Using Advanced Decision Analysis to Mitigate Project Risk for Large-Scale Wood Pellet Export Projects

Presented by Dr. William Strauss
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Who is FutureMetrics?

We are Globally Respected Consultants in the BioEnergy Space

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FutureMetrics Services:

Research, analysis, and strategic guidance for the bioenergy sector.

Data driven analysis and a depth of knowledge across the bioenergy sector providing full spectrum reporting that enables our clients to make optimal decisions.

Selection of Clients

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NATIONAL RENEWABLE ENERGY LABORATORY

graanul invest

DEPARTMENT OF CONSERVATION
Maine Forest Service
STATE OF MAINE

CATE STREET CAPITAL

FULGHUM FIBRES

Holson
Forest Products

BTEC
Biomass Thermal Energy Council

LAHMEYER INTERNATIONAL

MESYS
MAINE ENERGY SYSTEMS

SEEGER ENGINEERING

PRODESA

FutureMetrics LLC

Pellet Project:

Prefeasibility and feasibility studies

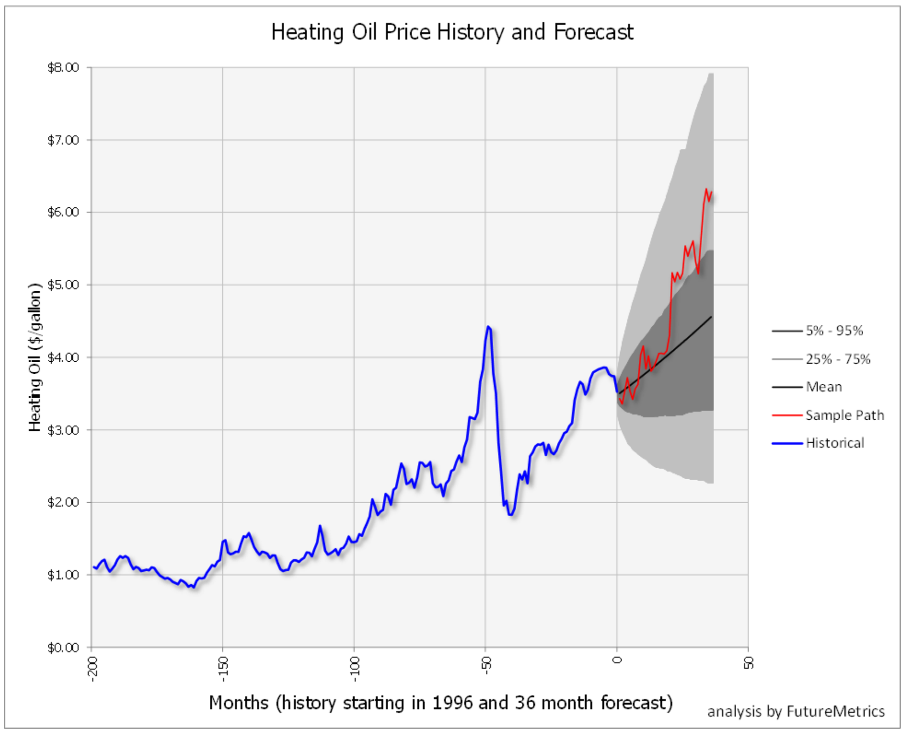
Due diligence

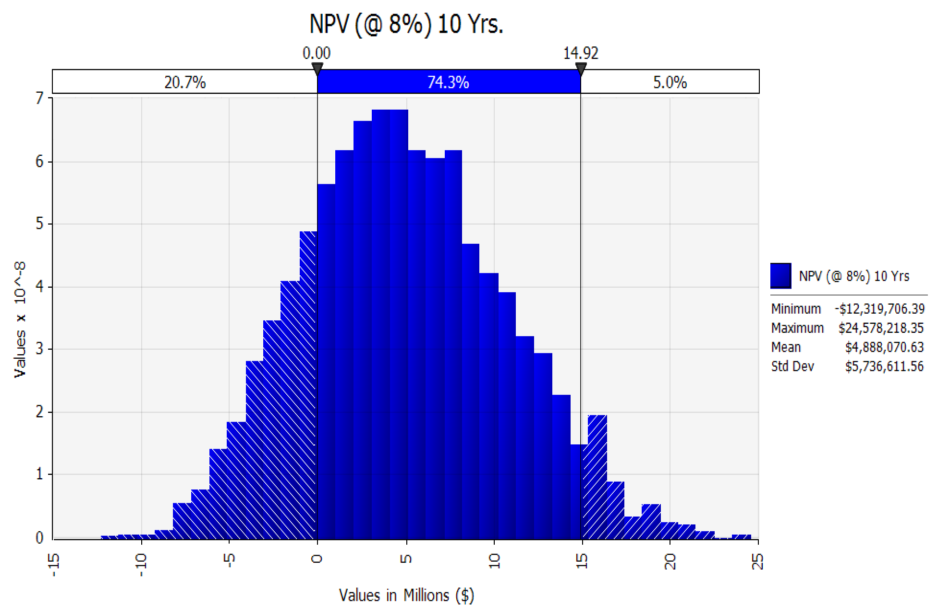
Financial modeling

Risk analysis

Economic impact analysis

Expert advice



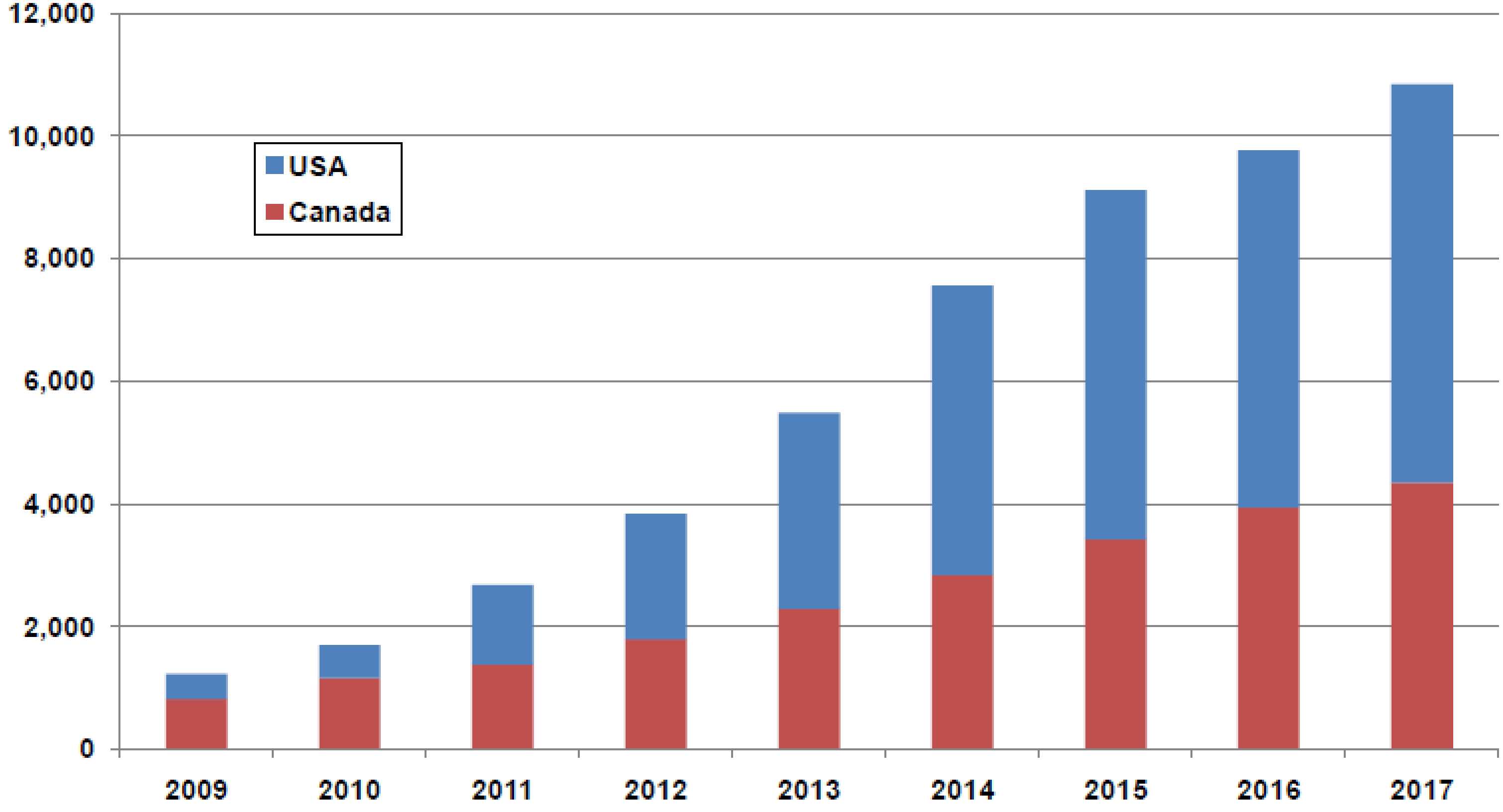


Dr. William Strauss

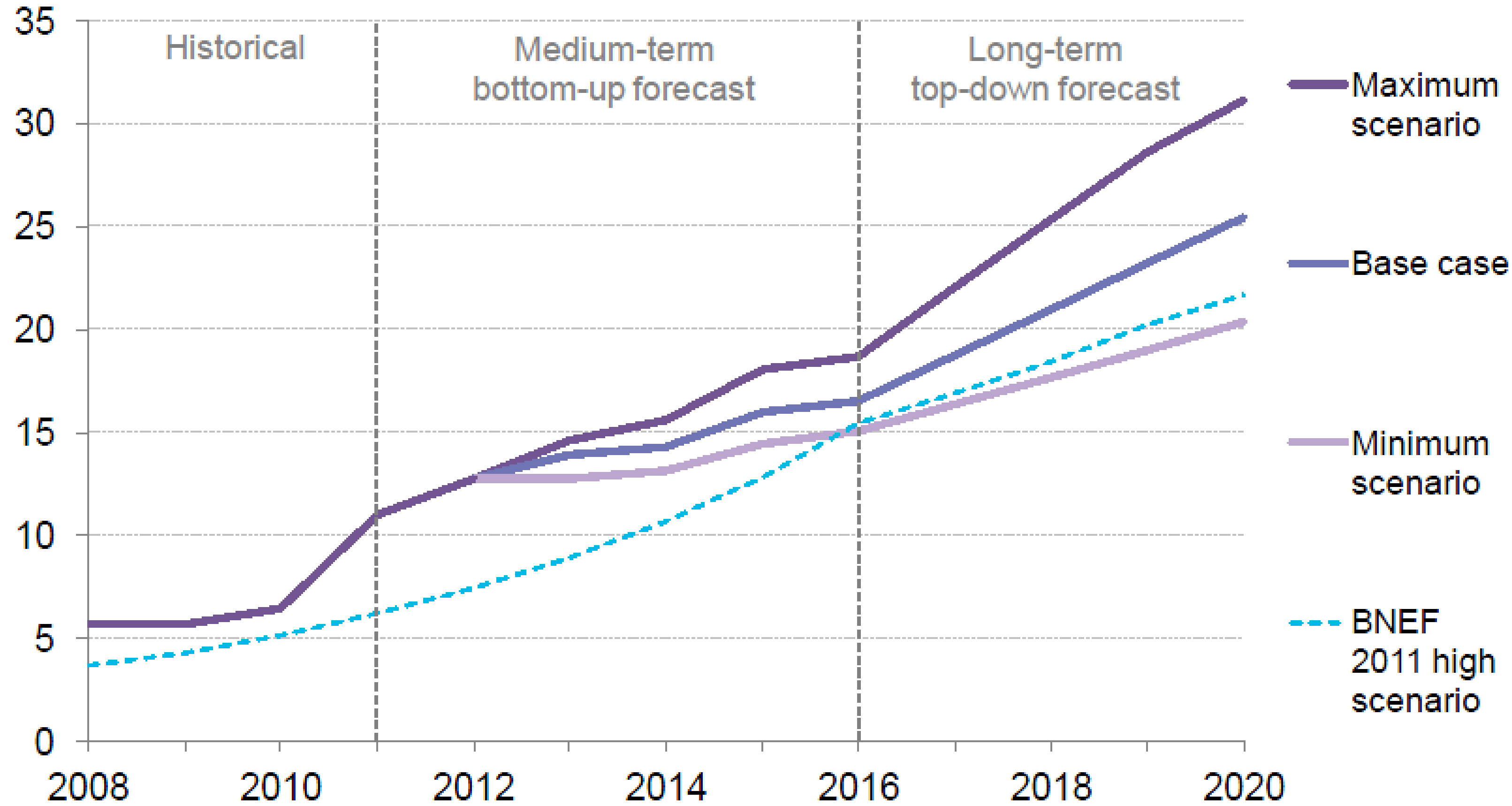
Recipient of the 2012 International Excellence in Bioenergy Award

US Energy Policy?

