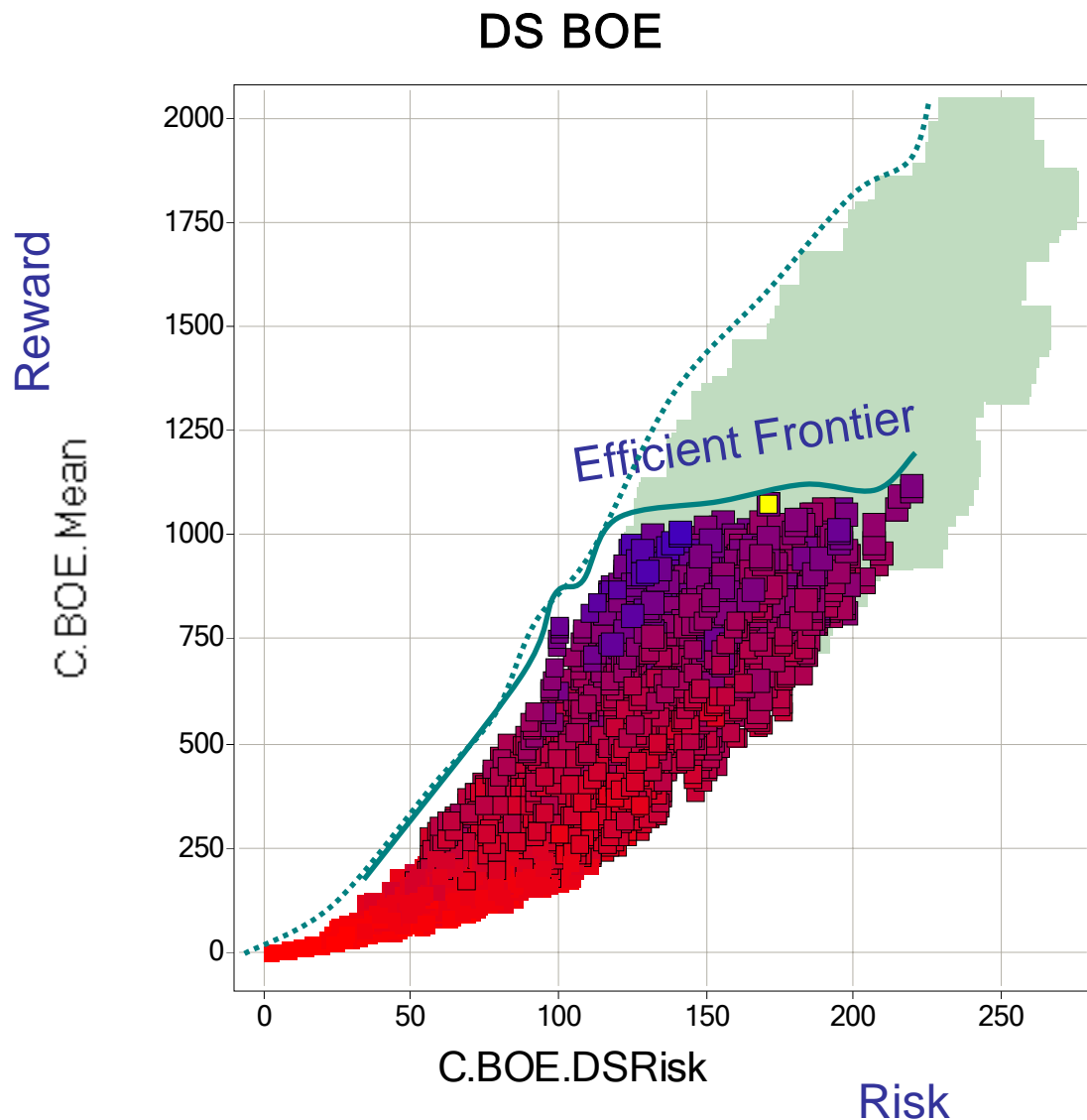


Definitions

- Efficient Frontier:
The line on a risk-reward graph comprised of all efficient portfolios.

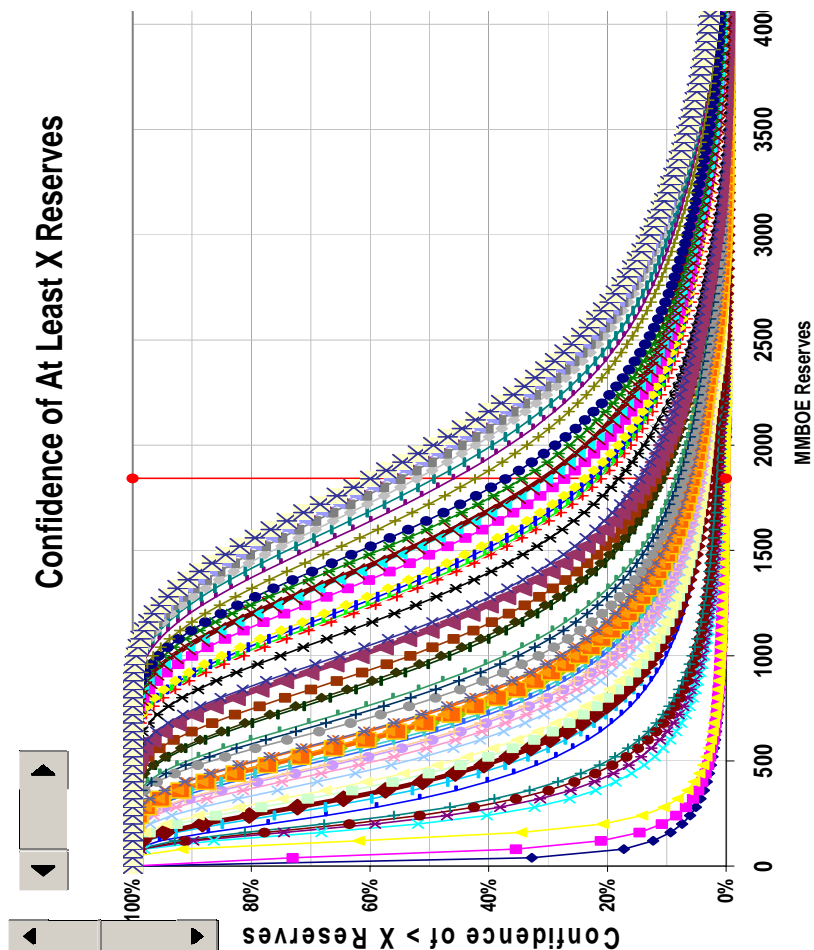
This is the Frontier for all portfolios with Capex limited to under 500 MMUSD.

So the Frontier is dependent on Budget and Goals



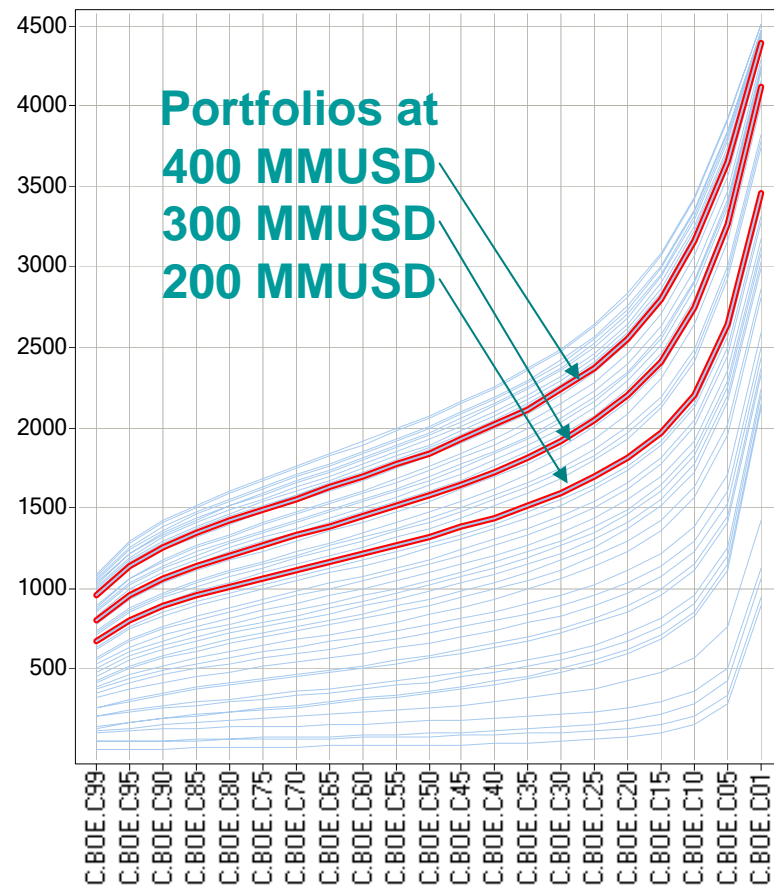
Confidence Curves in Excel and Spotfire

Excel (rotated)