North American Wood Pellet Export Forecast – thousand tonnes



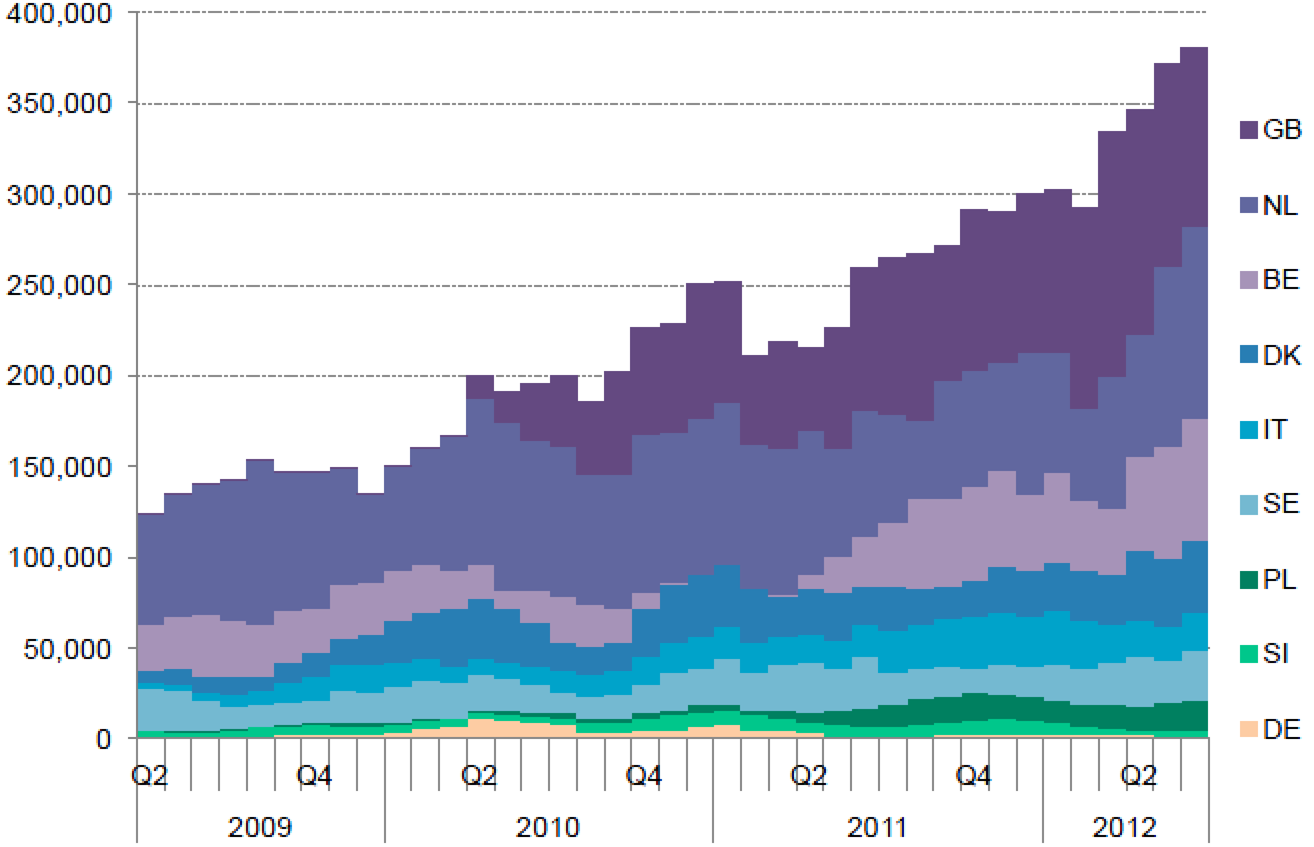
EU-27 WOOD PELLET DEMAND FORECAST, 2008–20 (MILLION TONNES)



Note: Medium-term forecast based on current project pipeline. Long-term forecast based on policy developments and coal market penetration.

Source: Bloomberg New Energy Finance

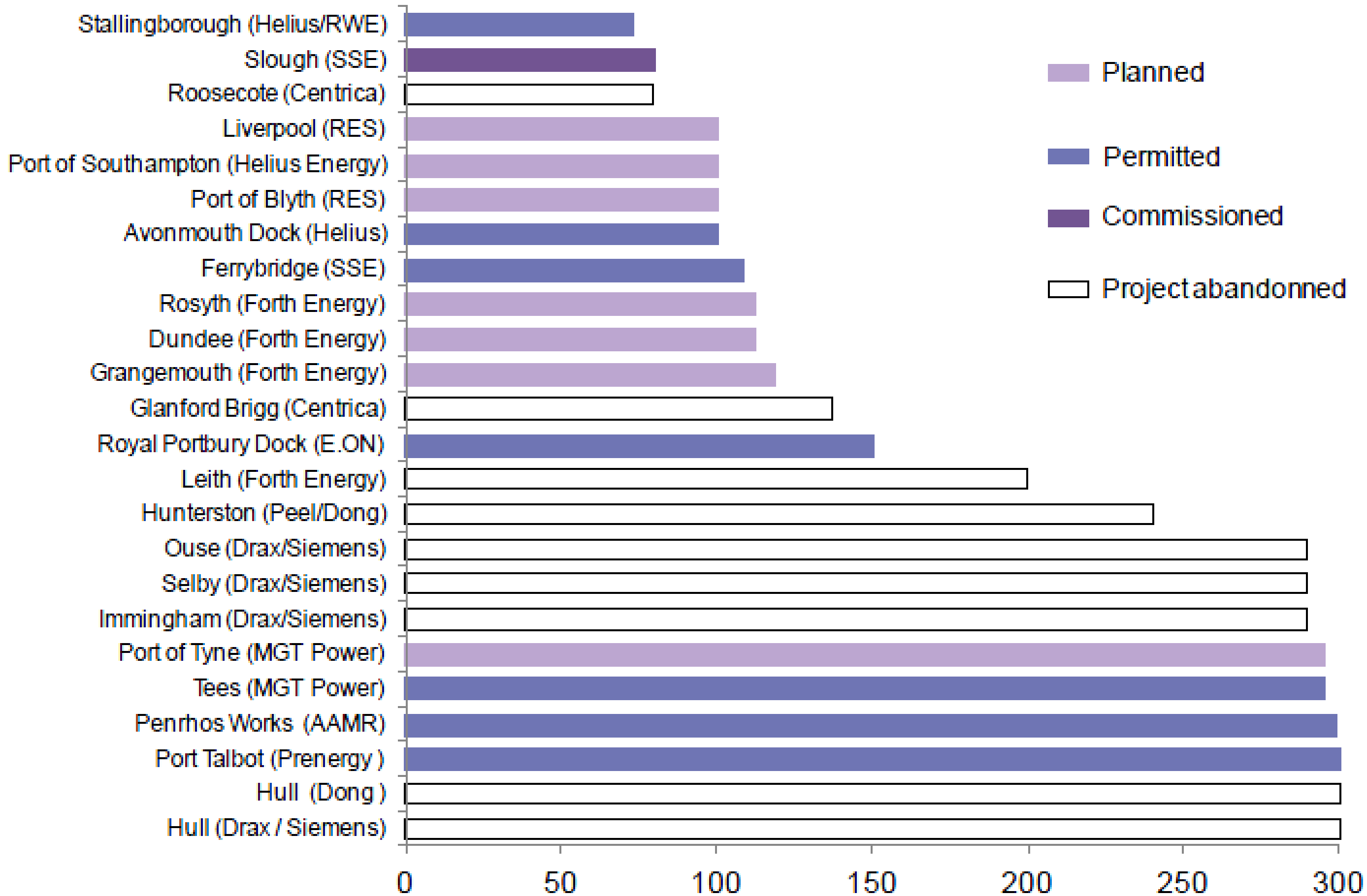
EU–27 AVERAGE MONTHLY WOOD PELLET IMPORTS FROM NON-EU COUNTRIES, Q2 2009 – Q2 2012 (TONNES)