Spotfire Profile Chart

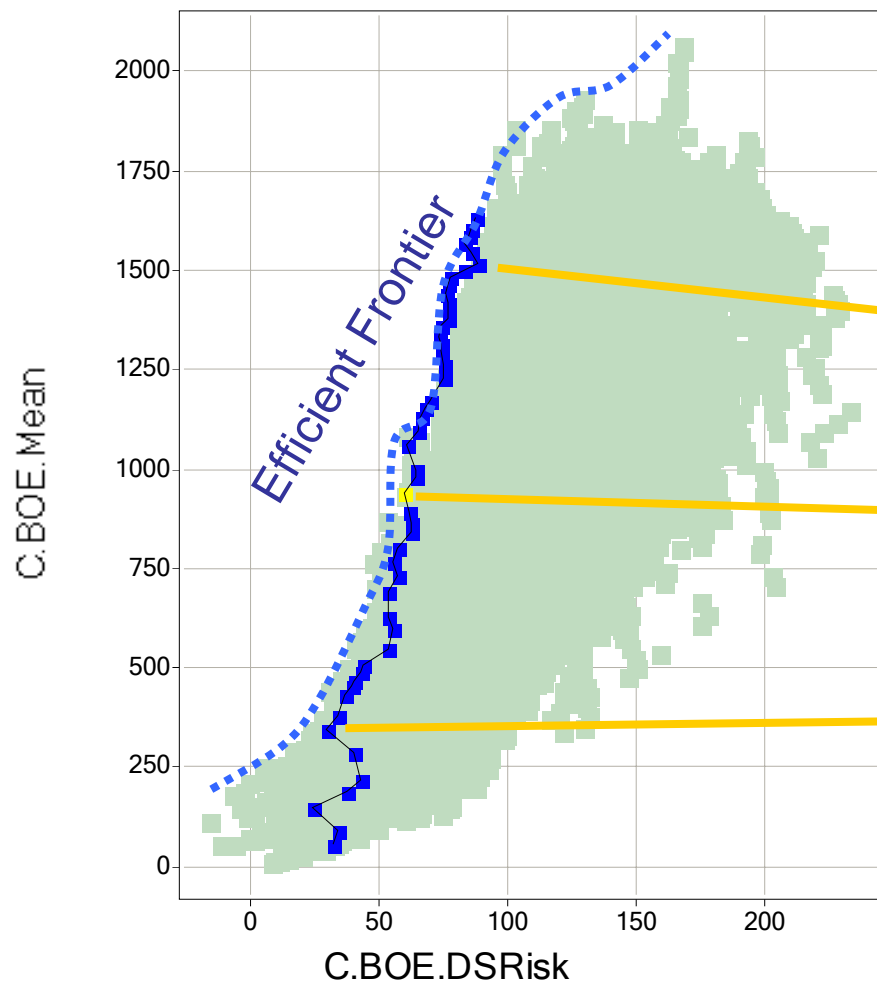
MMBOE Conf



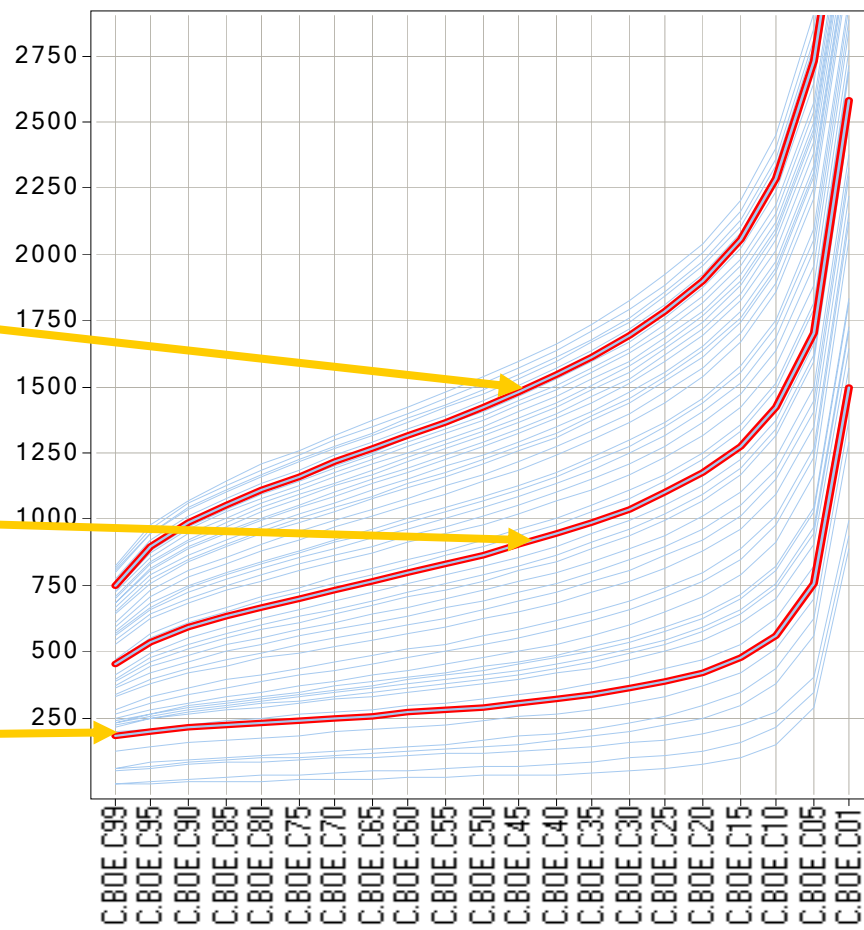
MMBOE Risk Reward Trace 1007

Each Portfolio Point on the Risk Reward Plot
Maps to a Confidence curve

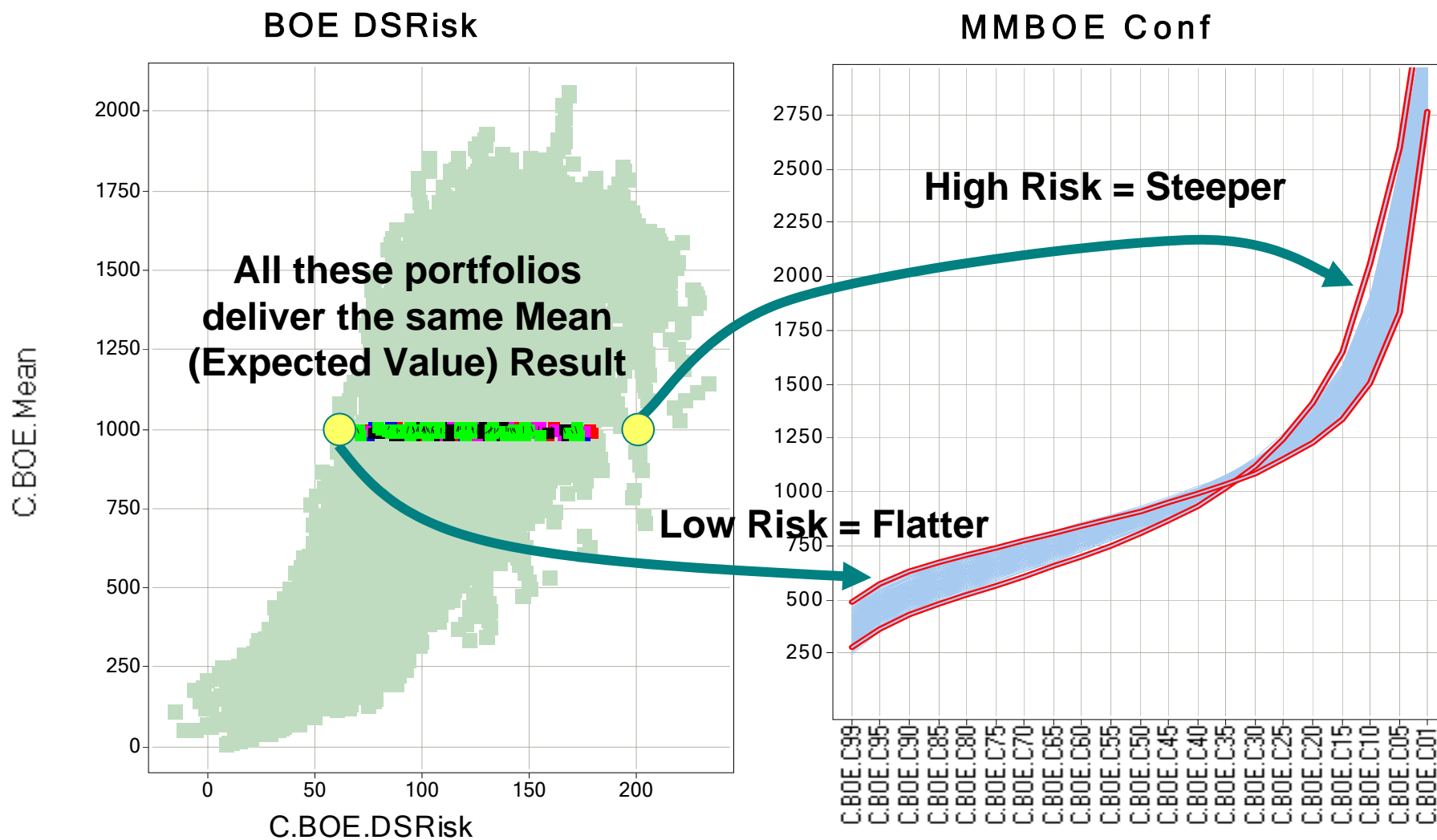
BOE DSRisk



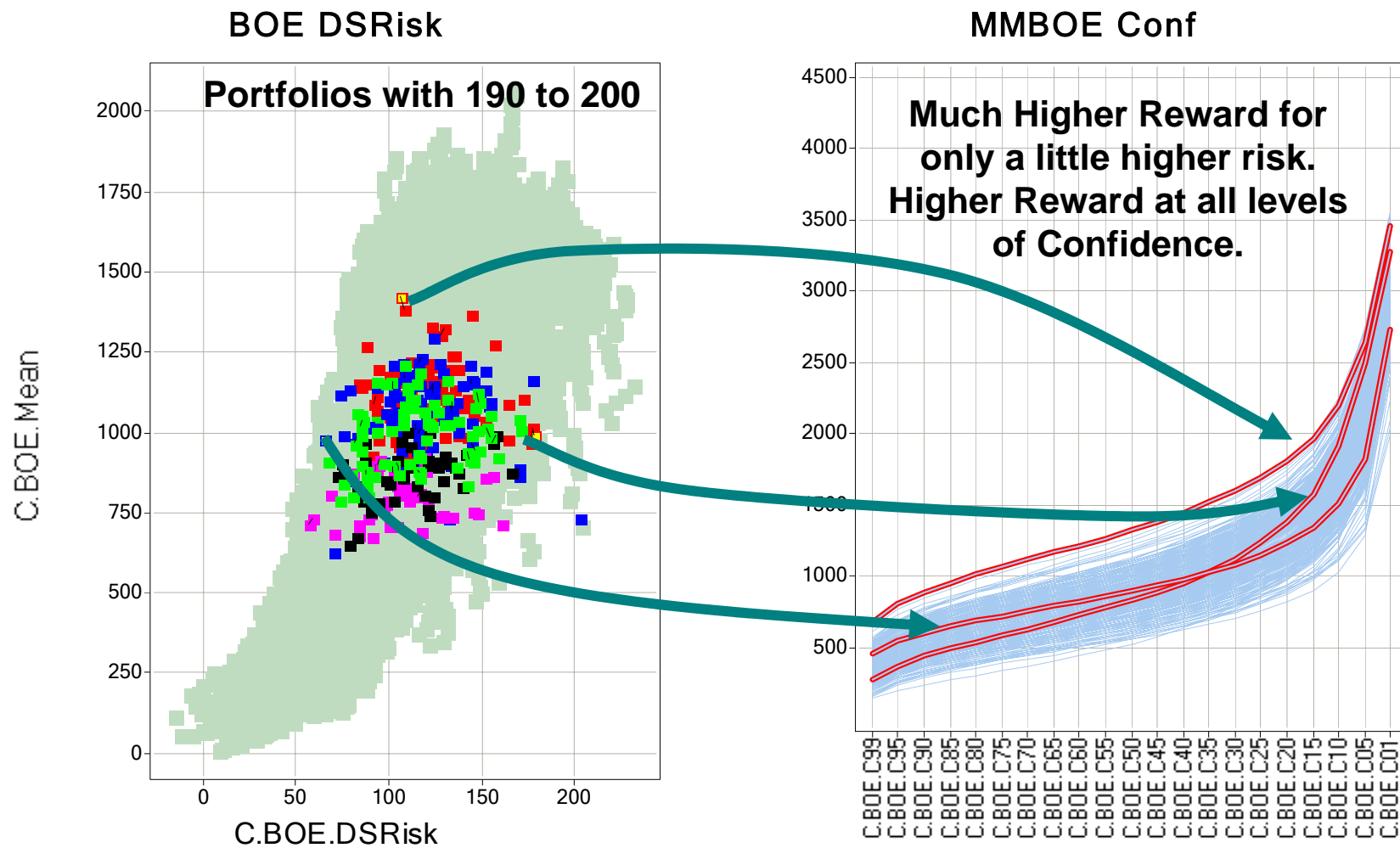
MMBOE Conf



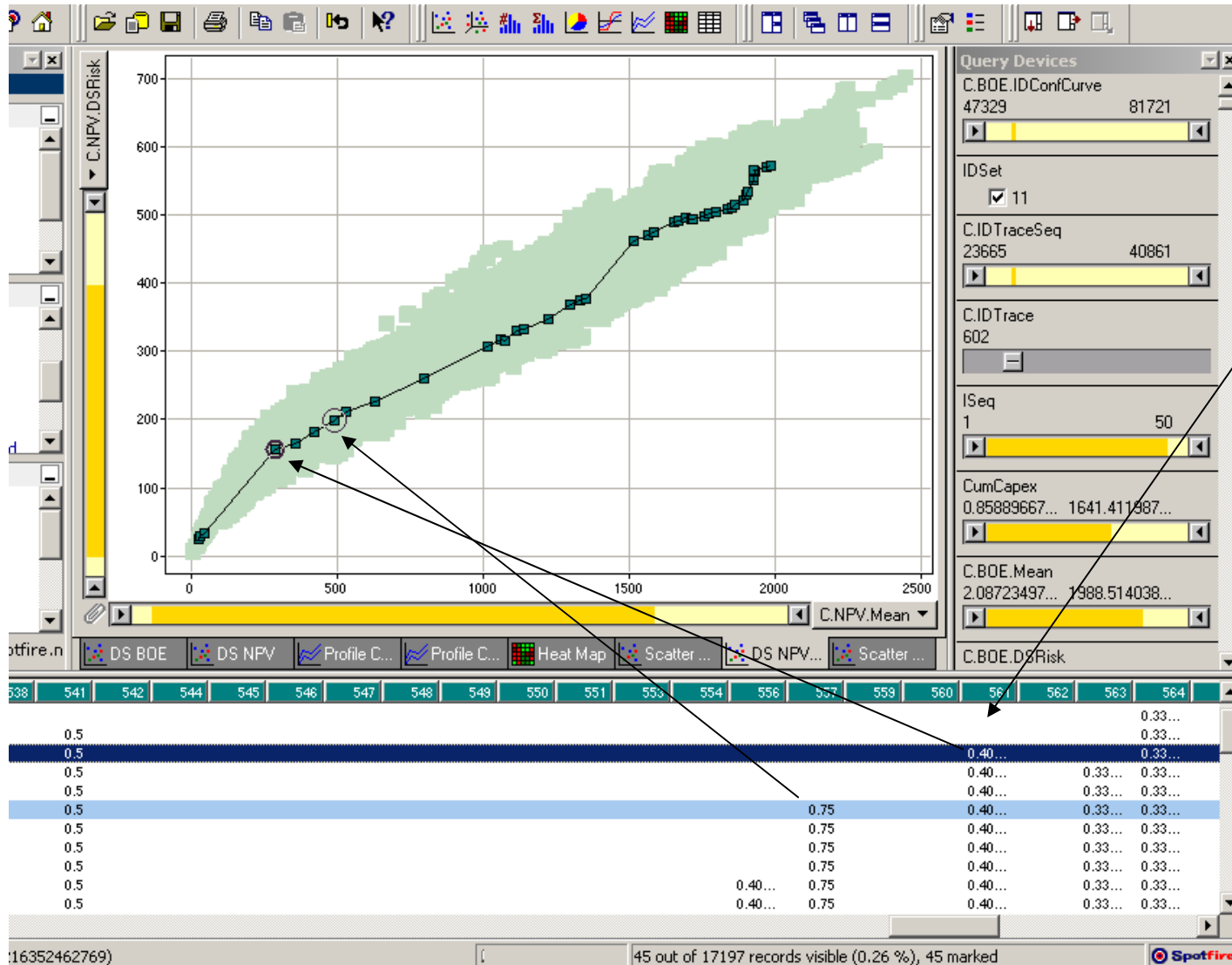
The Risk of a Portfolio = Steepness of the Confidence Curve



The Mean value is often more important than Downside Risk



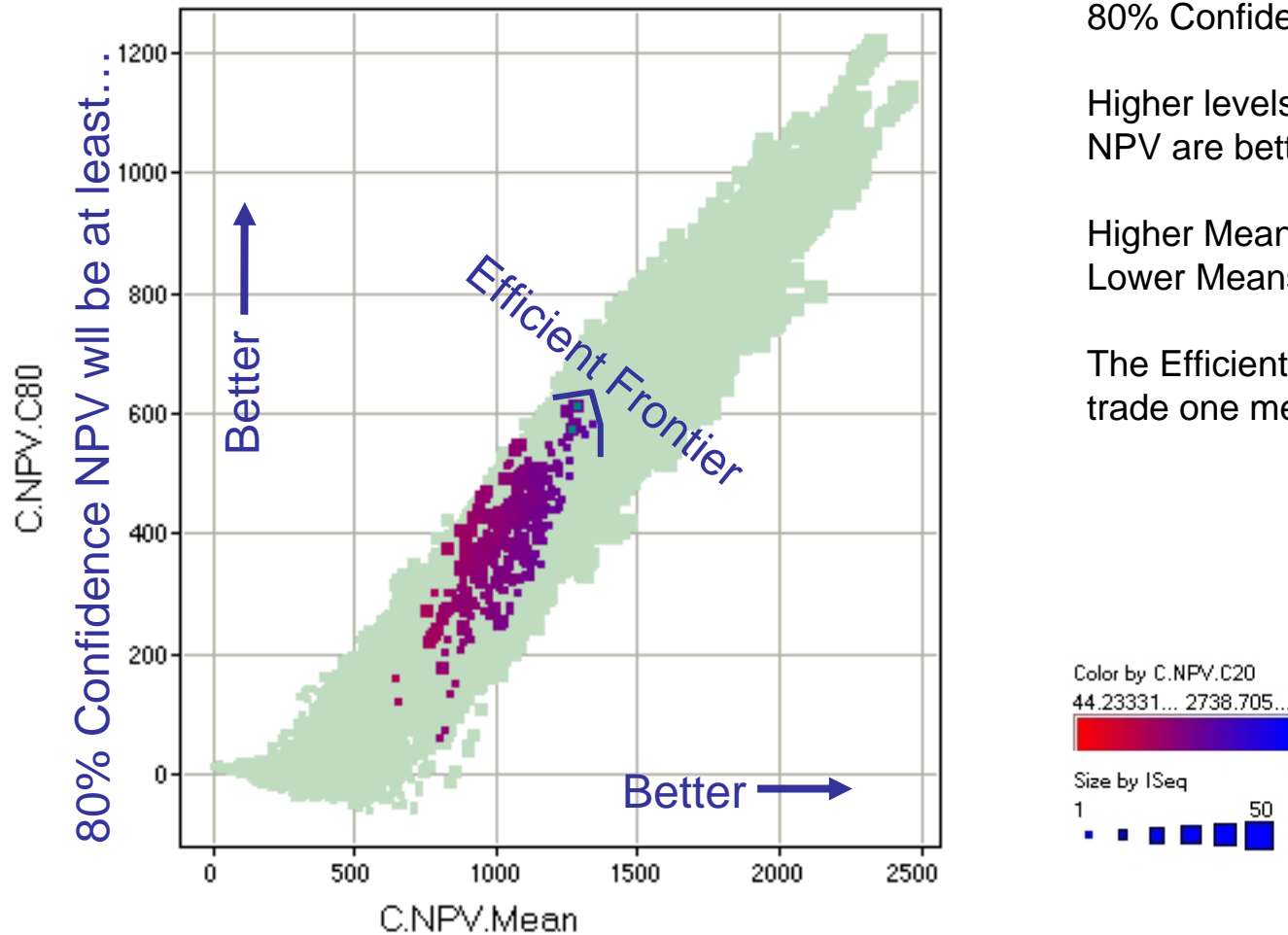
NPV Risk Reward, Trace 602, with Details of Project WI



Trace 602
Shown

Spotfire's
**Details on
Demand**
shows you
the
working
interest of
each
project (a
column) in
a portfolio
(row)

You can use any measure of risk



80% Confidence NPV vs Mean NPV.

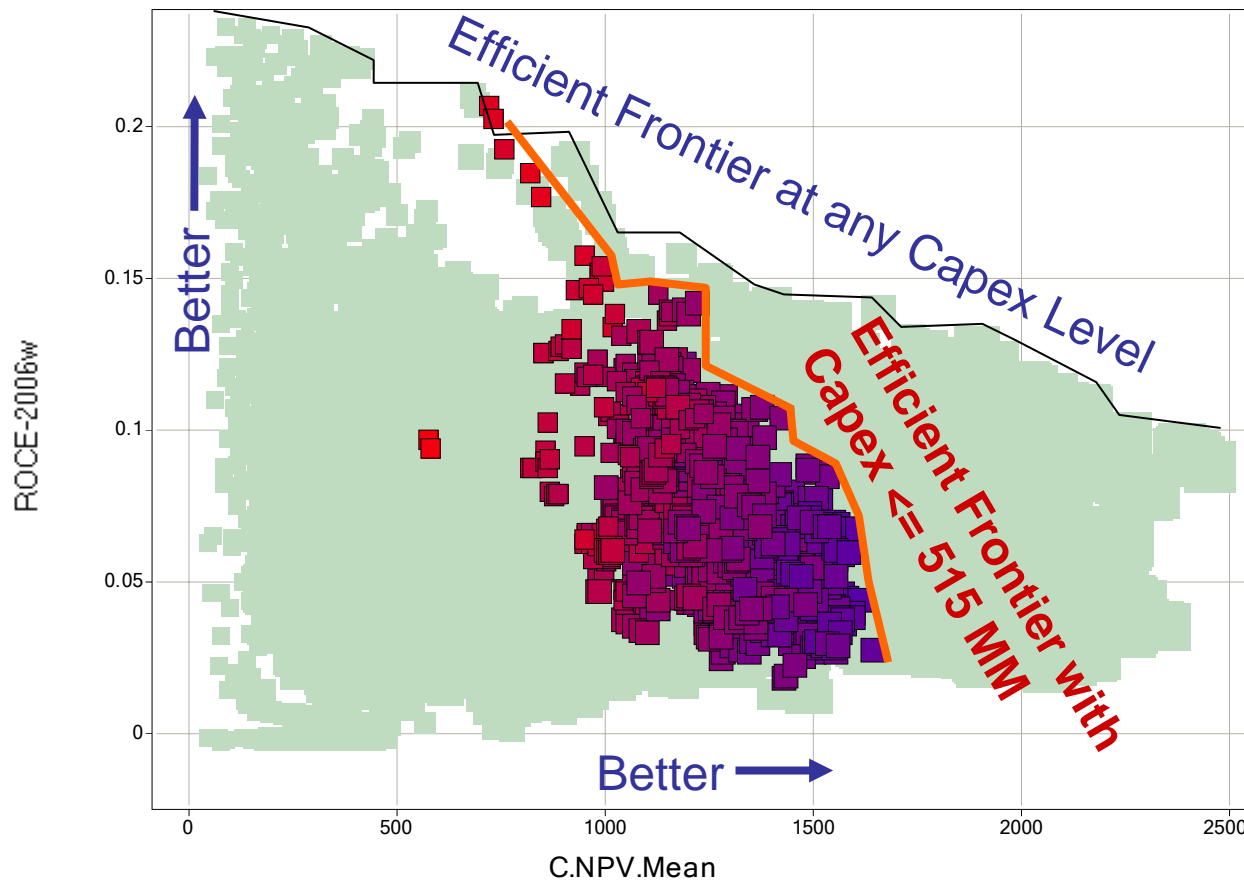
Higher levels of 80% Confidence NPV are better than low levels.

Higher Mean NPV are better than Lower Means.

The Efficient Frontier is where you trade one measure for another.

Efficient Frontiers can also compare trade-offs between conflicting goals

ROCE vs NPV - C.NPV.Mean vs. ROCE-2006w



Here we compare Return on Capital Employed in 2006 vs Portfolio NPV (in 2003)

The selected points (red-blue) are constrained by CumCapex between 450 and 515 \$MM

Are there any Companies using this Portfolio System?

¡Sí!



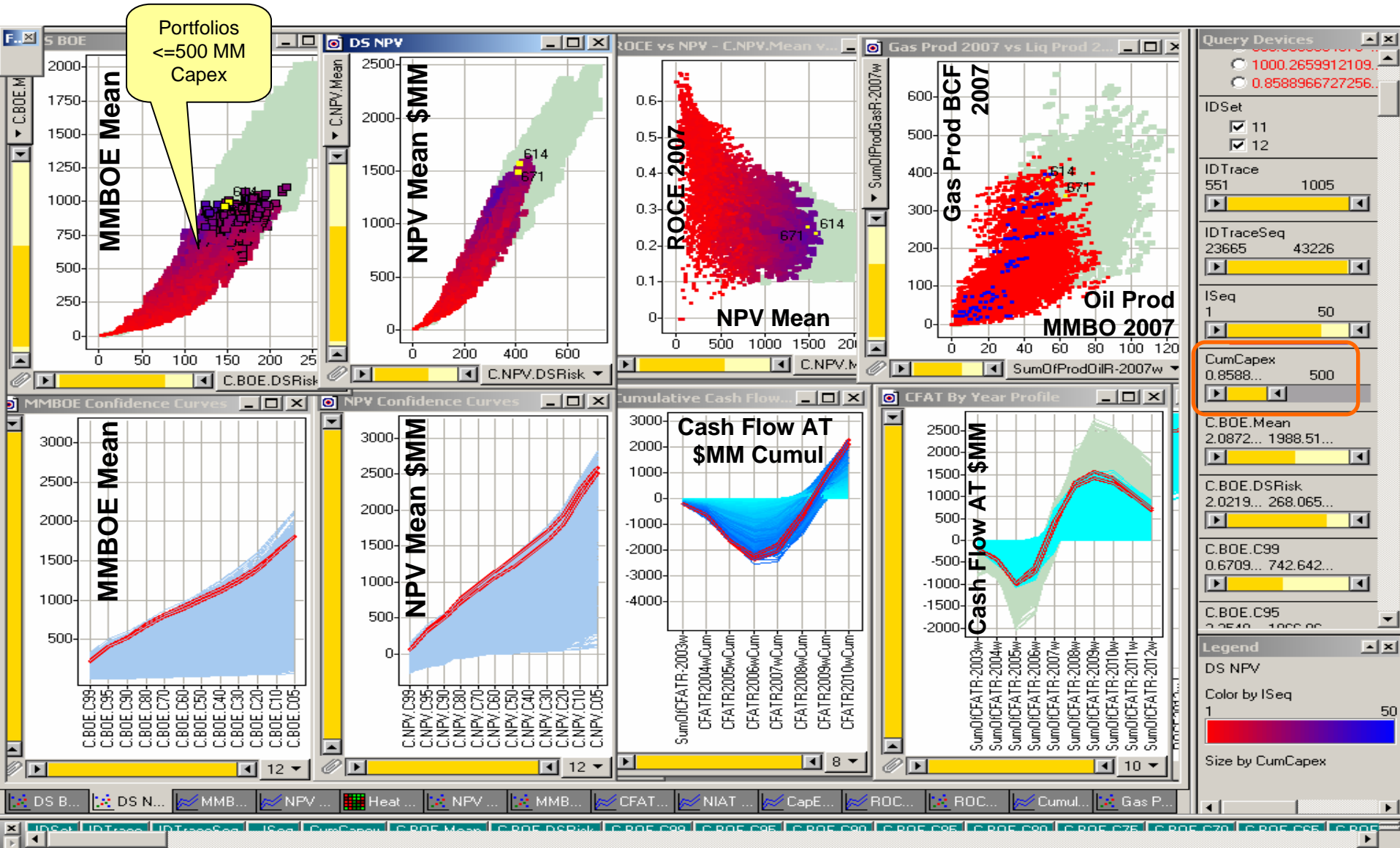
At the April 2002 AAPG Convention, Pemex presented their processes for Risk Analysis and outlines of their Prospect Inventory. They reported they had over 1000 prospects.

Brett Edwards of Custer Resources saw a version of this Portfolio Analysis presentation from the May 2003 London Spotfire User's Conference. We made a proposal to Pemex Exploration Executive Management on July 20. We got an immediate go-ahead.

By October 8, the we had generated over 1,500,000 portfolios on over 20,000 traces.

WiserWays Example data in common types of displays

Stable layouts are essential for quick understanding

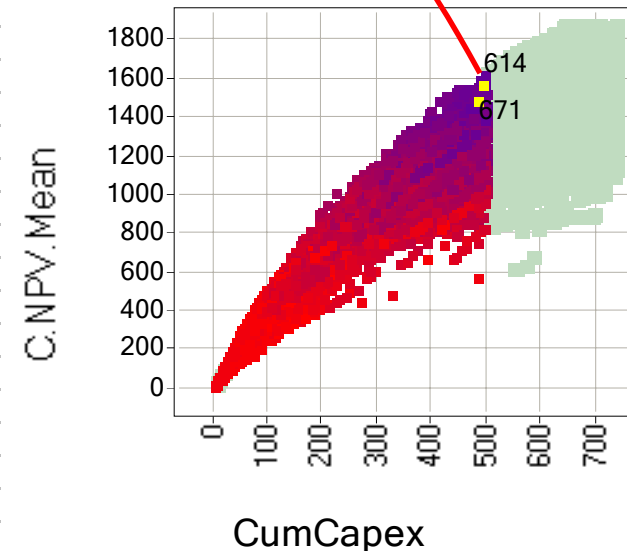


Project Census:

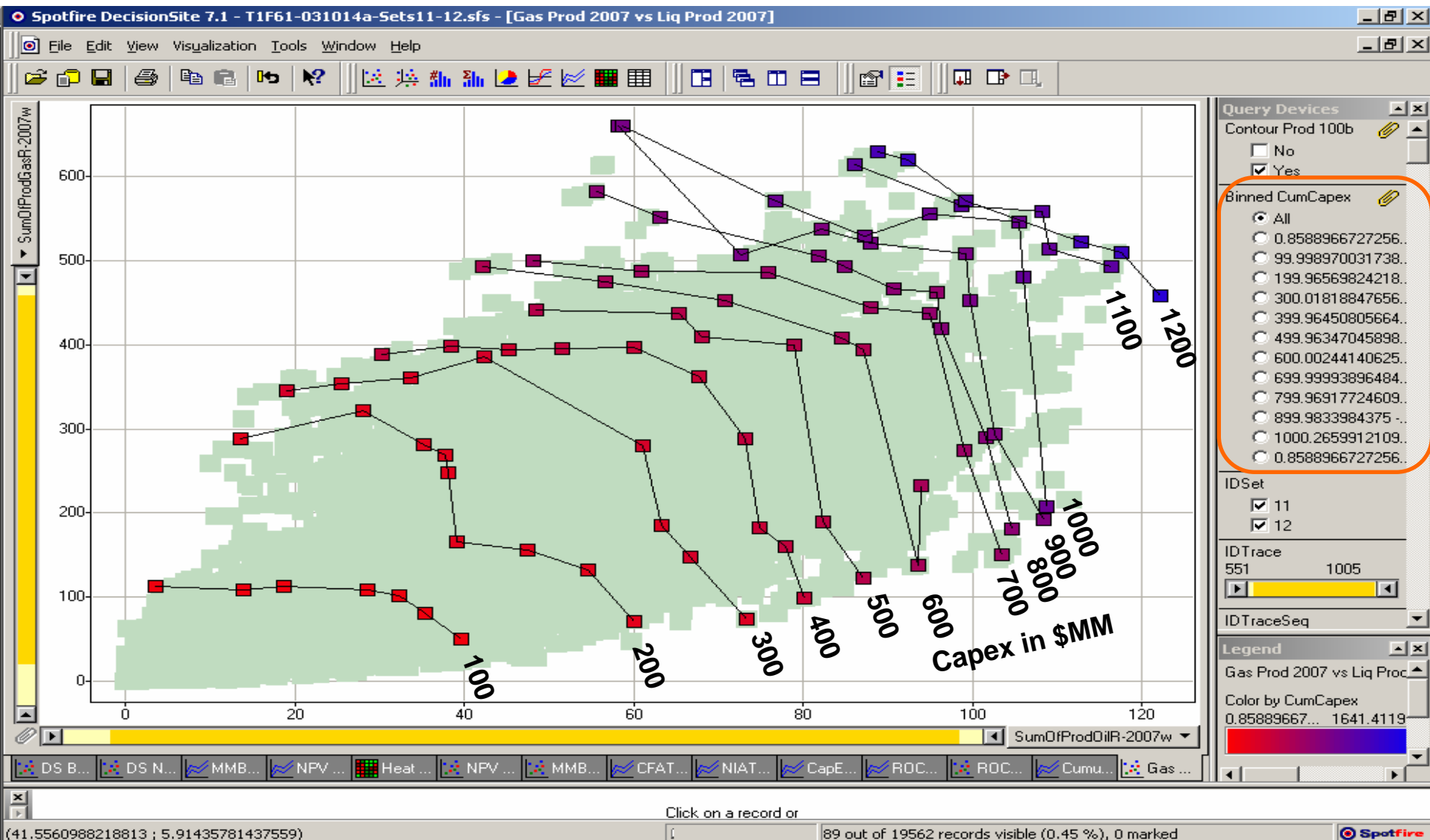
An Excel tool using VBA and Spotfire's API to list the Projects funded in each portfolio

Expl. Capex where Opportunity was funded					By Portfolio Trace				
Capex:		492		485	Capex:		492		485
Order Desc		C.NPV.Mean		1575 1487	Order Desc		C.NPV.Mean		1575 1487
Oport Clave	Oportunidad	Count	614	671	Oport Clave	Oportunidad	Count	614	671
578	Proj 578	2	5	16	380	Proj 380	1		262
359	Proj 359	2	41	28	392	Proj 392	1	296	
541	Proj 541	2	45	48	582	Proj 582	1	319	
561	Proj 561	2	65	41	518	Proj 518	1	330	
440	Proj 440	2	111	158	512	Proj 512	1		370
498	Proj 498	2	174	103	404	Proj 404	1		385
382	Proj 382	2	229	171	508	Proj 508	1		406
590	Proj 590	2	212	209	523	Proj 523	1		416
556	Proj 556	2	287	251	374	Proj 374	1		432
422	Proj 422	2	298	254	480	Proj 480	1	438	
479	Proj 479	2	387	319	464	Proj 464	1	445	
520	Proj 520	2	407	338	550	Proj 550	1		455
530	Proj 530	2	479	430	567	Proj 567	1	462	
557	Proj 557	1		54	391	Proj 391	1	465	
563	Proj 563	1	97		528	Proj 528	1		485
371	Proj 371	1		114	598	Proj 598	1	485	
609	Proj 609	1	124		360	Proj 360	1	488	
446	Proj 446	1	220		455	Proj 455	1	492	
546	Proj 546	1	245				0		

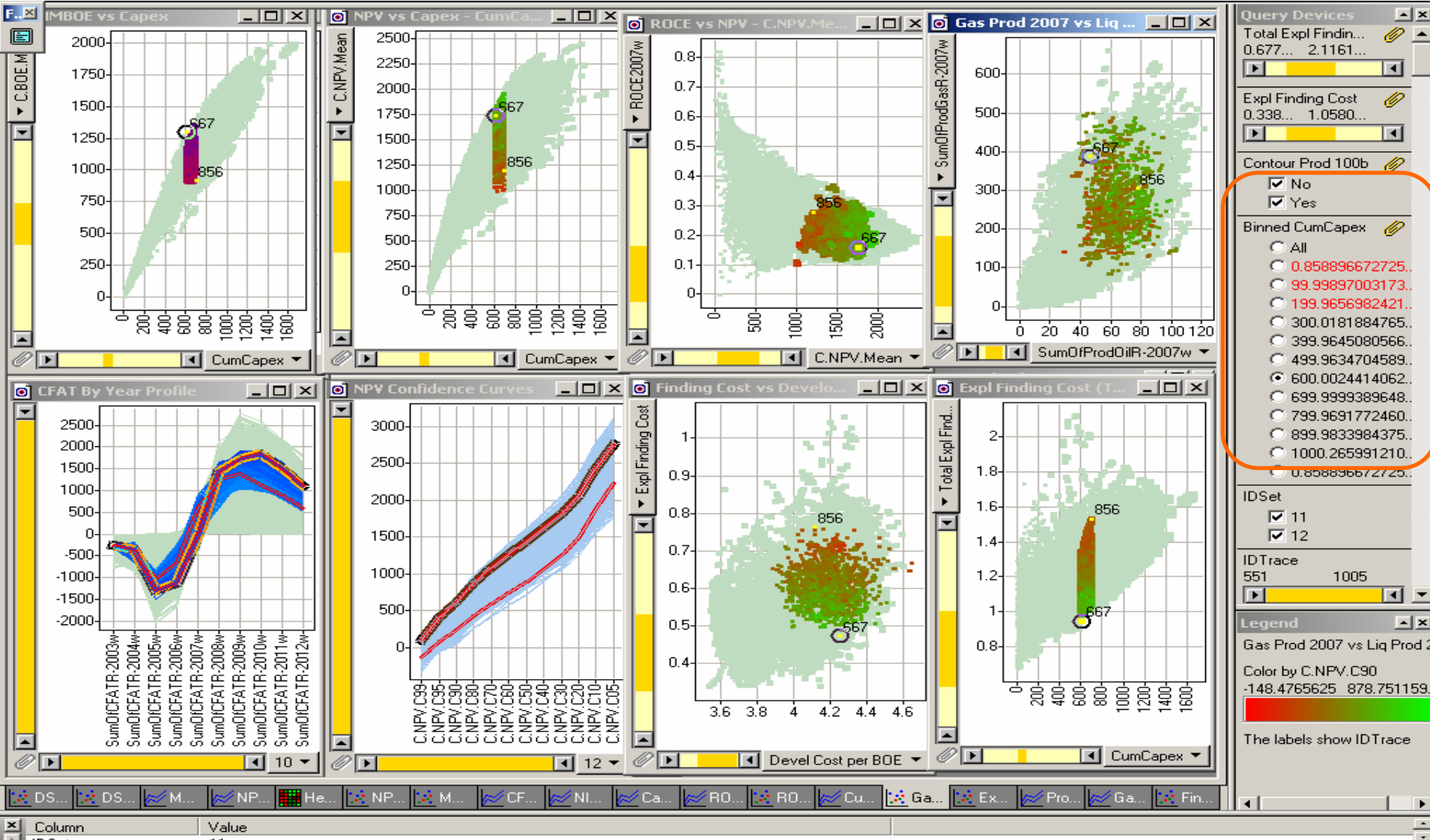
NPV vs Capex - CumCapex



Use a Binned measure to create Contour Plots: Gas Prod 2007 vs Oil Prod 2007

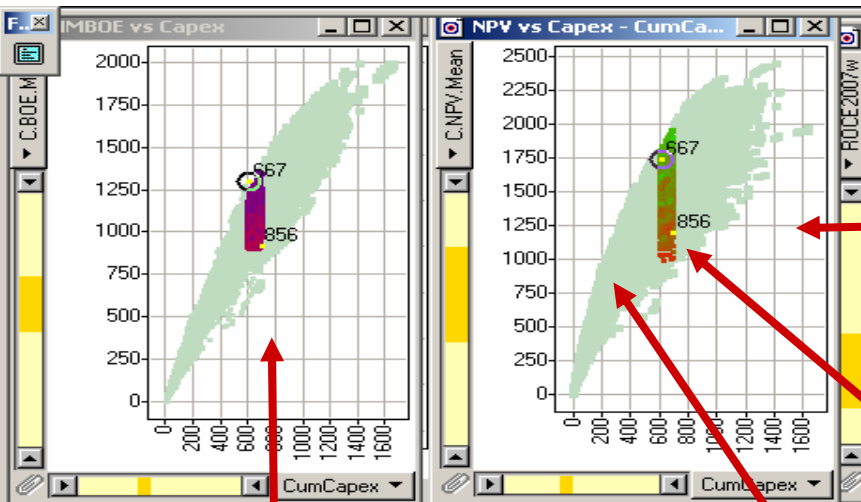


Case Study: Select 2003 Exploration Portfolios based upon Reserves, Finding Cost, Development Capex and Production.



Orientation: What are the Plots in the Display?

MMBOE and NPV vs Cumulative Capex



Y axis: Mean Portfolio Reserves Discovered (MMBOE)
X axis: Exploration Drill Capex (cumulative) (\$MM)

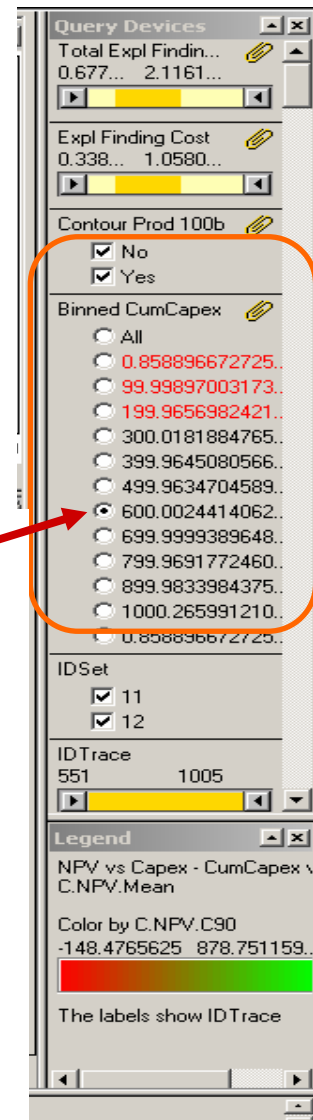
Color by 90% Confidence MMBOE (Low Red, High Blue)

Y axis: Mean Portfolio Risked Net Present Value (\$MM 2004)
X axis: Exploration Drill Capex (cumulative) (\$MM)

Color by 90% Confidence NPV (Low Red, High Green)

Having "Binned" the CumCapex, we show here only Portfolios between 600 and 700 MM Drill Capex.

We show "deselected" portfolios in a pale green



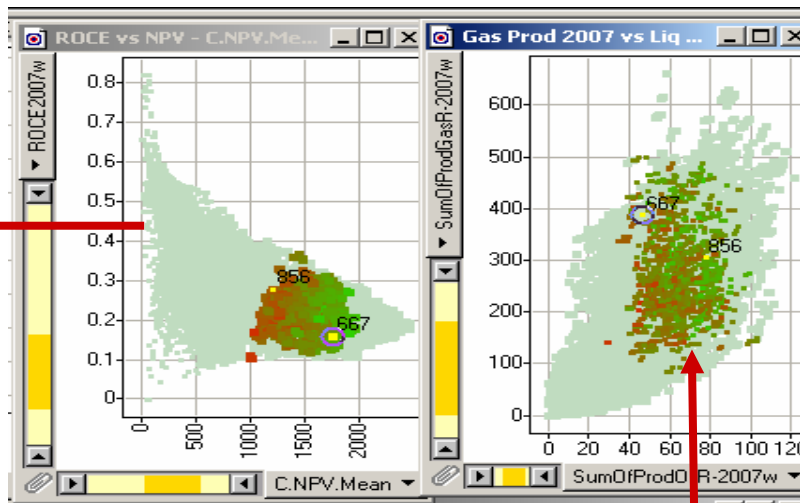
Orientation: What are the Plots in the Display?

ROCE-2007 vs NPV; 2007 Gas Production vs Oil Production

**Y axis: Return on Capital
Employed in 2007**

**X axis: Mean Portfolio Risked Net
Present Value (\$MM 2004)**

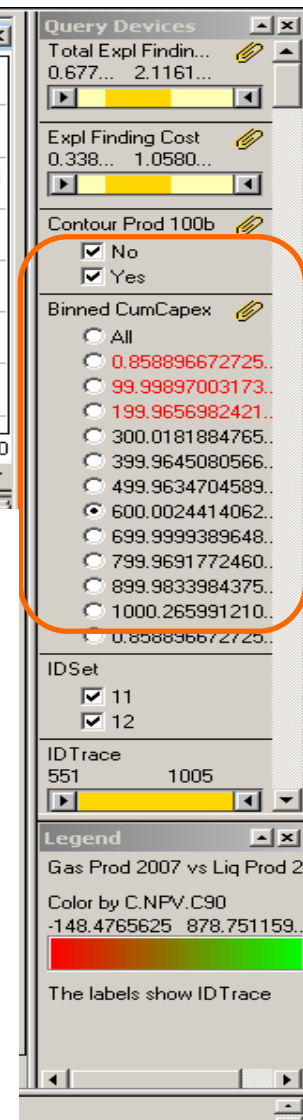
**Color by 90% Confidence NPV
(Low Red, High Green)**



**Y axis: Mean Gas Production in
2007 (BCF/yr)**

**X axis: Mean Liquid Production
in 2007 (MMBO/yr)**

**Color by 90% Confidence NPV
(Low Red, High Green)**



Orientation: What are the Plots in the Display?

Finding Cost vs Capex; Finding Cost vs Development Cost

The Y-axis of these two plots are the same.

The left one shows a potential trade off between Exploration Finding cost per BOE and the Development Cost per BOE

Y axis: Total Finding Cost per BOE of Reserves. (\$/BOE)

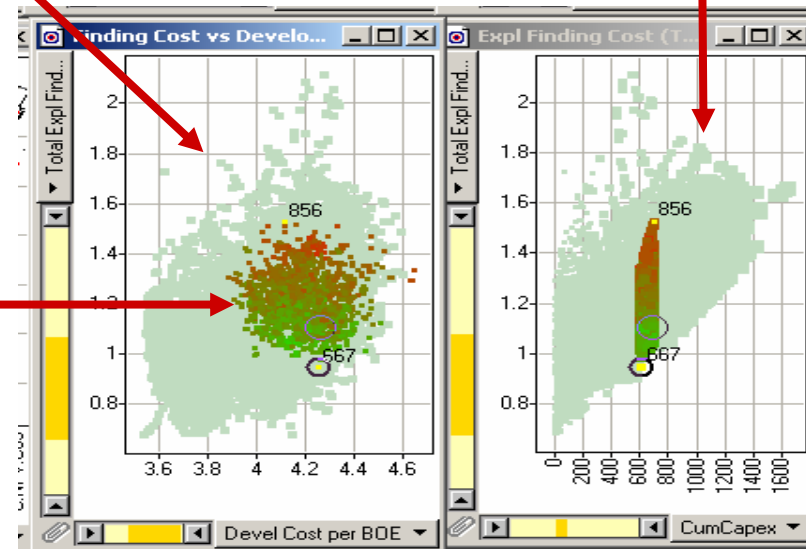
X axis: Mean Risked Development Cost per BOE of Reserves (\$/BOE)

Color by 90% Confidence NPV (Low Red, High Green)

Y axis: Total Finding Cost per BOE of Reserves. (\$/BOE)

X axis: Exploration Drill Capex (cumulative) (\$MM)

Color by 90% Confidence NPV (Low Red, High Green)



Query Devices

Total Expl Findin...
0.677... 2.1161...

Expl Finding Cost
0.338... 1.0580...

Contour Prod 100b
☒ No
☒ Yes

Binned CumCapex
☐ All
☐ 0.858896672725...
☐ 99.99897003173...
☐ 199.9656982421...
☐ 300.0181884765...
☐ 399.9645080566...
☐ 499.9634704589...
☐ 600.0024414062...
☐ 699.999389648...
☐ 799.9691772460...
☐ 899.9833984375...
☐ 1000.265991210...
☐ 0.858896672725...

IDSet
☒ 11
☒ 12

IDTrace
551 1005

Legend

Finding Cost vs Development cost

Color by C.NPV.C90
-148.4765625 878.751159...

The labels show IDTrace

Orientation: What are the Plots in the Display? Cash Flow by Year; NPV Confidence

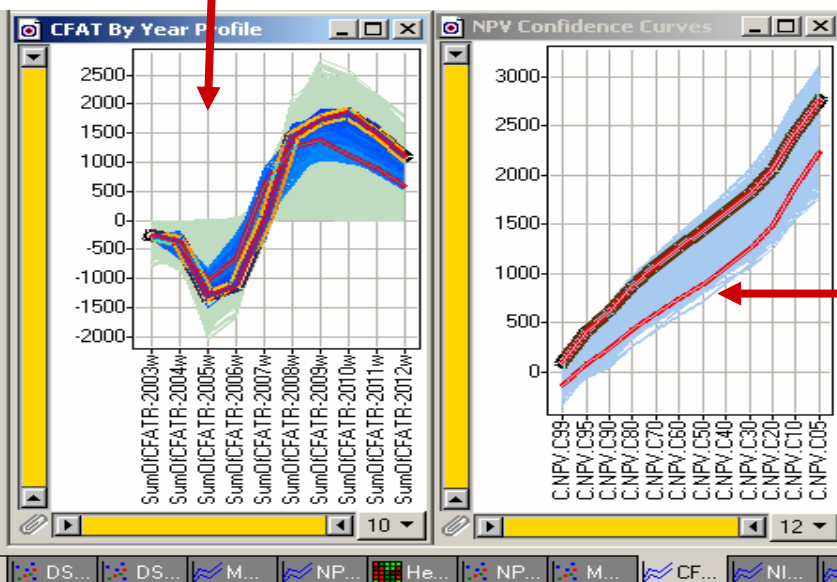
A Cash Flow Profile Plot:

Y axis: Cash Flow After Tax (\$MM)

X axis: Year

**Color by NPV mean
(Low: Cyan, High: Blue)**

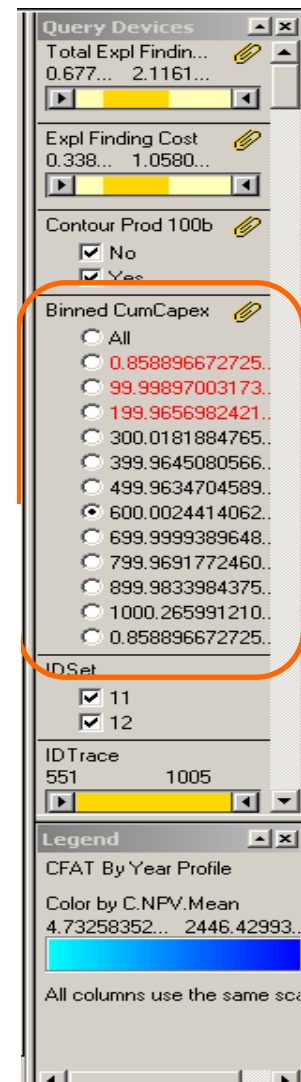
**Note: in a Profile Plot, one
Portfolio shows up as a LINE.**



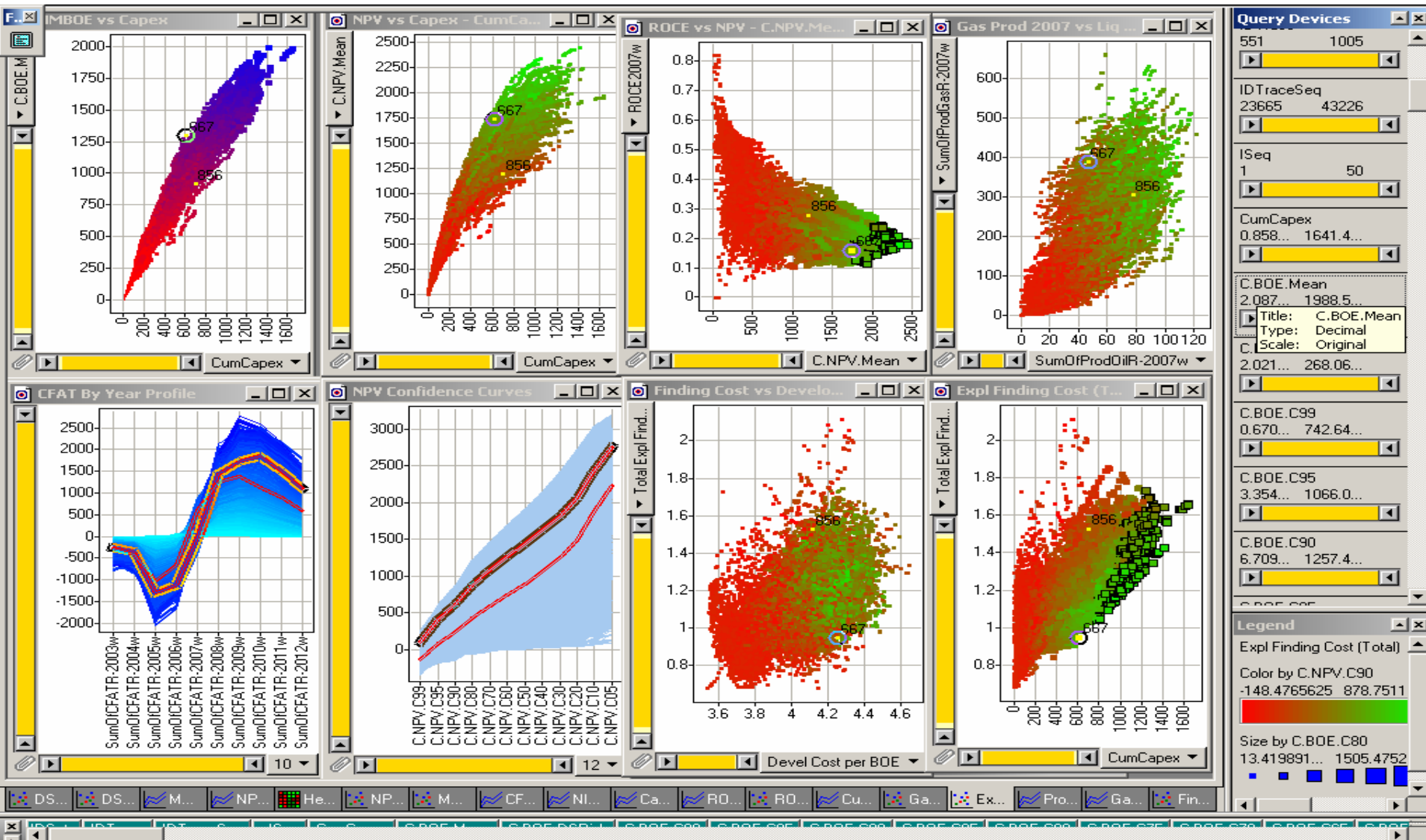
**The NPV Confidence Curve
Y axis: Risked NPV (\$MM 2004)**