Note: Figures are a four-month moving average of trade flows. Data represents the nine largest importers. Since January 2012 wood pellets are captured in a dedicated category (CN 4401-3100), before 2012 in code CN 4401-3020.

Source: Bloomberg New Energy Finance, Eurostat

UK LARGE DEDICATED BIOMASS PLANTS, NOVEMBER 2012 (MW)

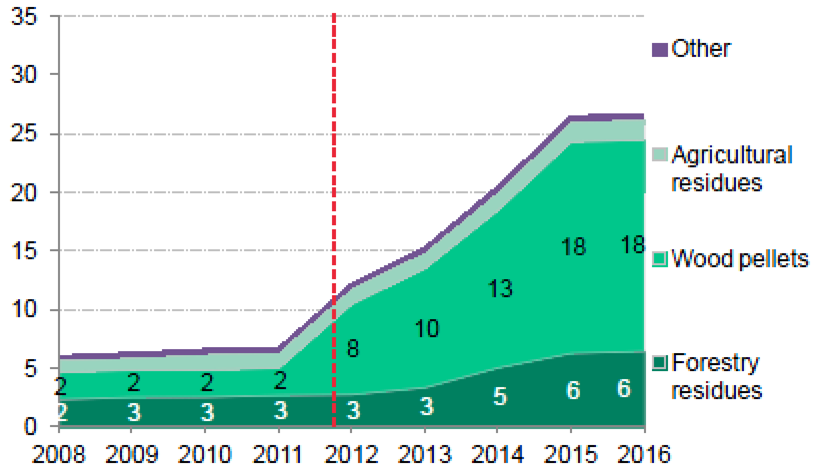


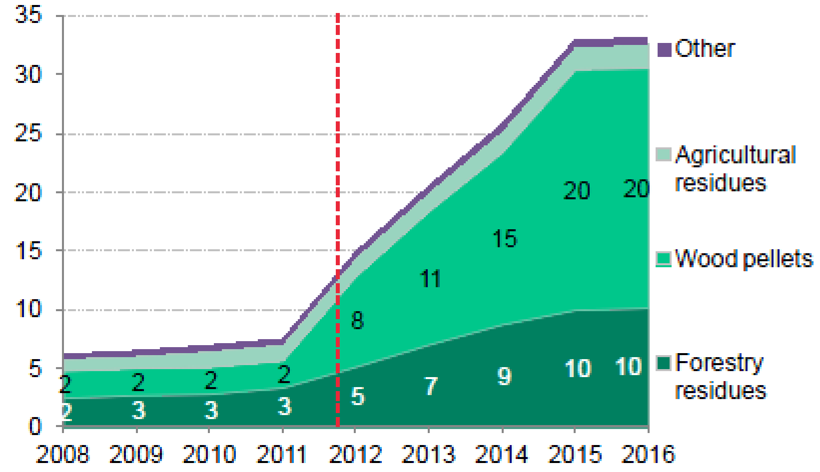
Note: The analysis only includes new build dedicated biomass plants with installed capacities of greater than 70MW; it does not include co-firing or coal conversions plants

Source: Bloomberg New Energy Finance

UK EXPECTED FEEDSTOCK DEMAND, 2008–16 (MILLION DRY TONNES PER YEAR)

BASE CASE	MAXIMUM CASE





Note: in this analysis we assume wood pellets are mostly made from sawdust; the sudden increase in wood pellet demand in 2012 is due to the coal-to-biomass conversion of Tilbury (750MW), and the expected conversion of Ironbridge (375MW); our demand forecast is based on nameplate capacity Other includes vegetable oils, energy crops and energy trees.