**X axis: The Confidence level that
we will exceed the Y value.**

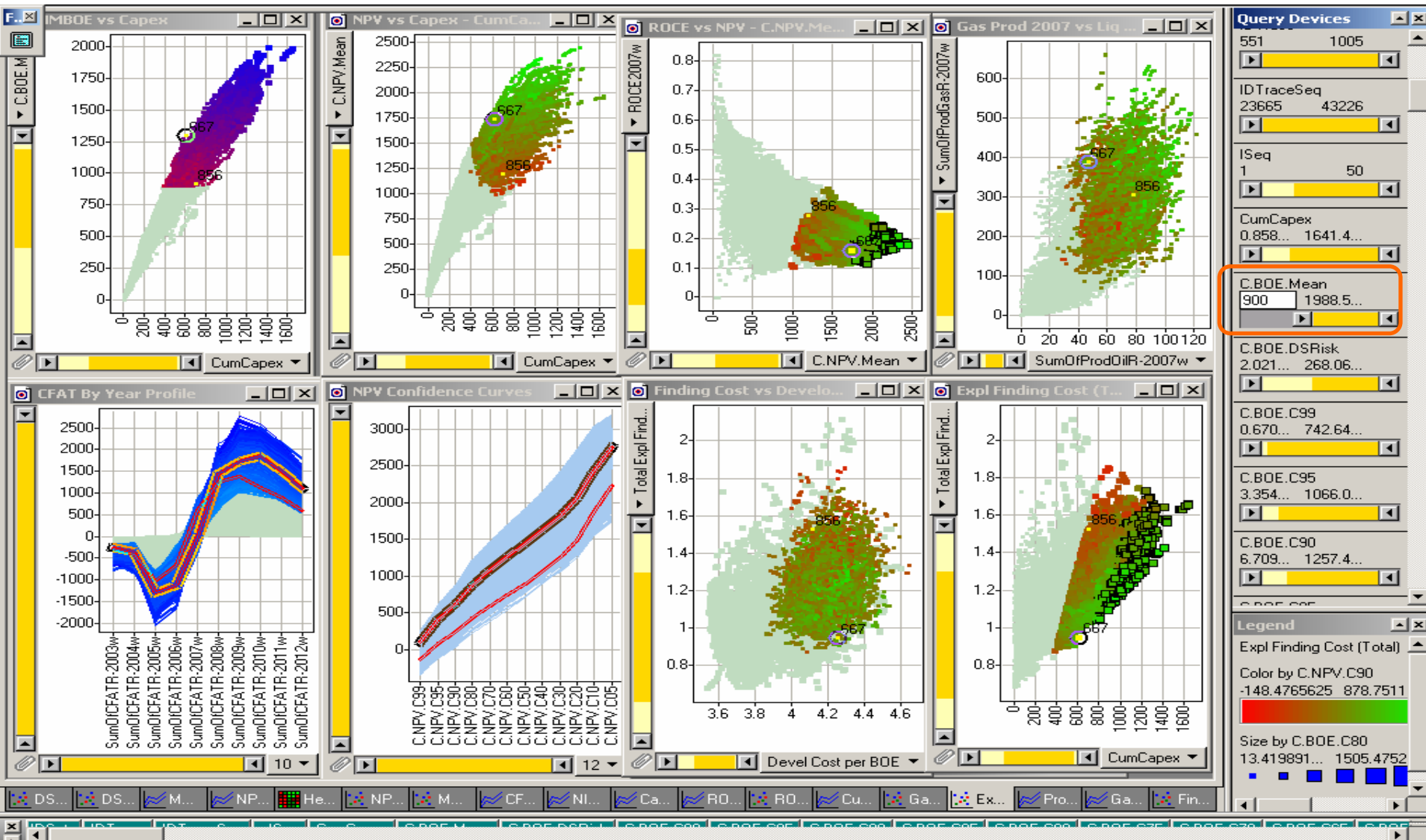
**Color is constant pale blue.
Deselected portfolios are NOT
shown**



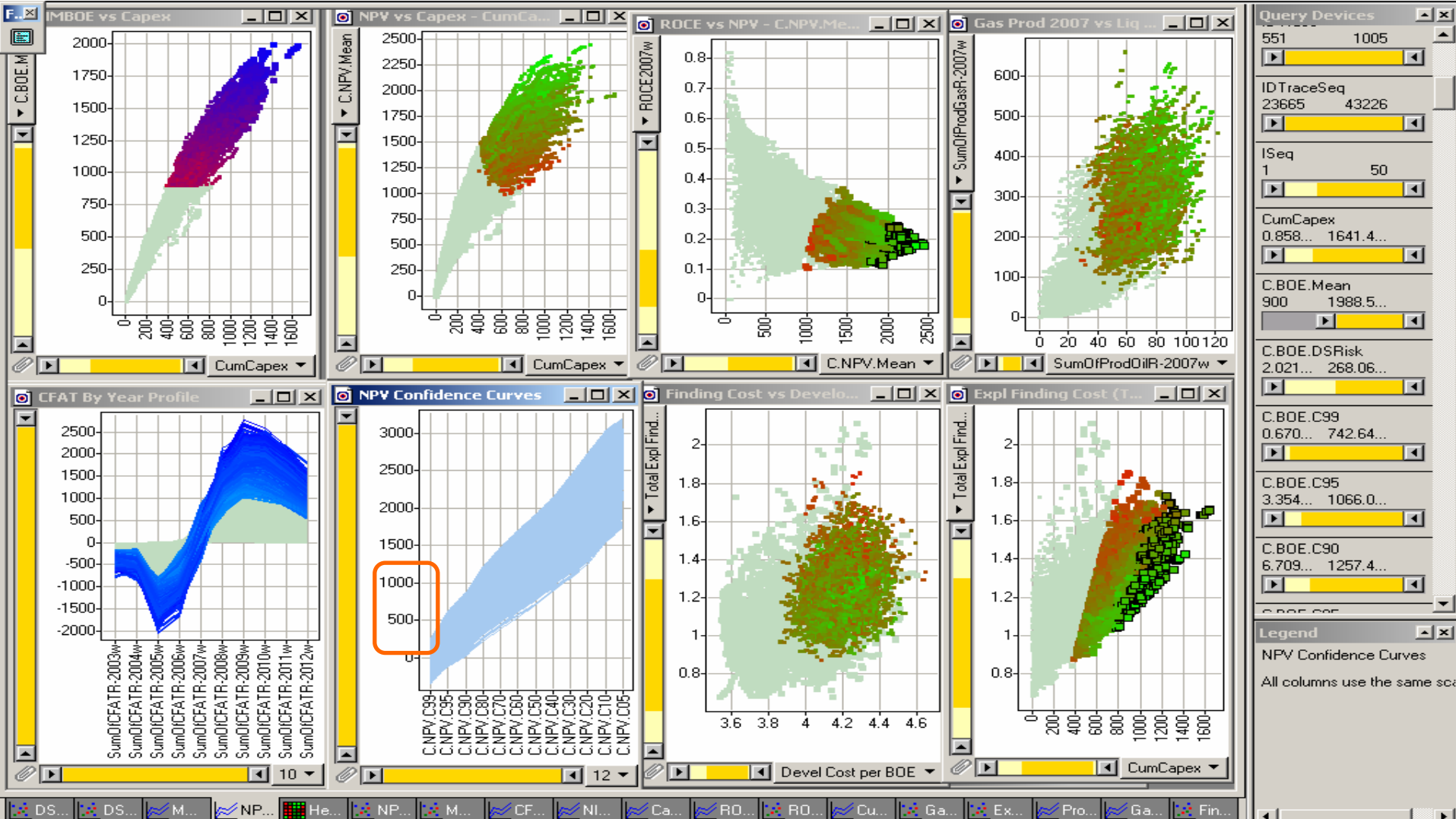
Step 1: Display all the available Portfolios. (Ctrl-R)



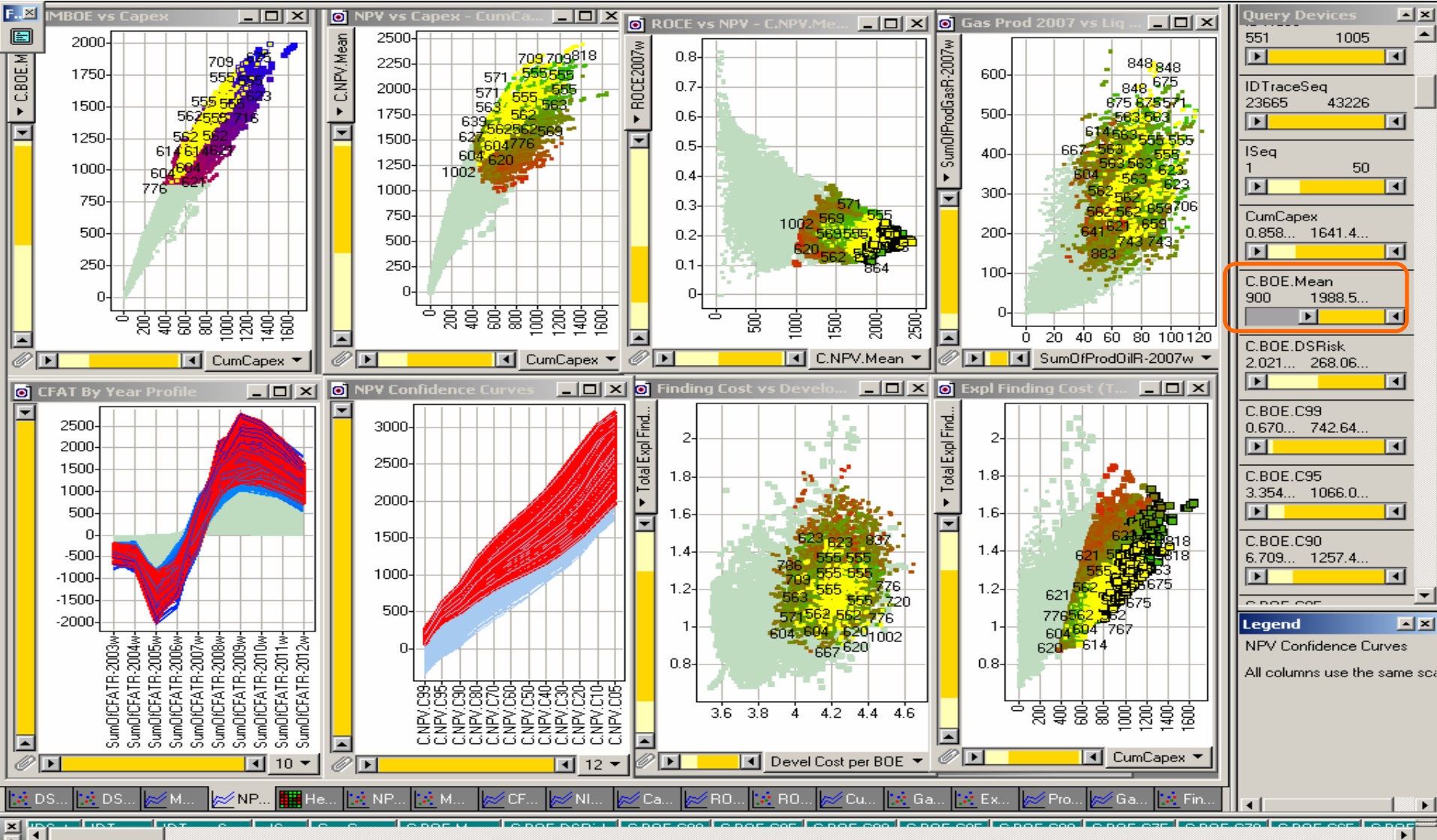
Step 2: Apply a minimum Mean Reserves Required.



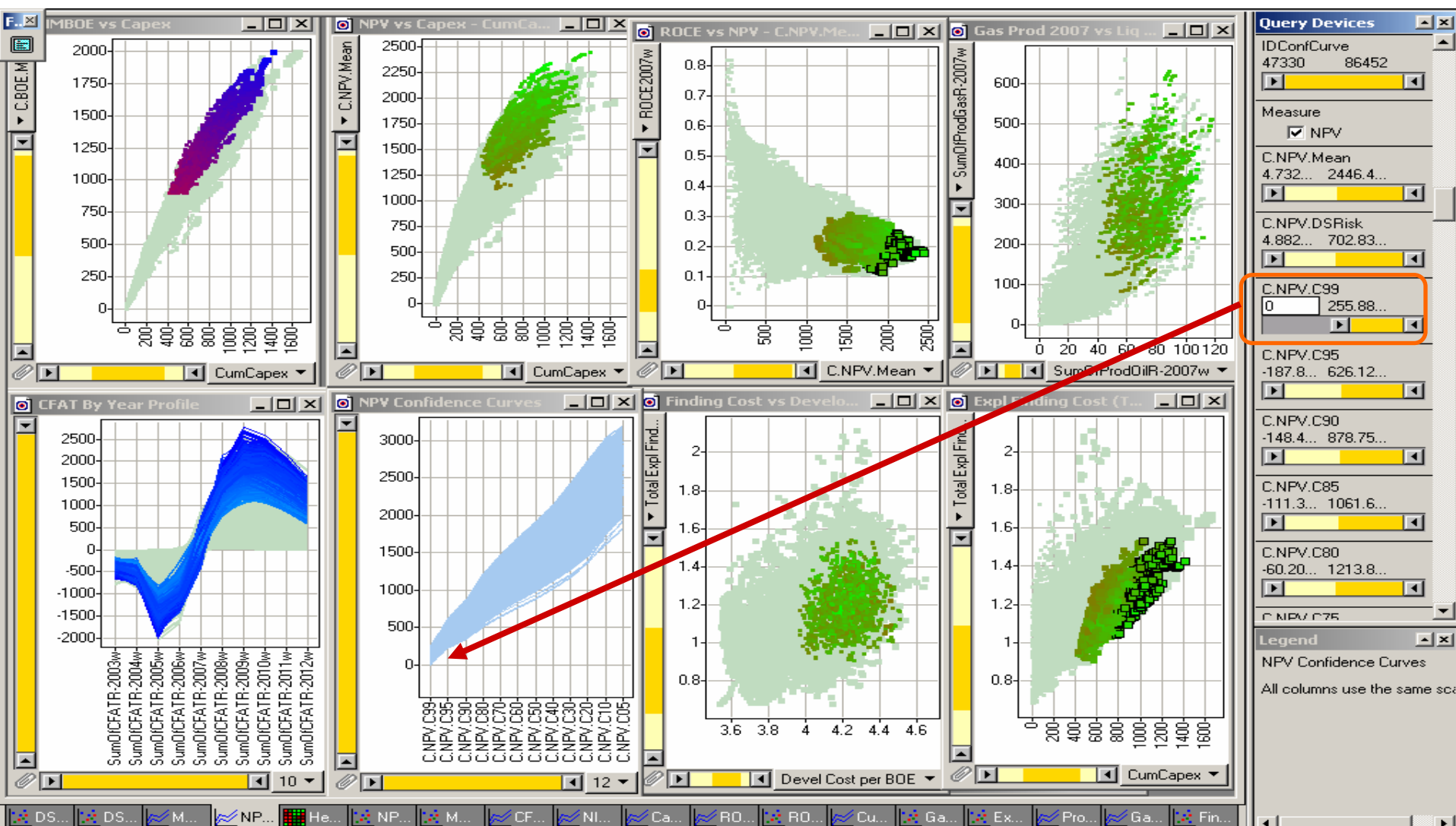
Step 3: If we require portfolios with a 99% Confidence of >0 NPV, are there good portfolios?



Step 3: If we require portfolios with a
99% Confidence of >0 NPV, are there good portfolios? YES.



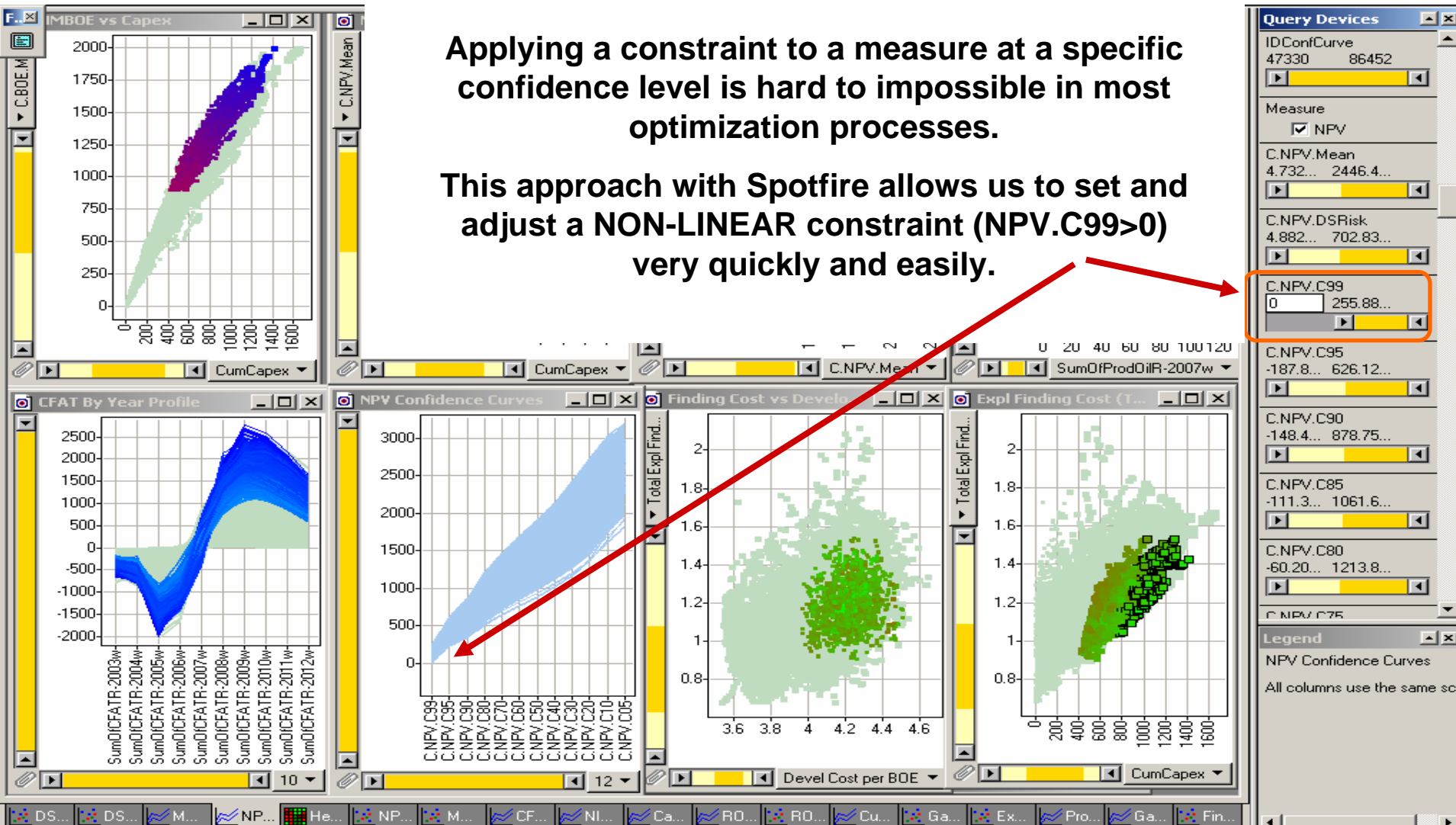
Step 4: Require that 99% Confidence of NPV > 0



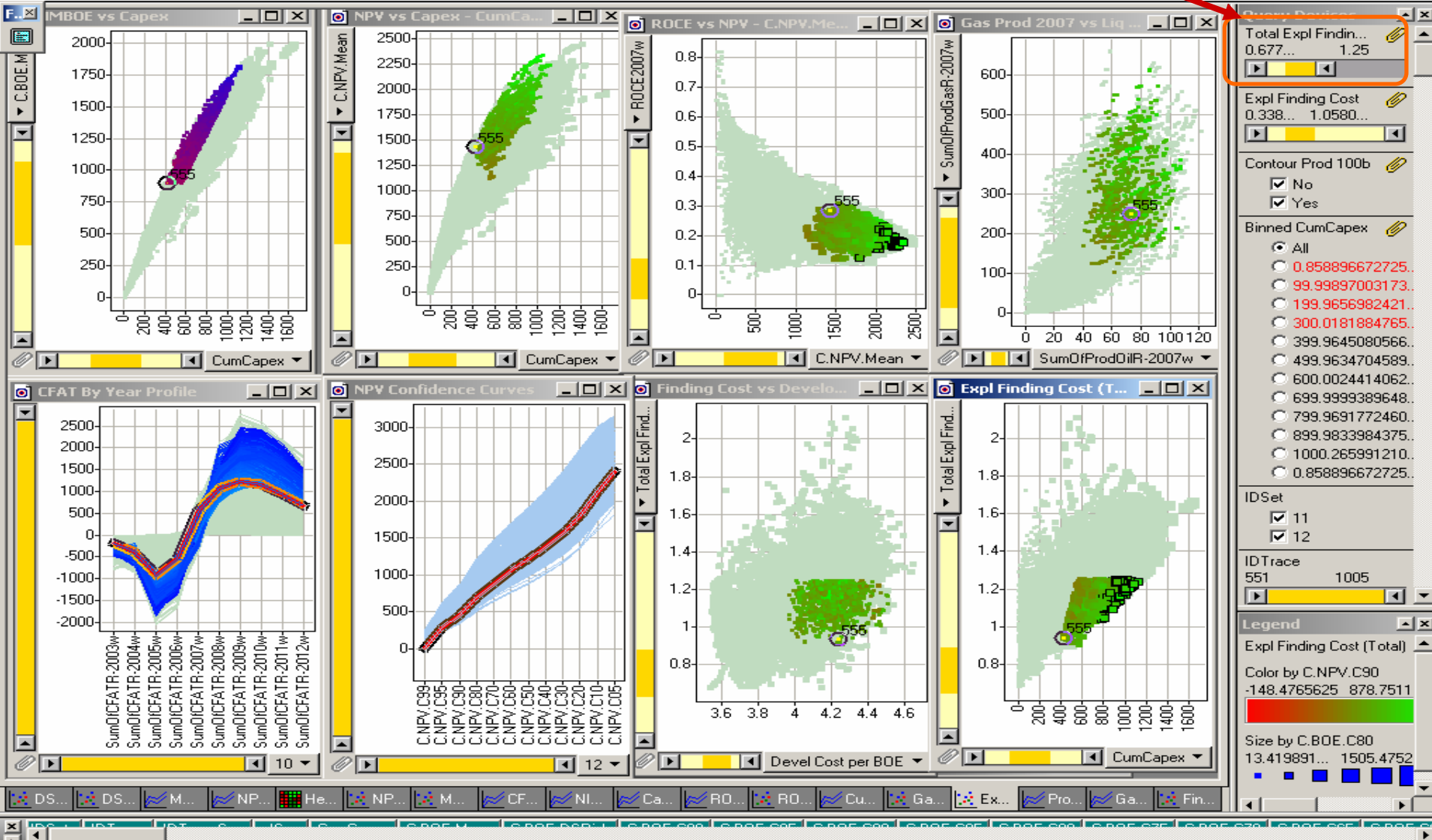
Step 4: Require that 99% Confidence of NPV > 0

Applying a constraint to a measure at a specific confidence level is hard to impossible in most optimization processes.

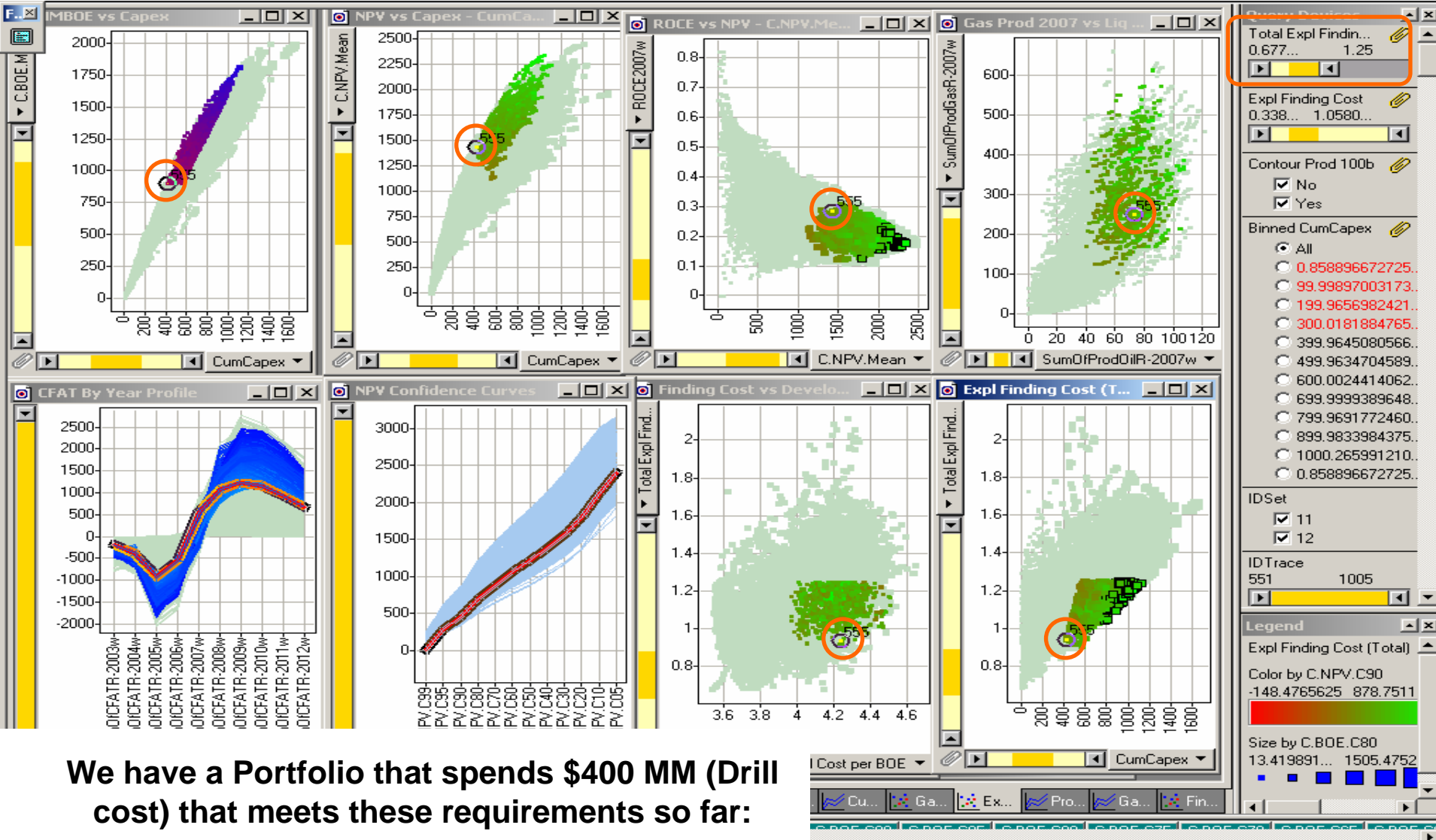
This approach with Spotfire allows us to set and adjust a NON-LINEAR constraint (NPV.C99>0) very quickly and easily.



Step 5: Top quartile performance means Exploration Finding Cost must be ≤ 1.25



Step 5: Top quartile performance means Exploration Finding Cost must be ≤ 1.25

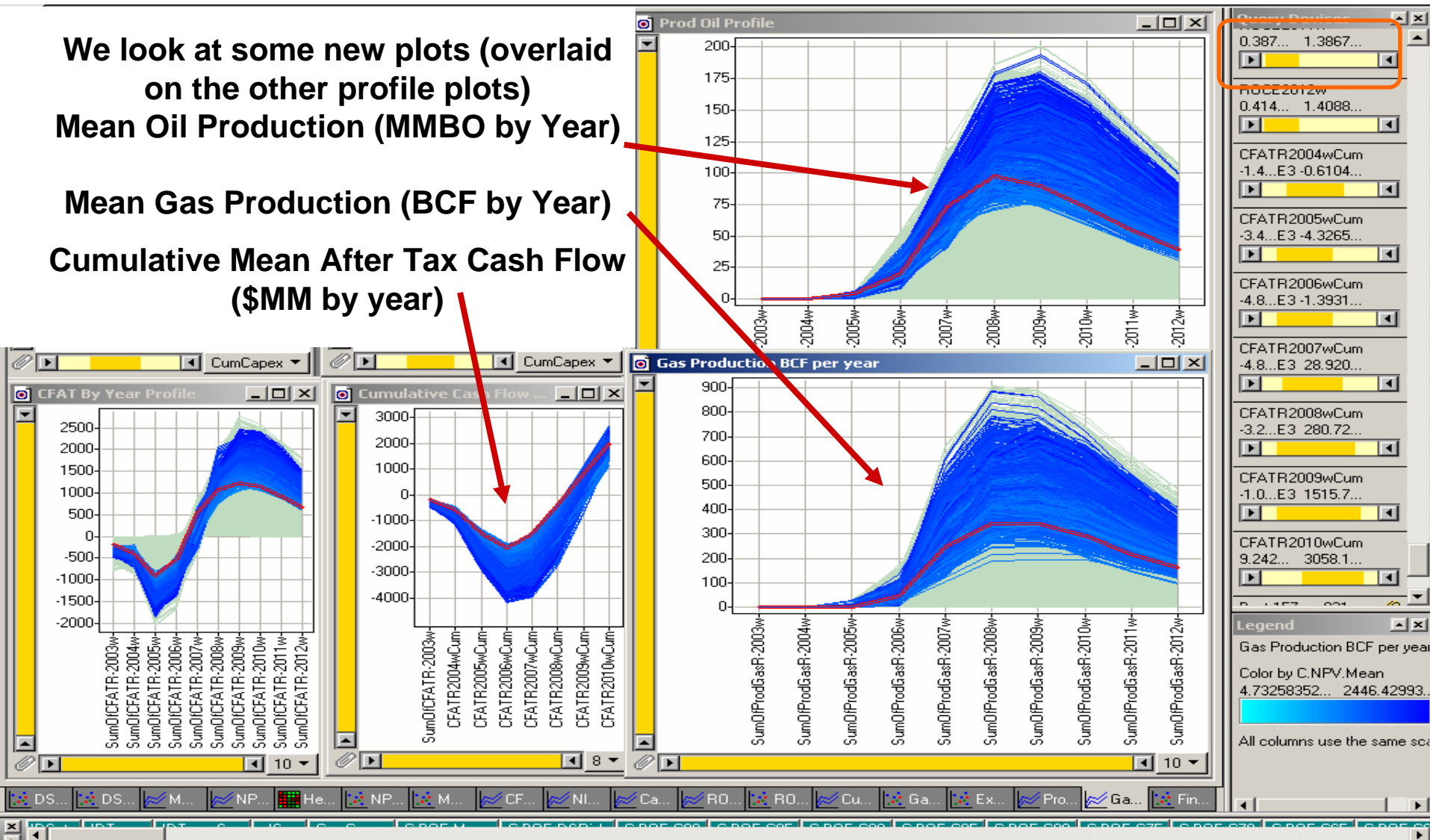


Step 6: Place Limits on Total Capex (including Development).

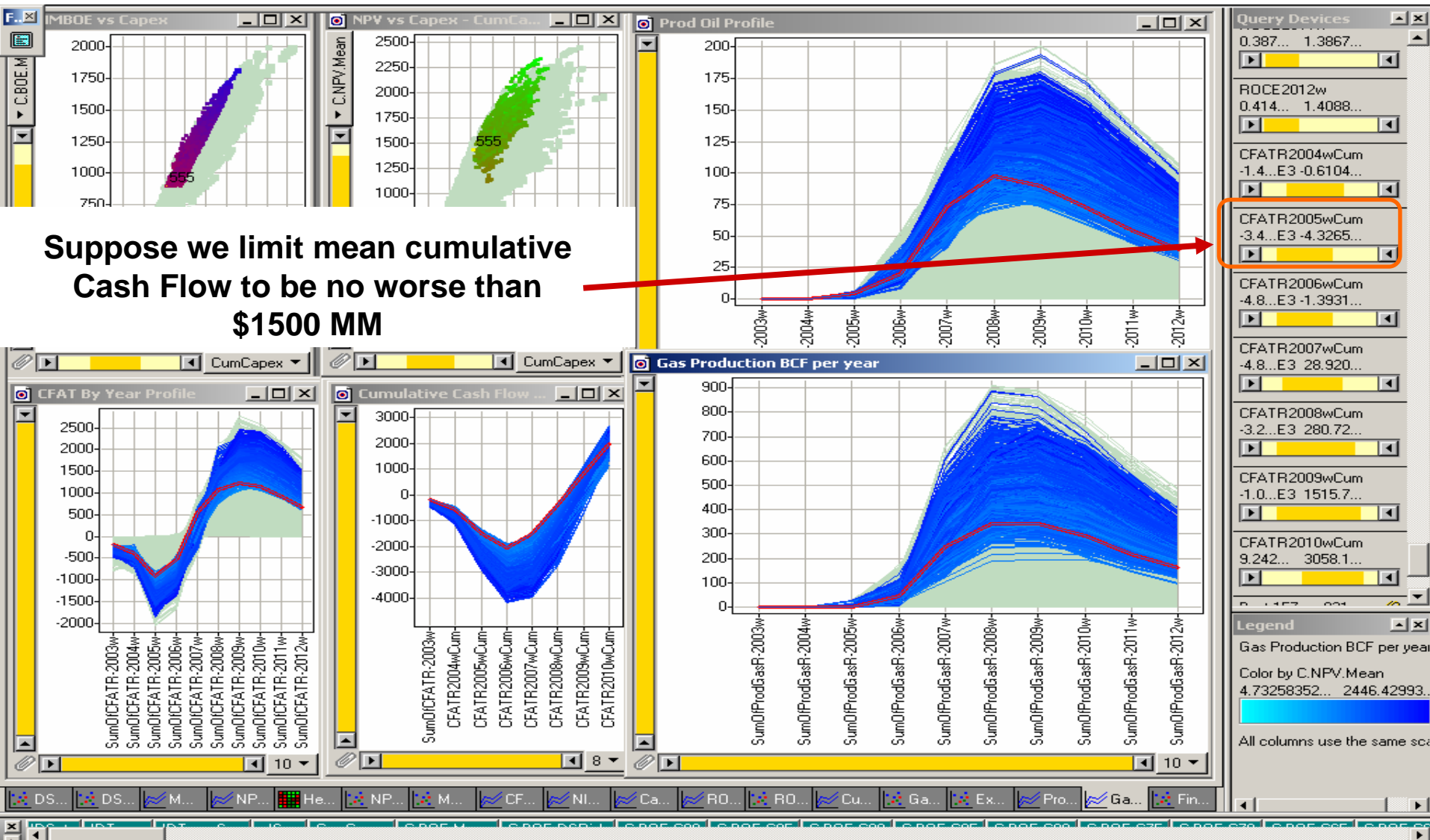
We look at some new plots (overlaid on the other profile plots)
Mean Oil Production (MMBO by Year)

Mean Gas Production (BCF by Year)

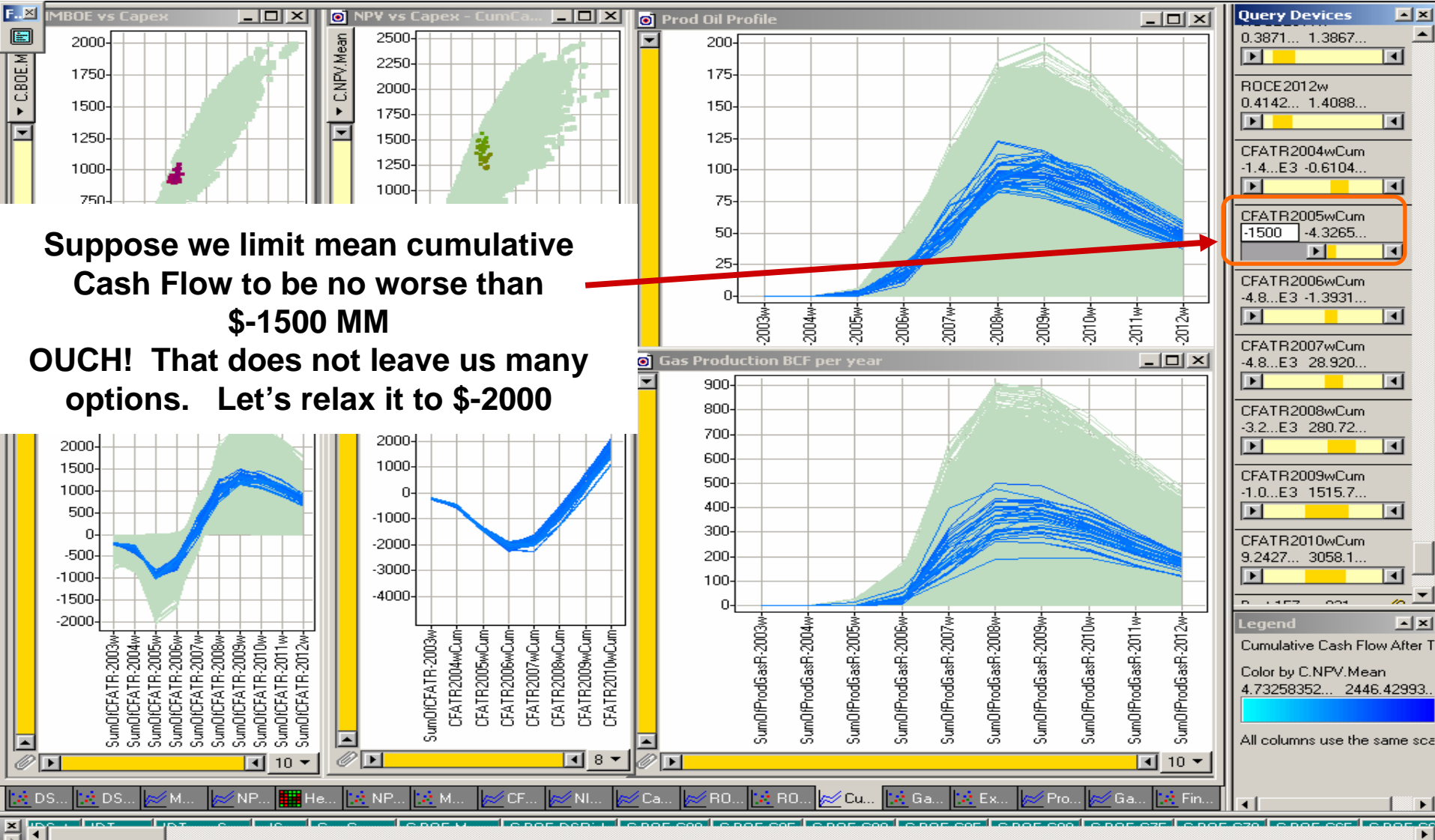
Cumulative Mean After Tax Cash Flow (\$MM by year)



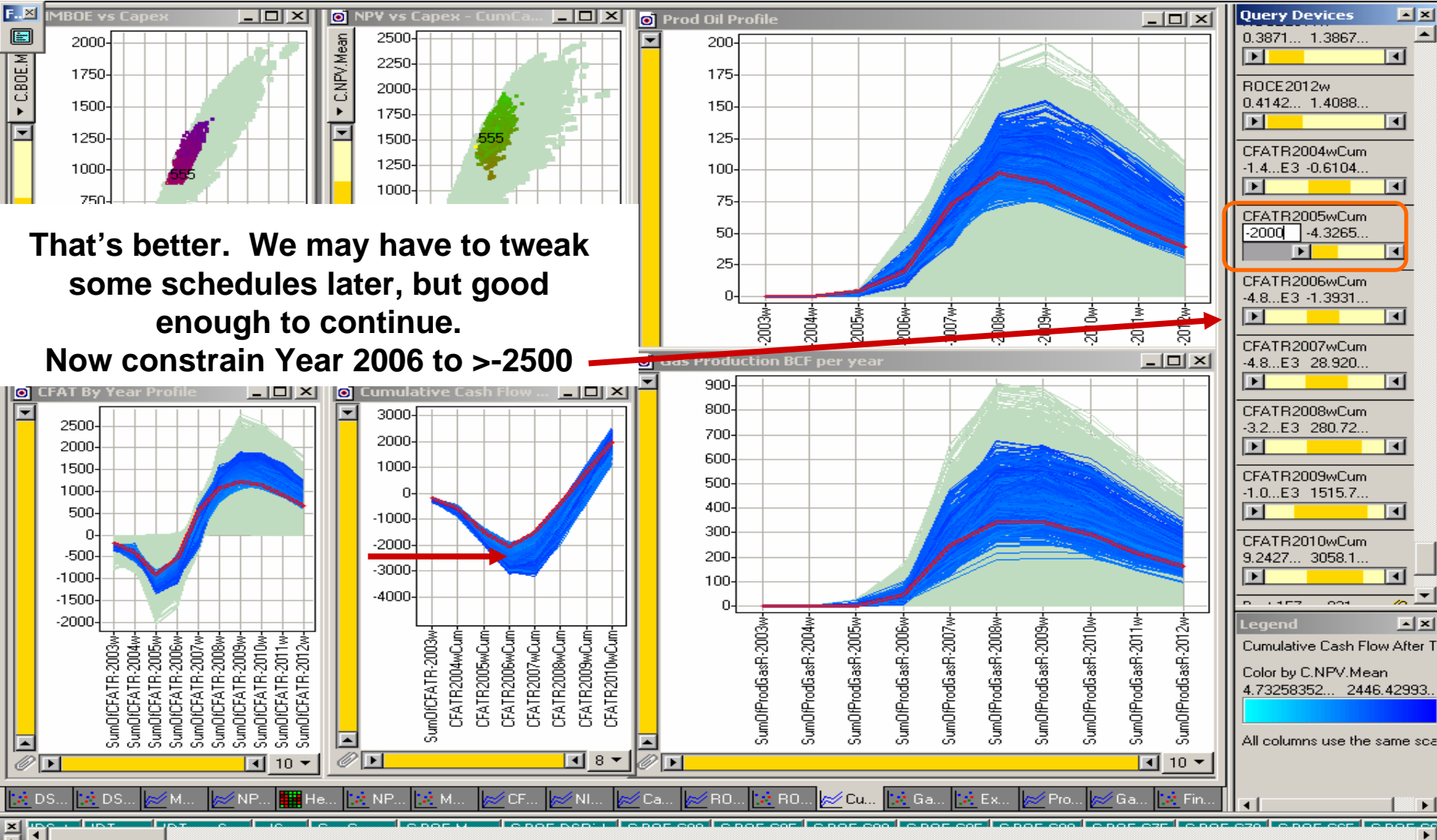
Step 6: Place Limits on Total Capex (including Development).