Source: Bloomberg New Energy Finance

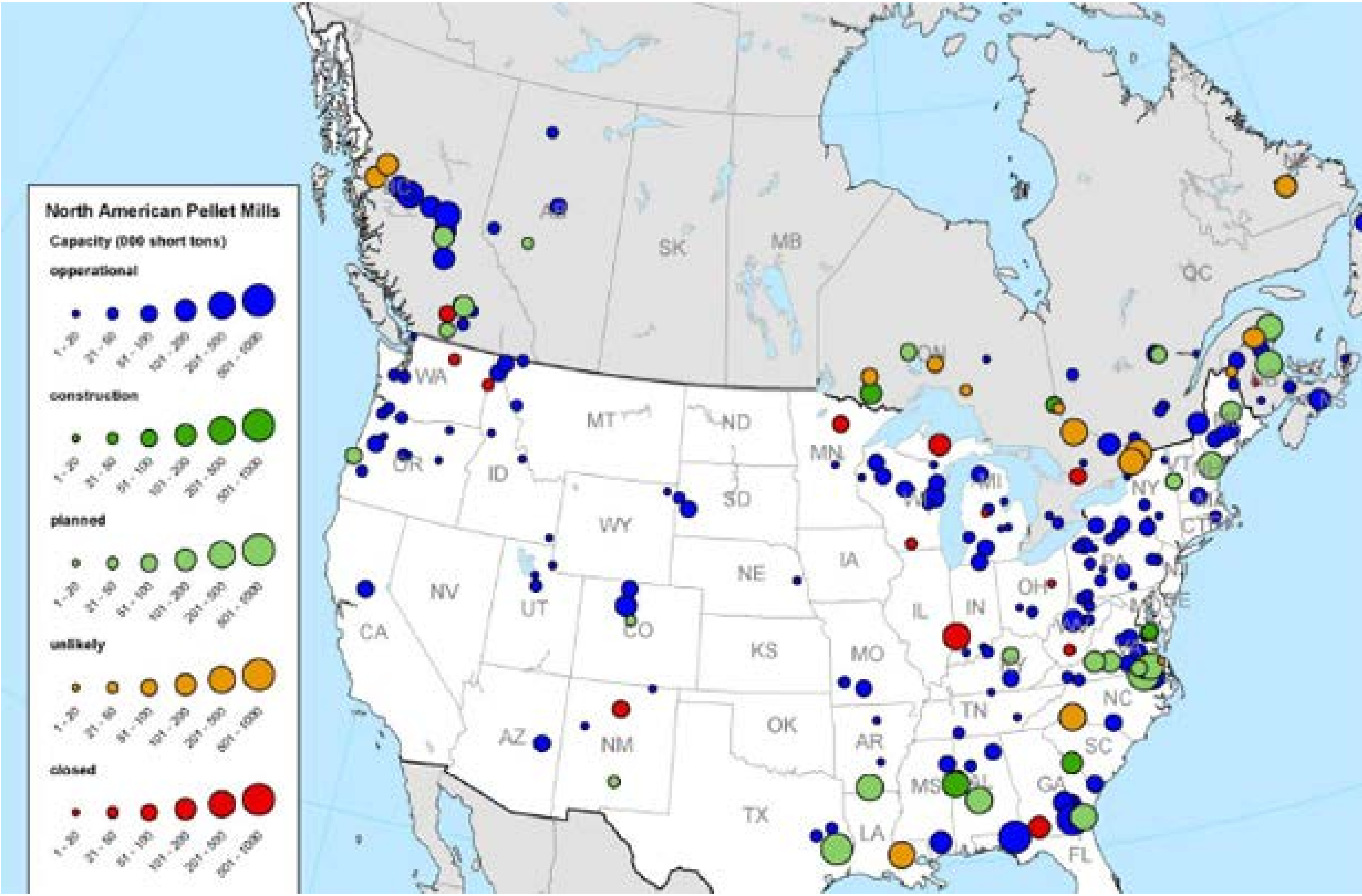
Total Renewable Energy Production in Europe in 1000's of tons of oil equivalent (TOE)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Solar energy	0.4%	0.4%	0.4%	0.5%	0.5%	0.6%	0.6%	0.7%	0.8%	0.9%	1.2%	1.6%
Biomass	**60.7%**	**60.5%**	**60.1%**	**59.2%**	**62.3%**	**64.1%**	**63.8%**	**65.4%**	**66.0%**	**66.8%**	**66.6%**	**66.8%**
Geothermal Energy	4.5%	4.7%	4.8%	4.5%	4.8%	5.0%	4.8%	4.6%	4.5%	4.3%	4.0%	3.9%
Hydro power	31.3%	30.9%	30.8%	31.5%	27.2%	24.8%	24.5%	22.4%	21.4%	19.8%	19.6%	18.7%
Wind power	1.0%	1.3%	1.9%	2.3%	3.1%	3.6%	4.5%	5.2%	5.7%	6.7%	7.2%	7.6%

source: Eurostat Energy Statistics, 2011

Year	2009
Solar energy	1.6%
Biomass	**66.8%**
Geothermal Energy	3.9%
Hydro power	18.7%
Wind power	7.6%

FutureMetrics is the lead consultant on three large pellet export projects



Lets look at a Hypothetical 250,000 ton per year export project

There are many areas of uncertainty.

We will look at:

- Wood price (which also includes diesel fuel price)
- Pellet selling price (which also includes price appreciation above inflation)
- Capital Cost
- Inflation
- And a few other items…

In this presentation we will not look at (except the “Tilbury effect” and at bit on optimal insurance):

- policy risk
- currency risk
- shipping cost risk
- coal price risk
- market disruption risk (the “Tilbury effect”)

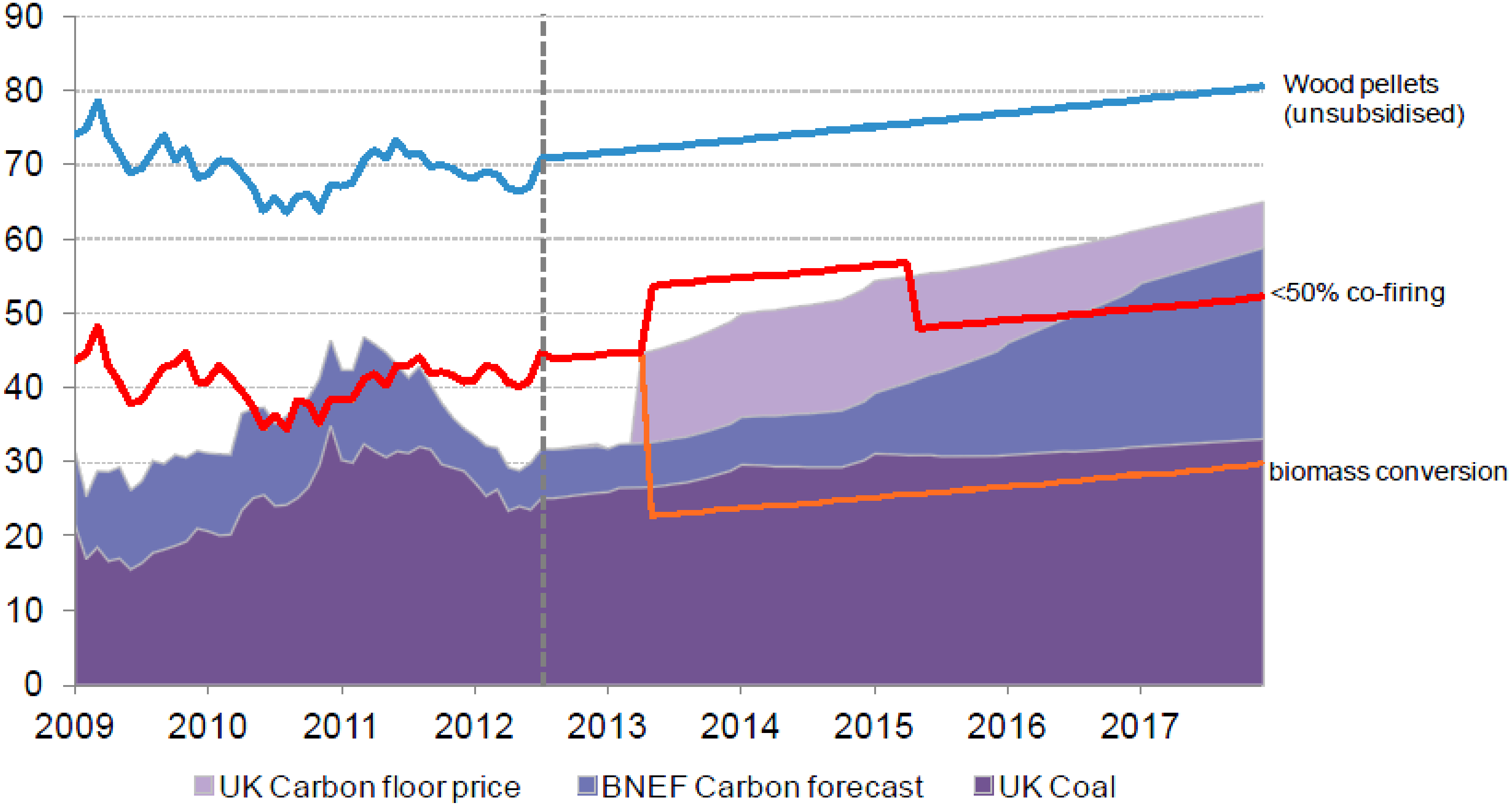
Torrefied pellet production;