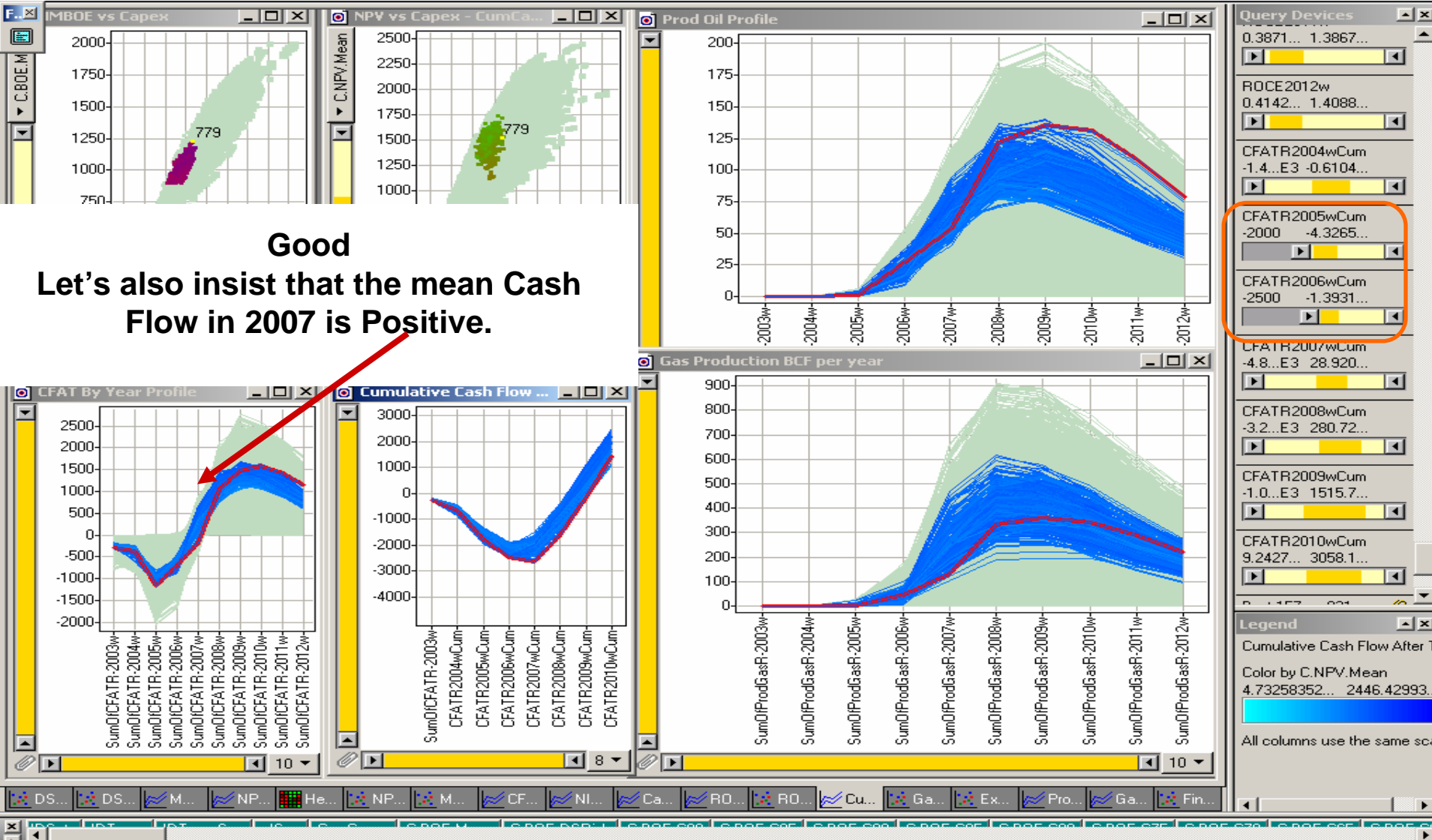
Step 6: Place Limits on Total Capex (including Development).



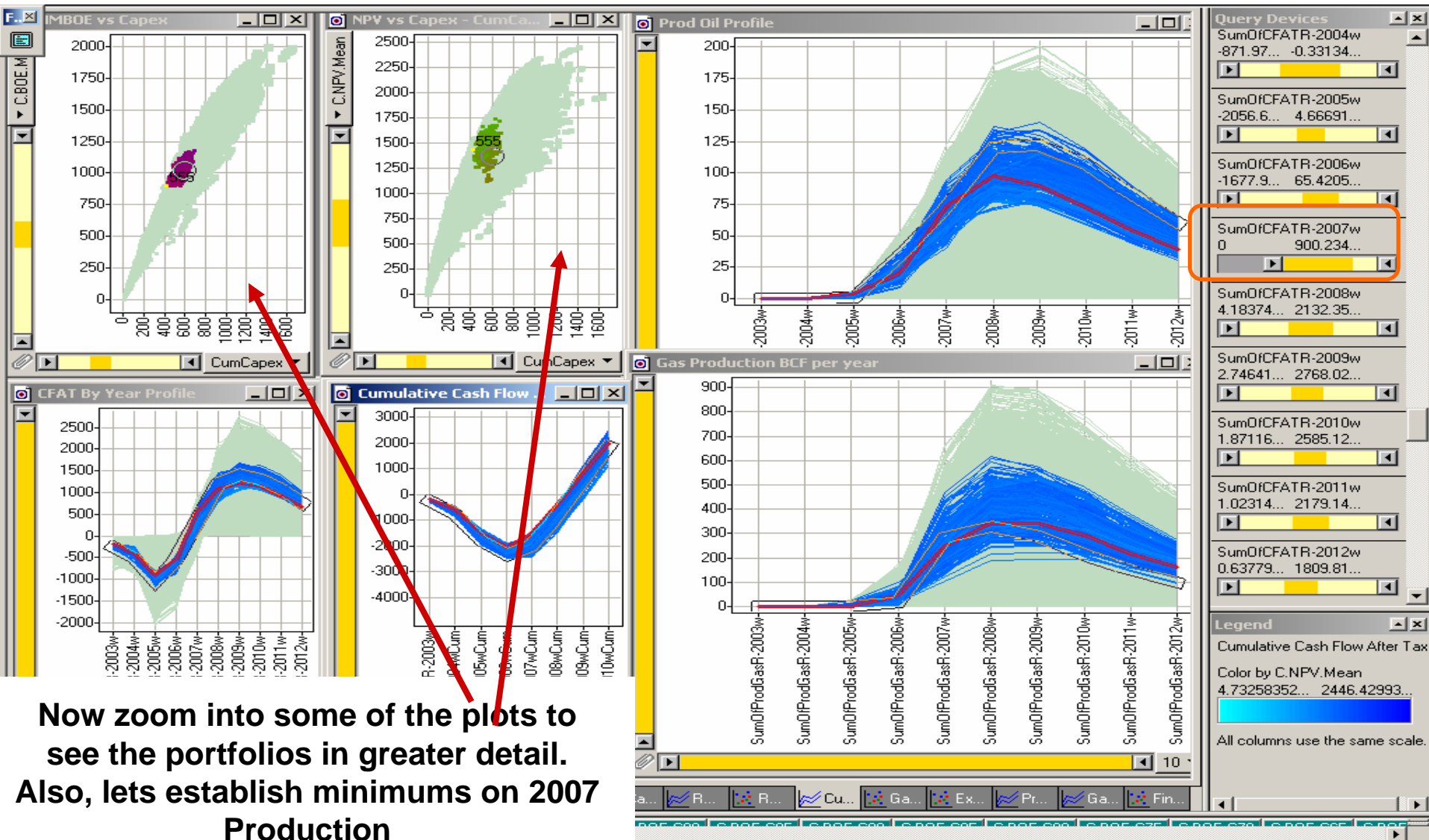
Step 6: Place Limits on Total Capex (including Development).



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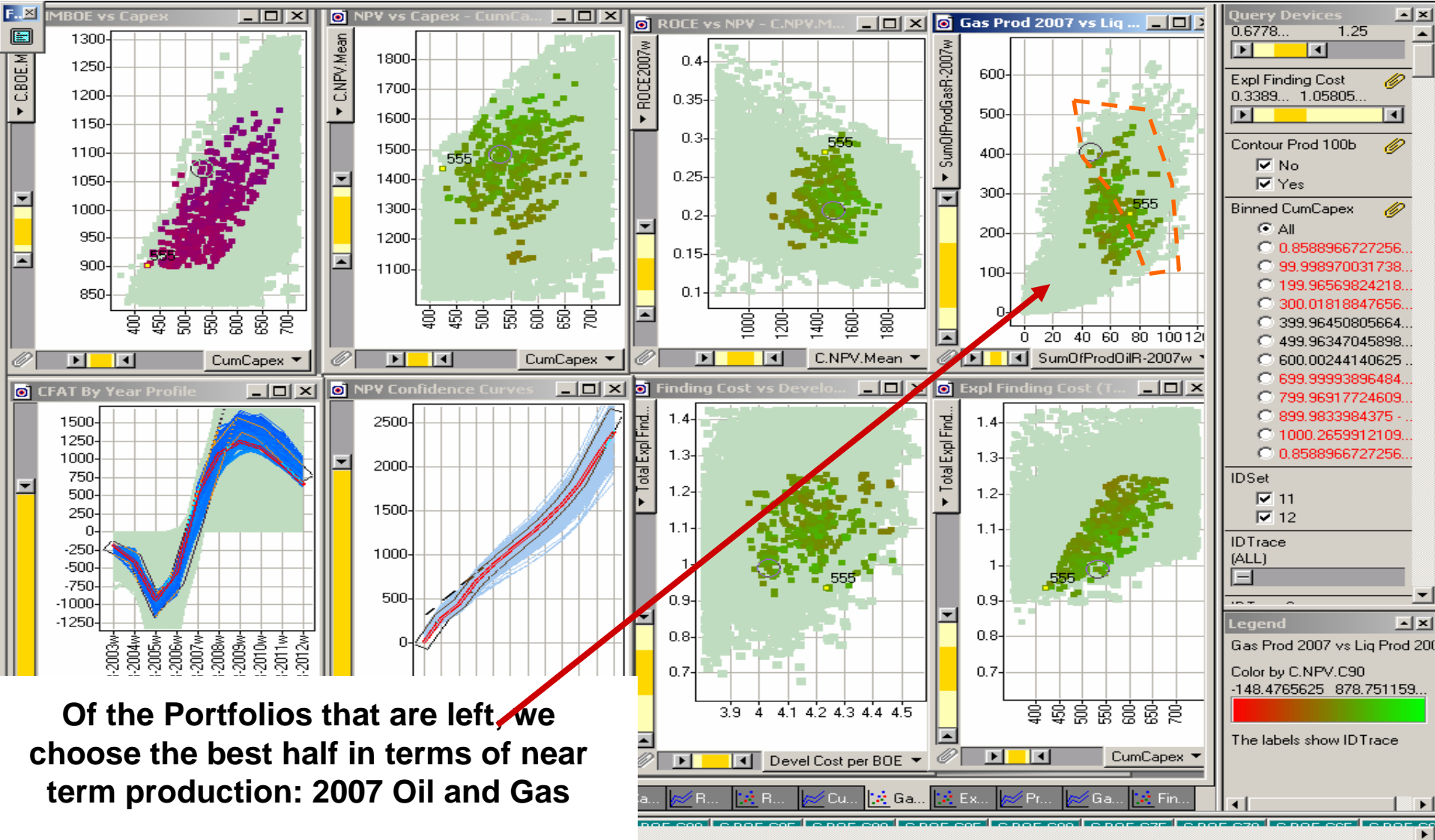


Step 6: Place Limits on Total Capex (including Development).

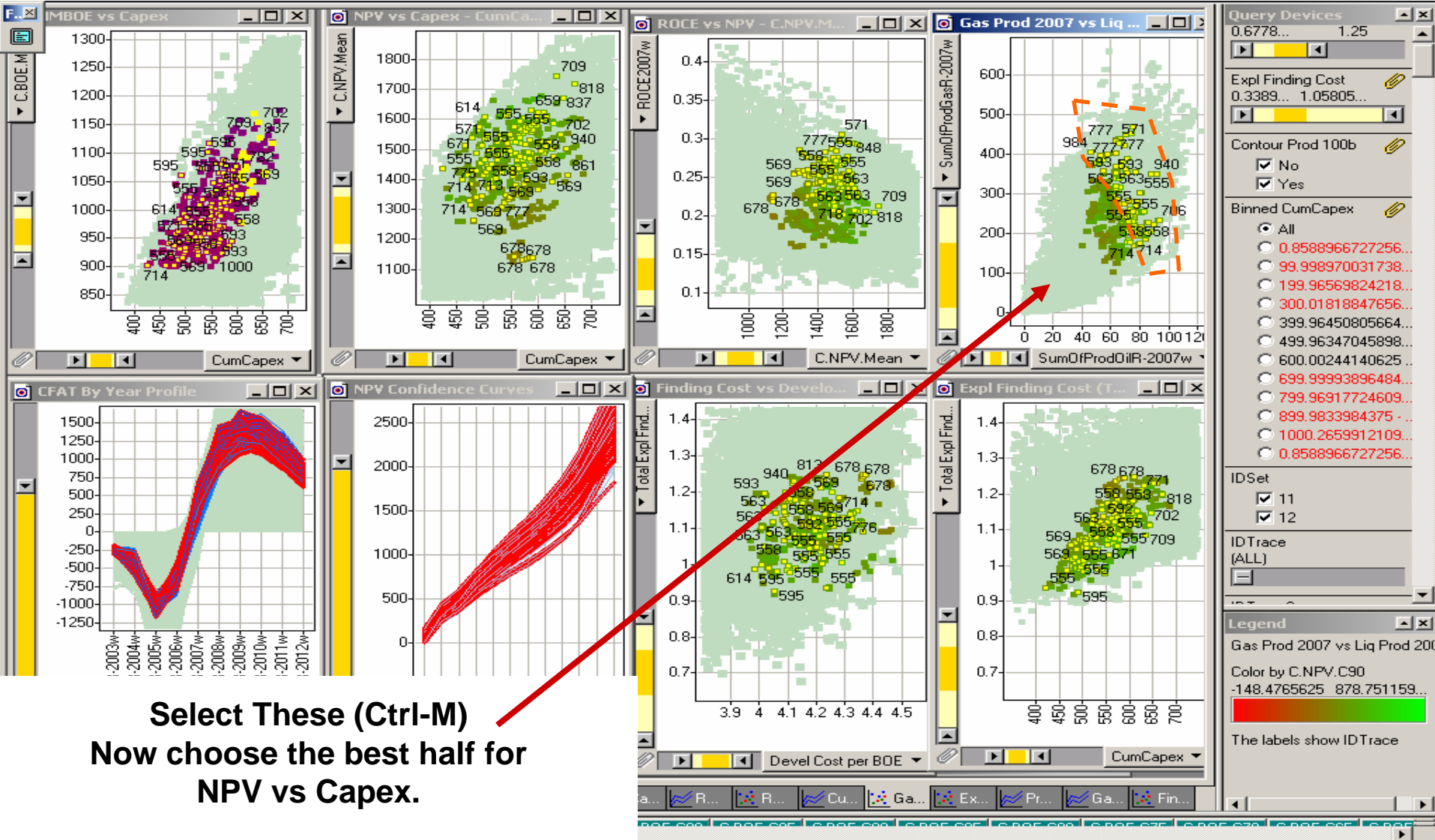


Now zoom into some of the plots to see the portfolios in greater detail. Also, let's establish minimums on 2007 Production

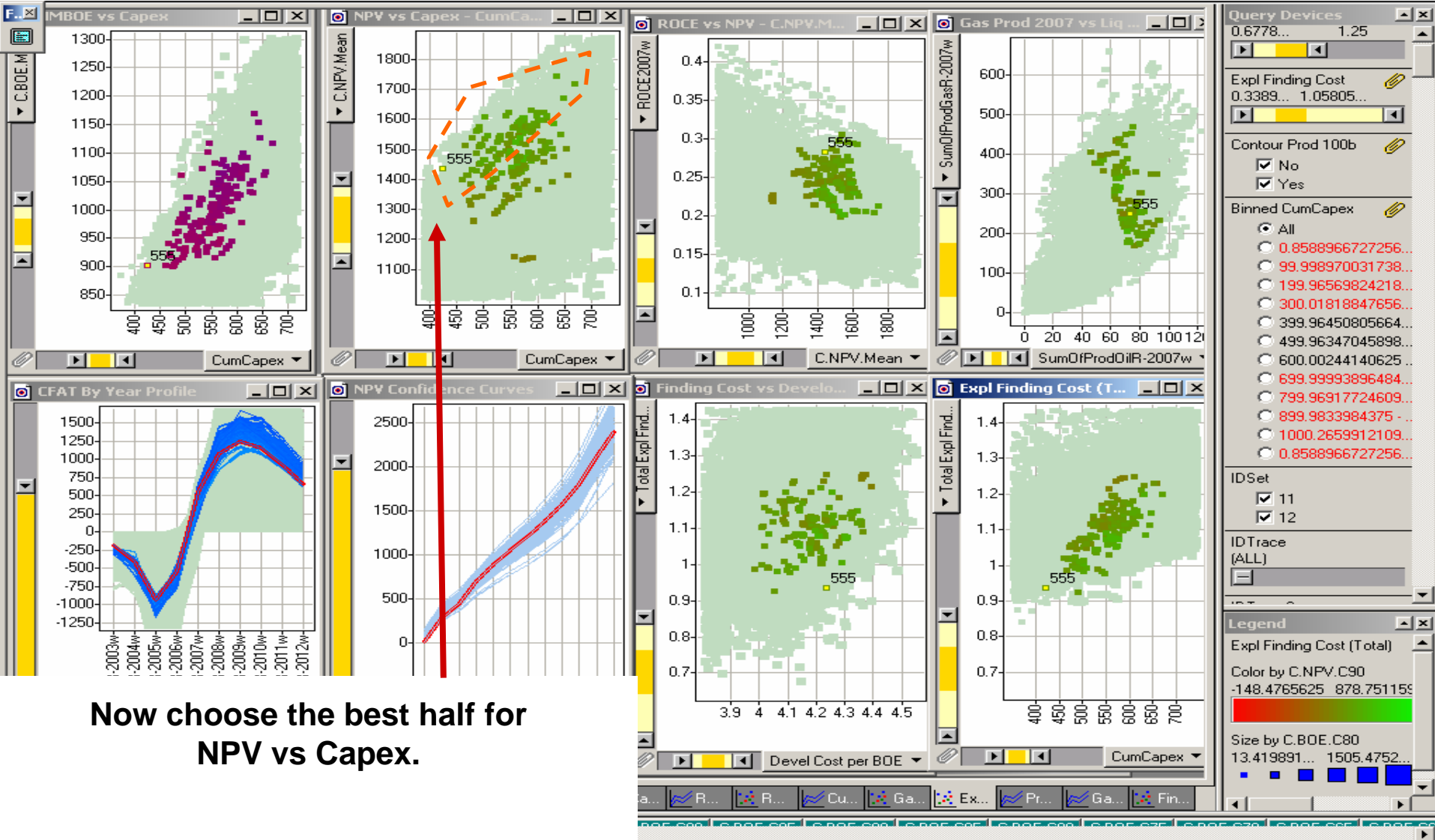
Step 7: Zoomed in. Choose Best 2007 Production requirements



Step 7: Zoomed in. Choose Best 2007 Production requirements

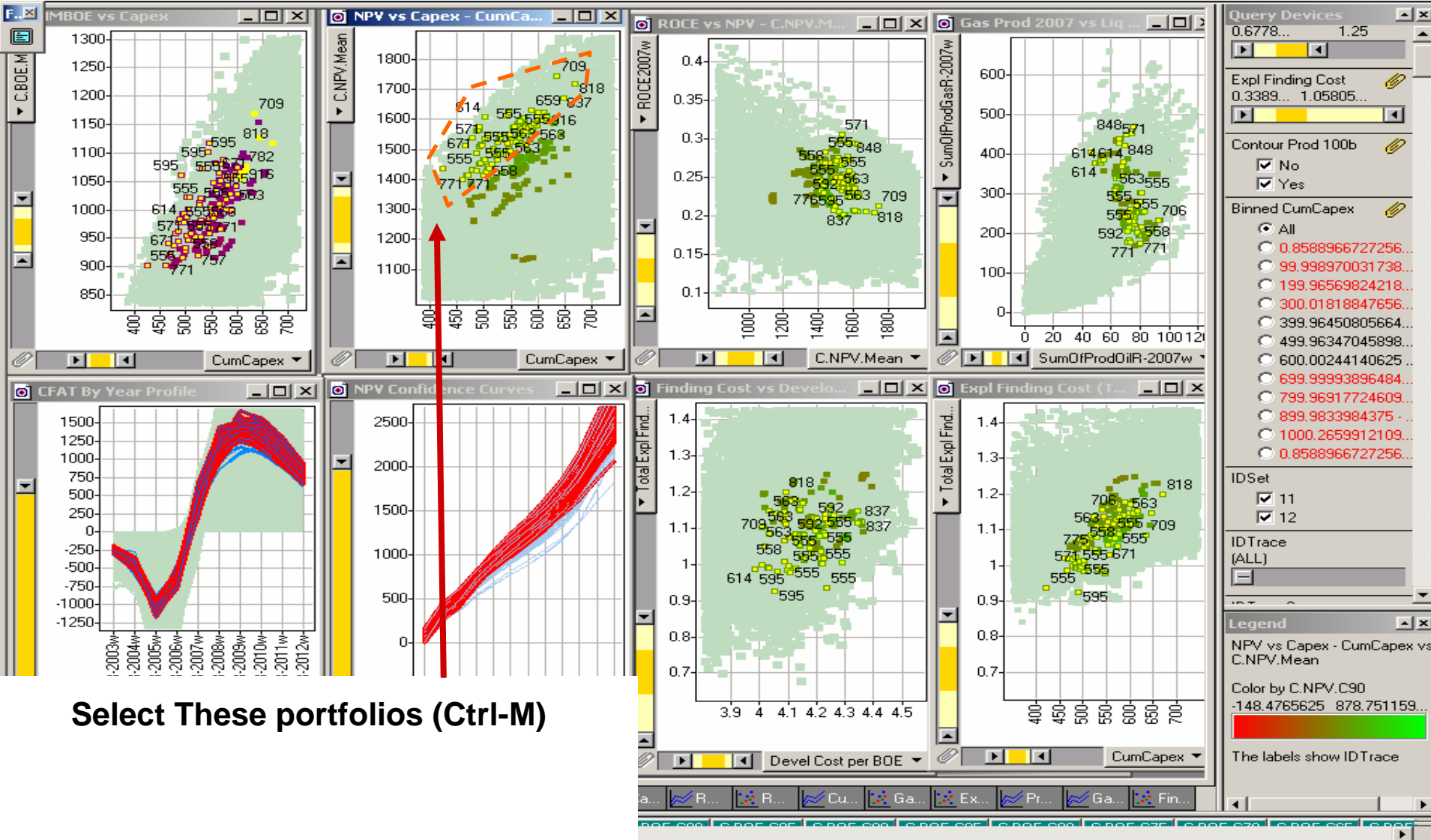


Step 8: Zoomed in. Choose Best half of NPV vs Capex

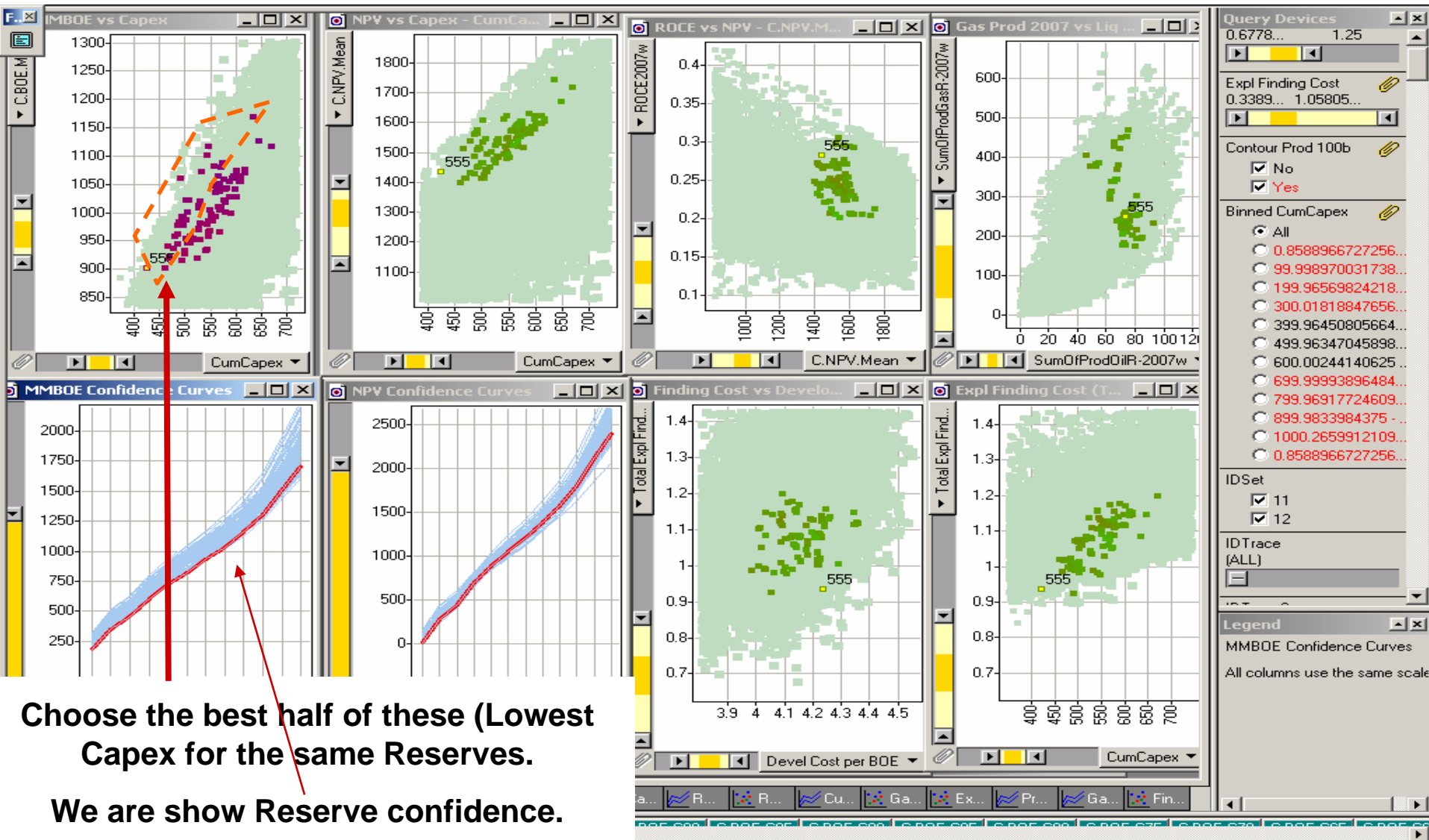


Now choose the best half for
NPV vs Capex.

Step 8: Zoomed in. Choose Best half of NPV vs Capex



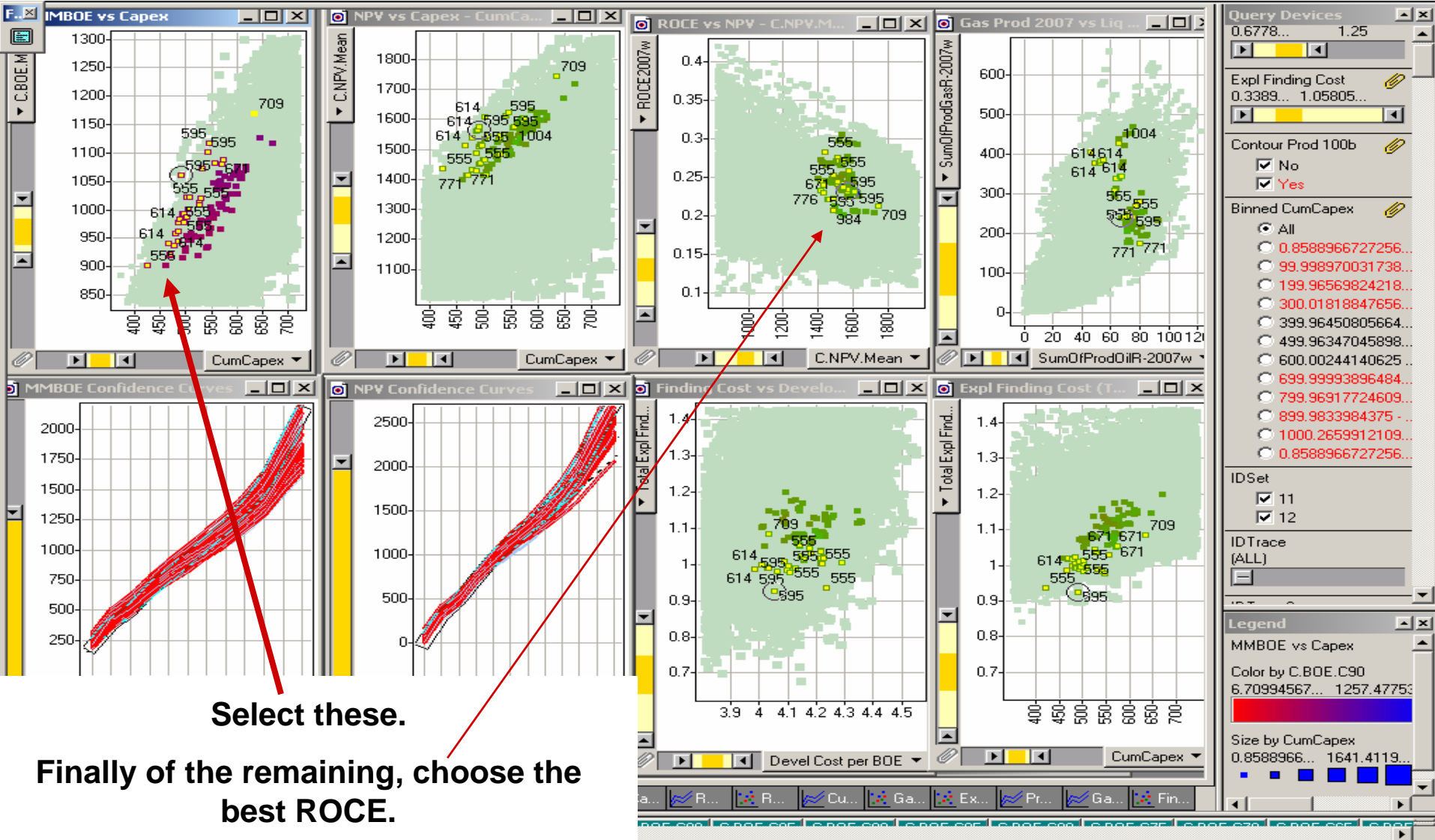
Step 9: Zoomed in. Choose Best half of Reserves vs Capex



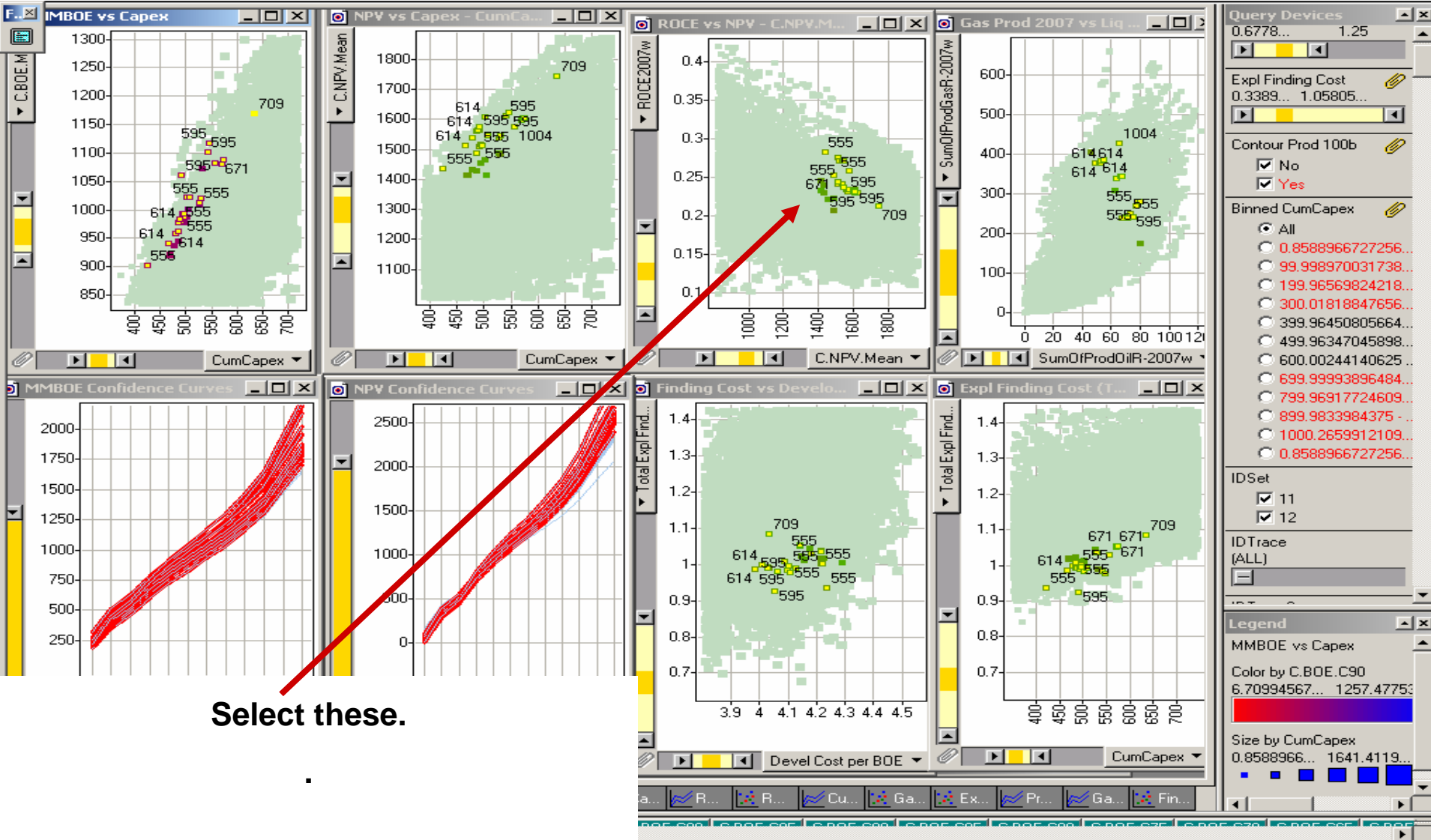
Choose the best half of these (Lowest Capex for the same Reserves.

We are show Reserve confidence.

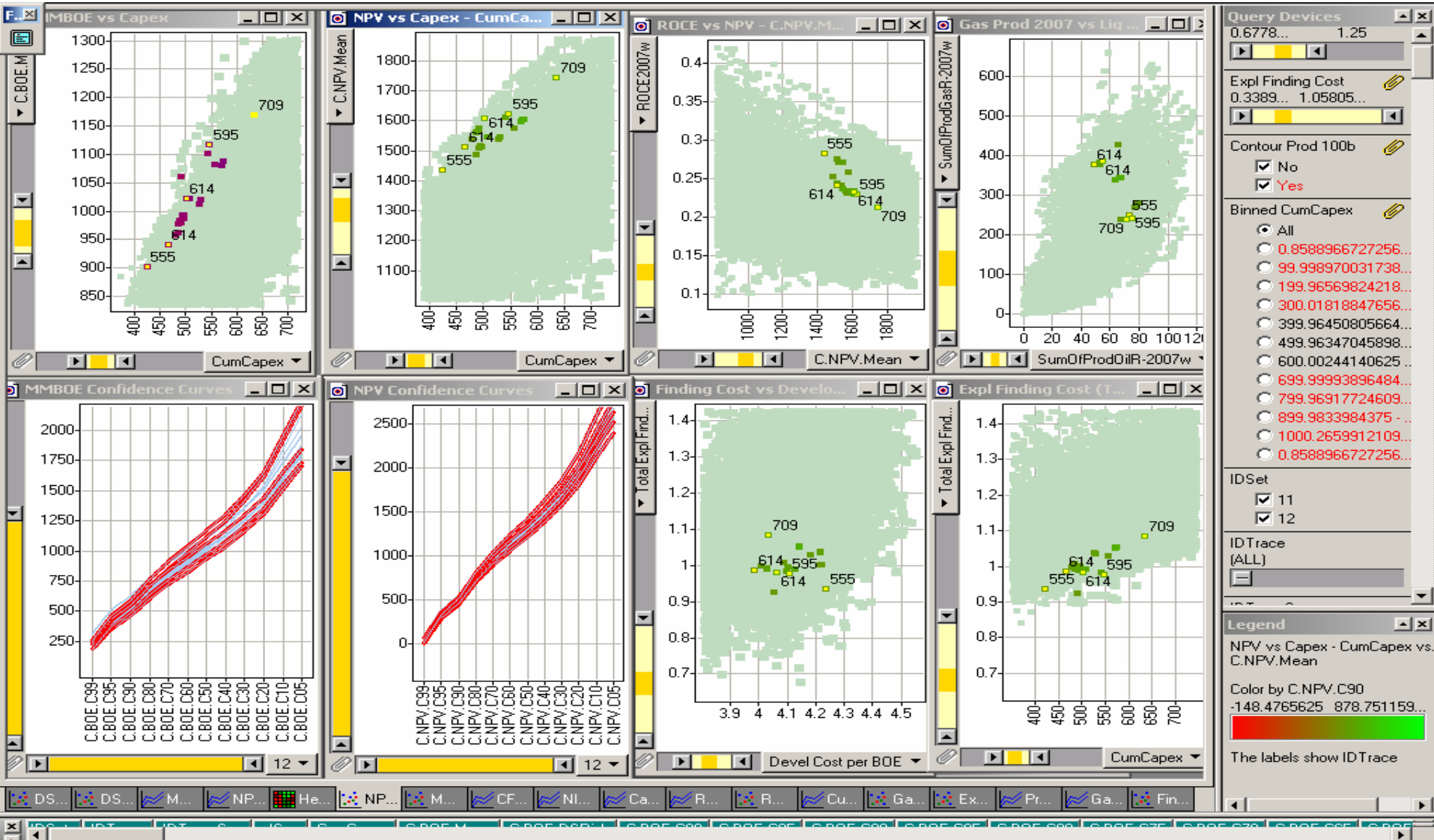
Step 9: Zoomed in. Choose Best half of Reserves vs Capex



Step 10: Zoomed in. Choose Best half of ROCE vs NPV



Step 11: Zoomed in. Choose the Best Portfolios at different capex levels



Step 12: Use the Project Census tool find which Projects are funded in the selected portfolios.

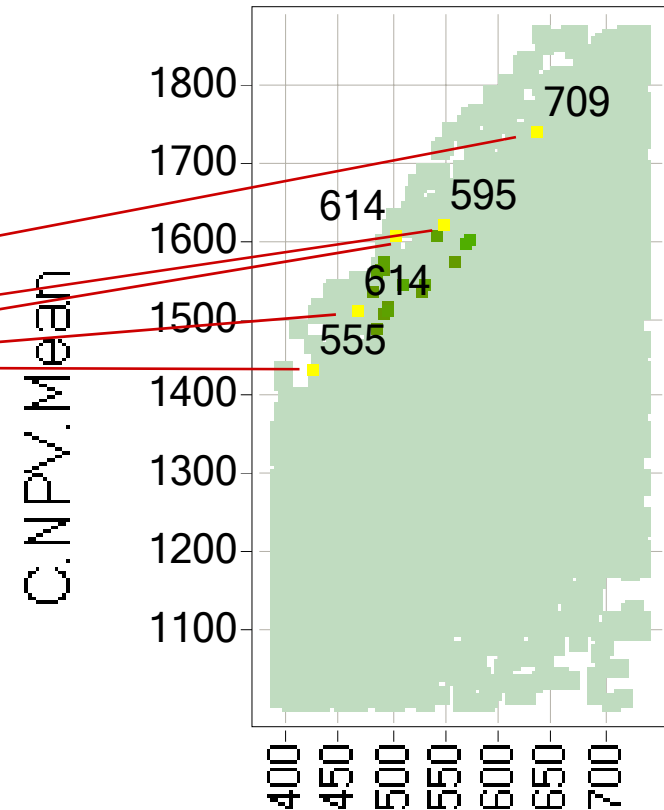
Expl. Capex where Opportunity was funded By Portfolio Trace							
Capex:		635		547		501	
Order Desc		C.NPV.Mean		1745		1624	
Oport Clave	Oportunidad	Count	709	595	614	614	555
578	Jackson	4	8	5	5	5	8
561	Williams	4	47	65	65	65	67
498	Gehrig	4	269	129	174	174	153
422	Rickey	4	293	200	298	298	156
564	Chance	3	9	6			9
541	Appling	3	27		45	45	74
440	Johnson	3	145	173	111	111	
446	Yount	3	292	198	220	220	
590	Clemens	3	331		212	212	224
556	Aaron	3	283		287	287	199
512	Clemente	3	394	360			286
429	Hornsby	3	486	349			302
490	Palmer	3	623	454			576
436	Marichal	2	54	77			
557	Griffey, Jr.	2	58				98
563	Bench	2		88	97	97	
546	Smith	2		215	245	245	
492	Hubbell	2		300			241
520	Alexander	2		222	407	407	
479	Cobb	2		250	387	387	
582	Robinson	2	415		319	319	
412	DiMaggio	2		388			351
464	Kaline	2			445	445	323
508	Reggie	2	461	400			
475	Fingers	2			501	501	365
569	Heilmann	2		547	572	572	
481	Young	2		569			620

What the Project Census Drill down tells us....

We retrieve the Projects funded in each Portfolio we Marked in the Spotfire Visualization.

NPV vs Capex -

			Expl. Capex where Opportunity was funded By Portfolio Trace				
Capex:			635	547	501	465	423
Order Desc	C.NPV.Mean		1745	1624	1610	1514	1435
Oport Clave	Oportunidad	Count	709	595	614	614	555
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563	Bench	2		88	97	97	
546	Smith	2		215	245	245	



CumCapex

What the Project Census Drill down tells us....

Portfolios (by Trace Number and Capex)

Ordered by NPV decending left to right

Expl. Capex where Opportunity was funded
By Portfolio Trace

Capex:			635	547	501	465	423
Order Desc	C.NPV.Mean		1745	1624	1610	1514	1435
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Portfolio Capex

NPV of Portfolio

Trace Number.

The 5 Portfolio points
come from 4 Portfolio
Traces.

Trace 614 was picked
at two Portfolios with
different Capex Levels.

What the Project Census Drill down tells us....

Portfolios (by Trace Number and Capex)

Ordered by NPV decending left to right

Expl. Capex where Opportunity was funded
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Capex:			635	547	501	465	423
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563	Bench	2		88	97	97	
546	Smith	2		215	245	245	

Projects are in Rows

The cells show the
Capex level where that
Project is funded in
that Portfolio.

The Lower the number,
the stronger the
project.

The Higher up in the list,
the better the project helps meat your goals....

Portfolios (by Trace Number and Capex)

Ordered by NPV decending left to right

Expl. Capex where Opportunity was funded
By Portfolio Trace

Capex:			635	547	501	465	423	
Order Desc			C.NPV.Mean	1745	1624	1610	1514	1435
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557	Griffey, Jr.	2	58				98	
563	Bench	2		88	97	97		
546	Smith	2		215	245	245		

The Projects are
sorted first by the
Number of Traces that
Fund the project.

Next by the average
Capex level that
funded the project.

These 4 projects were
funded in all four
Traces.

These 9 Projects were
funded in 3 of 4 traces.

The Higher up in the list,
the better the project helps meat your goals....

Portfolios (by Trace Number and Capex)

Different Capex Levels.

Expl. Capex where Opportunity was funded
By Portfolio Trace

Capex:			635	547	501	465	423
Order Desc	C.NPV.Mean		1745	1624	1610	1514	1435
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557	Griffey, Jr.	2	58				98
563	Bench	2		88	97	97	
546	Smith	2		215	245	245	

A Grey number means
that the project was
funded in a Trace
higher than the Capex
for that selected
portfolio

It is useful when
comparing portfolios
of different capex
levels.

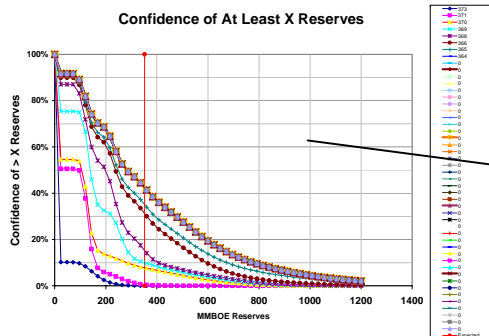
Spotfire Sheds Light on a Complicated Problem

- Woolsey's 1st Law
 - “A Manager would rather live with a problem he cannot solve than accept a solution he does not understand.”
- Woolsey's 2nd Law
 - “A Manager does not want, and will not pay for, an OPTIMUM solution. He wants to be better off now, as quickly and as cheaply as possible.

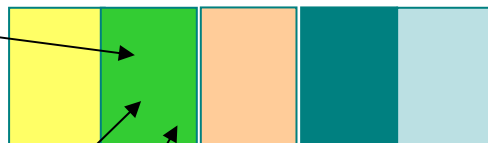
*Dr. R. E. D. Woolsey, Professor of OR/MS, Colorado School of Mines
Woolsey & Swanson, Operations Research for Immediate Applications, Harper & Row, 1974.

Spotfire Communicates Portfolio Decisions. How and where the Portfolios are built matters not.

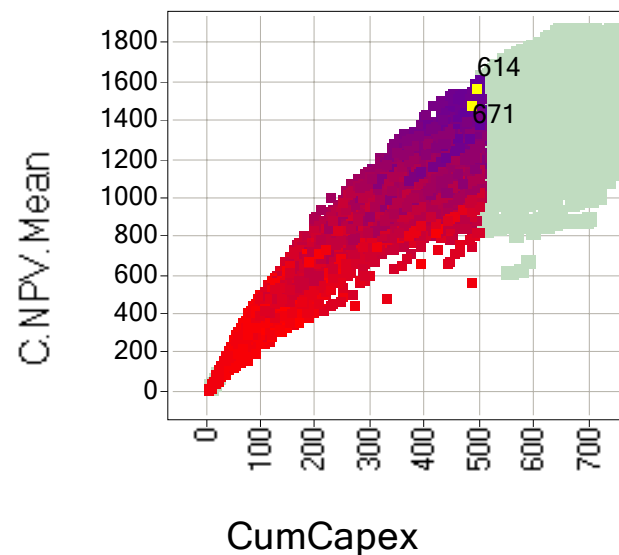
BlitzPort MultiField



Prospect and Portfolio Database



NPV vs Capex - CumCapex



**Management
Created Portfolios**

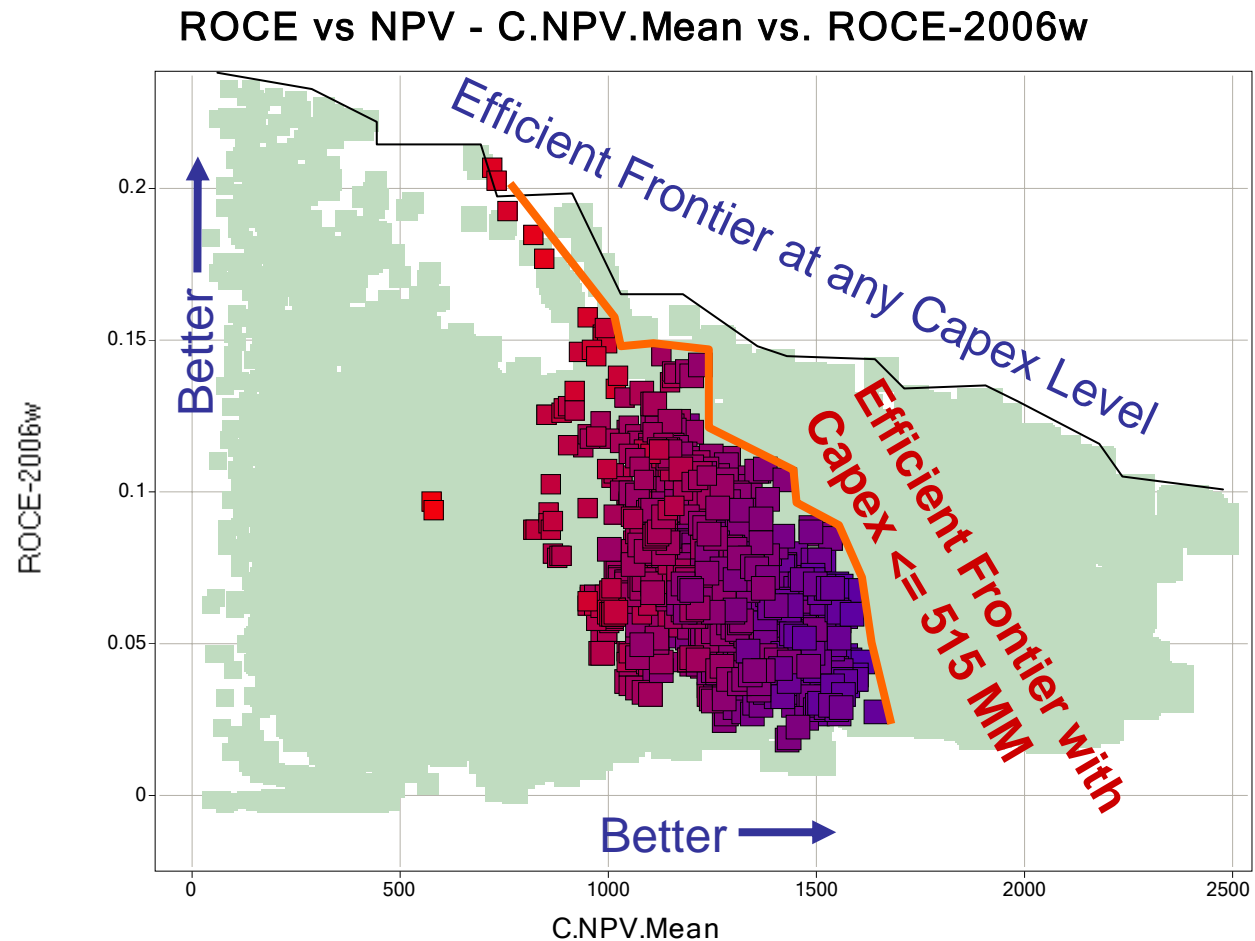
**Integer/Linear
Programing Portfolio
Optimizer**

**Once the Portfolios are stored in the
database, Spotfire can compare them all**

Goals for Improving the Portfolio Management process

- To know which portfolios are superior to other in the Performance measures that matter.

To “trade-off” one goal with another

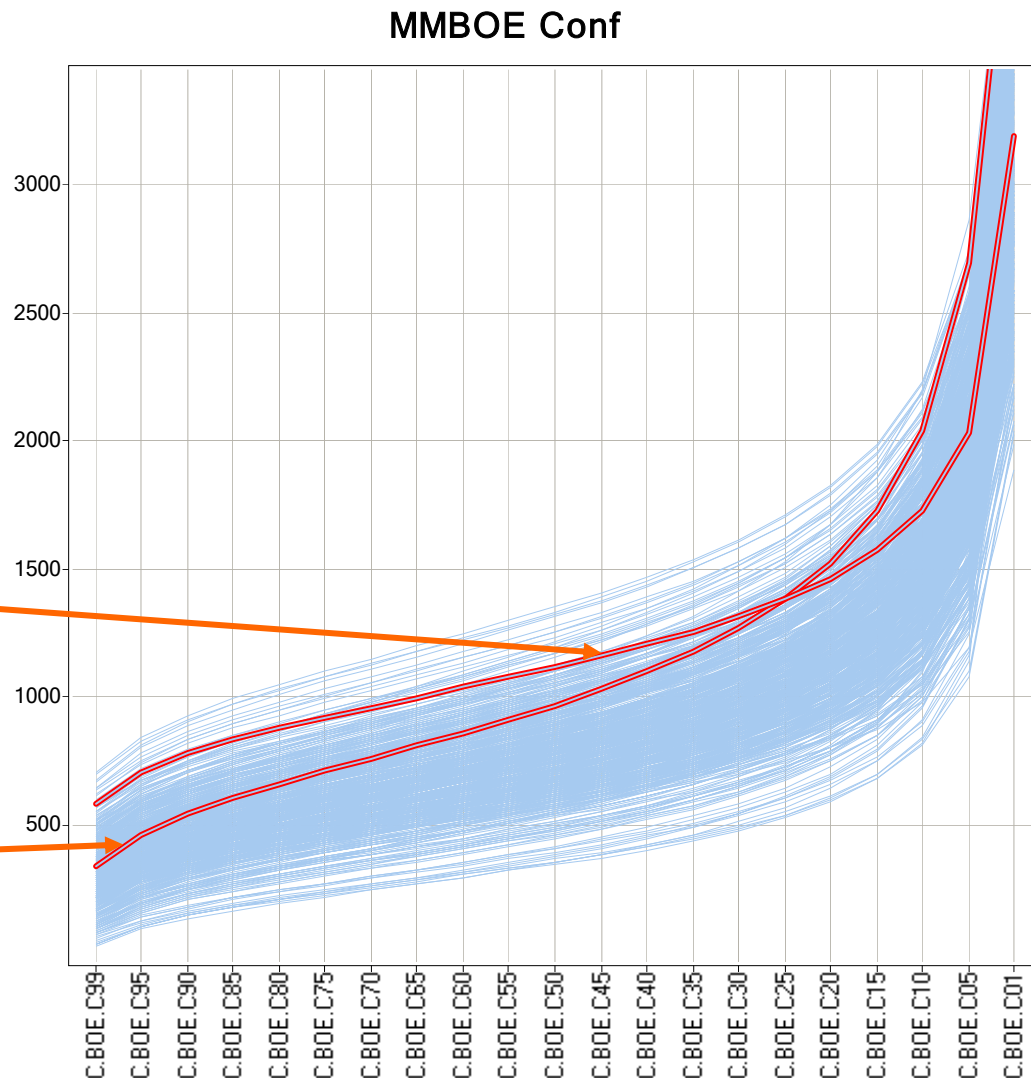


Goals for Improving the Portfolio Management process

- To Understand, Predict, and communicate the range of possible outcomes of any funded Portfolio

This Portfolio has a
 5% Probability for > 2000 MMBOE
 65% Probability for > 1000 MMBOE
 90% Probability for > 750 MMBOE

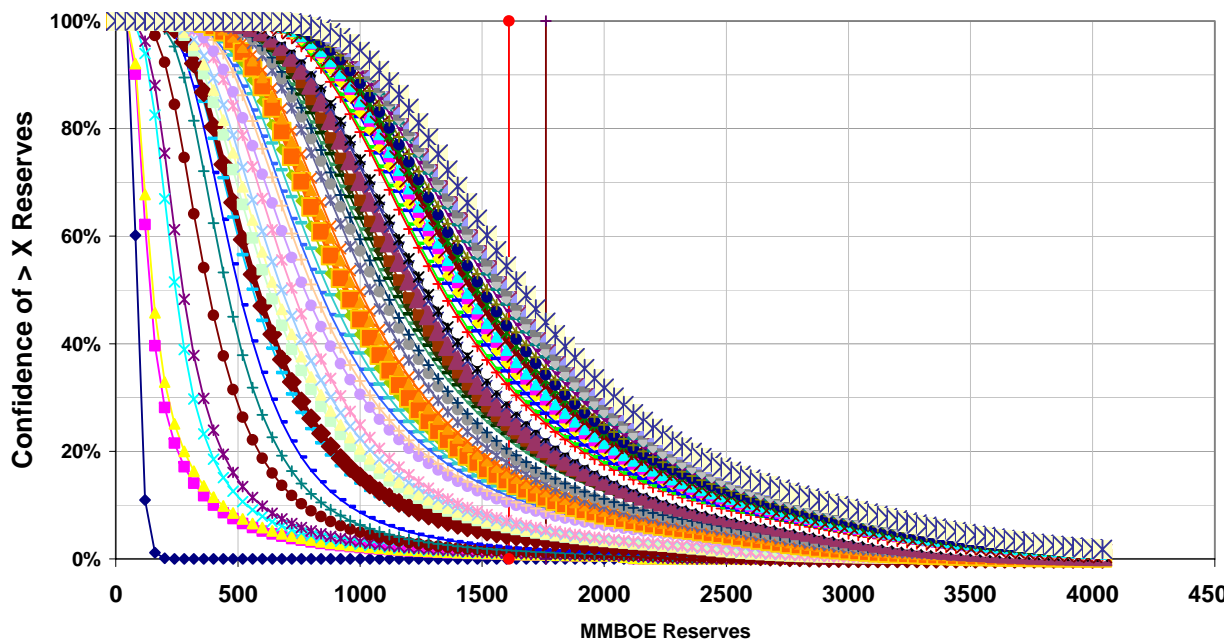
A different Portfolio has a
 10% Probability for > 2000 MMBOE
 45% Probability for > 1000 MMBOE
 65% Probability for > 750 MMBOE



How the proposed project meets these goals

- The MultiField Portfolio Confidence Curve Calculator can quickly generate the range of results for candidate portfolios quickly.

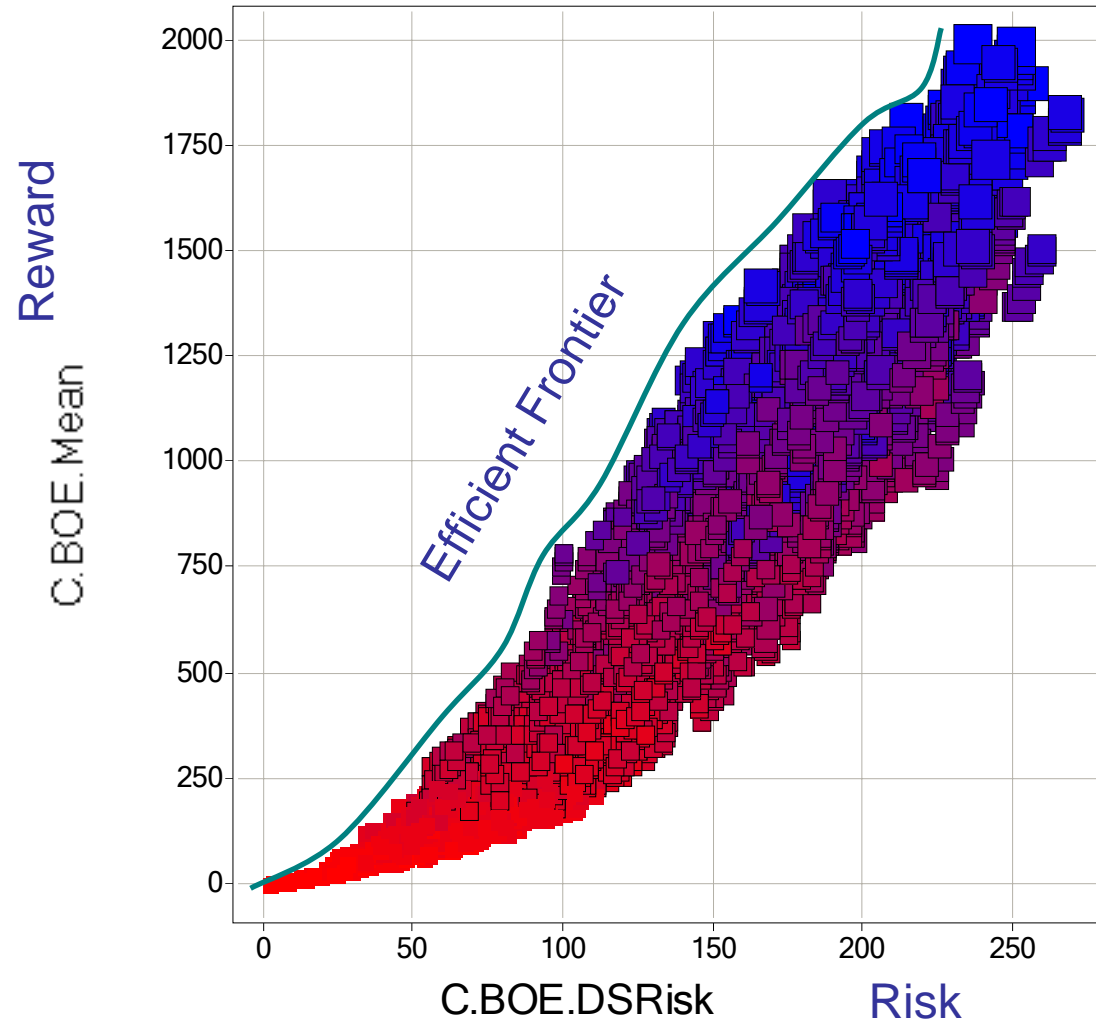
Confidence of At Least X Reserves



Goals for Improving the Portfolio Management process

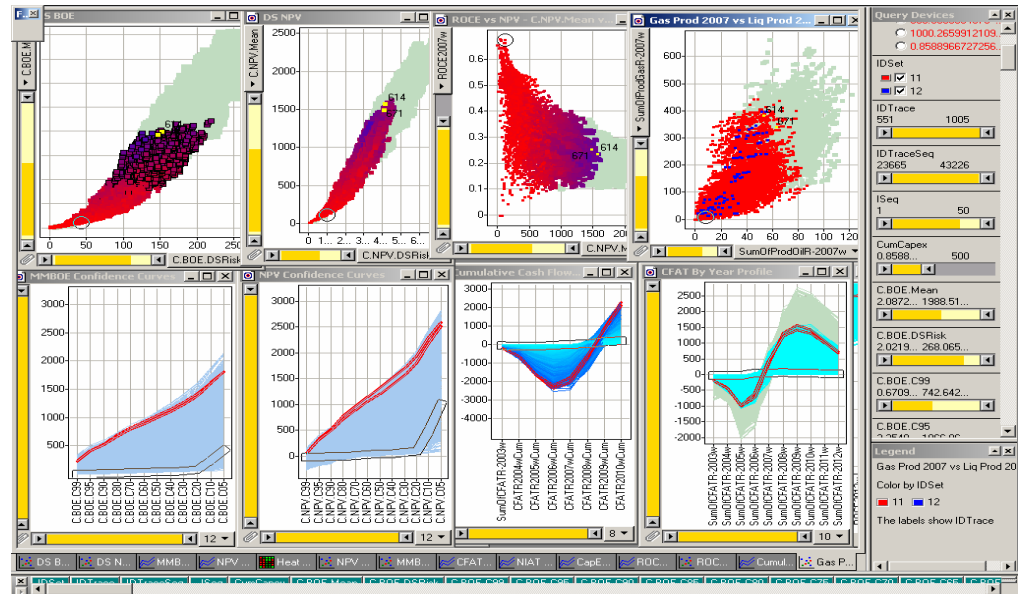
DS BOE

- To Reduce the time to assemble, calculate and analyze the candidate portfolios
- To increase the number of candidate portfolios that can be considered within a given amount of time, thereby exploring more options.



WiserWays Portfolio Calculator and Analyzer

- By making VISIBLE the potential funding opportunities, **DECISION MAKERS** can see available alternatives and the degree of difference (or equivalence) between them.



- You can **change your constraints** in the conference room for real-time turnaround.
- Understandable. Quick. Easy. Inexpensive.

Thanks to

- Spotfire
 - For the opportunity to speak here and for the work we have done together since 2001.
- Adán Oviedo Pérez, Subdirector, Exploración Vicepresident, Pemex
- Brett Edwards, President, Custer Resources

And Thank You for your attention.

- The San Francisco version of this presentation is available on-line at
<http://wiserways.com/downloads/031015Spotfire.pdf>

You can do the job many ways....

Do it better with



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