- mass and energy balance sensitivities and cost of goods risk
- reliability and maintenance cost risk
- market demand risk (all of the above for export plus competition from white pellets)

Working capital issues;

- supply chain risk (catastrophic failure!)
- product lost risk (optimal insurance coverage)

UK MARGINAL COST OF COAL-FIRING AND CO-FIRING, 2009–2017E (GBP PER MWHE)



Note: The marginal cost of coal-firing is essentially the cost of coal and carbon. We have assumed a 35% conversion efficiency factor. Currently, co-firing is eligible to 0.5 ROC support regardless of fuel mix. In April 2013, the UK will establish a minimum carbon price floor, shown here as an increment over our EU ETS carbon forecast. Costs exclude capex and OPEX costs.

Note: Bloomberg New Energy Finance, Endex

Tilbury Fire – Feb. 27, 2012

What is THE number?

Wrong Question

The Power of Probabilities:
Adding Insight to Enable Better Decisions

The content about "The Number" and the benefits of probabilistic analysis in the next 12 slides are excerpted from a presentation by Randy Heffernan, Palisade Corporation.

Risk Analysis: What Most People Think Of

- » Lots of companies always performed risk analysis using 3-point estimates
- » They used numbers: best case, worst case, most likely
- » It was quantitative, it used spreadsheets, and it gave “a” number

No Longer Good Enough

- » Well, it never was
- » 3 point estimates only give:
  - 3 possible outcomes of thousands
  - No probability to assess importance
- » Point estimates provide no actionable direction
- » So what if worst case is X? In a world of limited resources, you need more information to decide what to do about it

Why is Probabilistic Analysis Important?

» Because the world is uncertain

» Uncertainty can be defined as “A parameter, the measurement of which we do not know, and cannot know until some time in the future.”*

* source: Leach: *Why Can’t You Just Give Me The Number*, p. 8

» What if you don’t think in ranges?
» What if you ignore probability?
» What if you analyze risk another way?

Many companies use:

- 3-point estimates
- Scoring methods
- What-ifs
- Just plain “gut feel”

They All Lead to “The Number”

» All these methods lead to “The Number”

» Most likely case in 3-point estimate = “The Number”

» Scoring methods produce a final single “score” = “The Number” that determines course of action

They All Lead to “The Number”

- » Running lots of subjective What-ifs forces managers to pick “most likely” point assumptions to get “The Number”
- » Gut feel simply guesses “The Number” (and is at least faster than the other methods)

“The Number” is Evil

- But you don’t want “The Number”
- If anyone tells you they have “The Number,” run away
- If any report bottom-lines “The Number,” send it back

The Number as (Dangerous) Gospel

» "The Number," once written, becomes set in stone
» "The Number" is disseminated
» "The Number's" underlying assumptions – and errors - are forgotten
» "The Number" become the basis for big decisions

Probabilistic Analysis: The Antidote to "The Number"

- With Probabilistic Analysis, you can answer:
  - "What is the probability of meeting our target?"
  - "What are the chances of losing money?"
  - "Where's the graph?"
- These are questions you *must* ask

Probabilistic Analysis: The Antidote to “The Number”

- Not possible with spreadsheets alone
- Monte Carlo simulation turns static spreadsheets into probabilistic ranges

Probabilistic Analysis vs. Other Methods

» You avoid perils of all other methods:

- You avoid getting lost in numbers
- You capture correlations between related variables
- Everyone can understand the results: common language
- Results are based on data, not arbitrary perceptions

Benefits of Probabilistic Analysis

» Improve the odds of success

- Identify pitfalls to avoid you might have missed – fewer surprises
- Uncover opportunities to chase you might have missed
- Research supports effectiveness

Benefits of Probabilistic Analysis

» Identify drivers of risk

- Sensitivity analysis ranks variables according to impact on your output
- Understand which factors are most important
- Target specific variables that have the biggest impact
- Don’t waste resources on low-impact events, or allocate too much to low-probability events

Benefits of Probabilistic Analysis

» Improve your credibility

- Make your case more persuasively to those above (and below) you
- Gain “buy in” from others in the company whose cooperation you need to make the project work
- Get funding: from corporate, from banks, from investors

Monte Carlo simulation is a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making.

The technique is used by professionals in a variety of fields such as finance, project management, energy, manufacturing, engineering, insurance, oil & gas, transportation, and the environment. (And now in Wood Pellet Project Analysis)

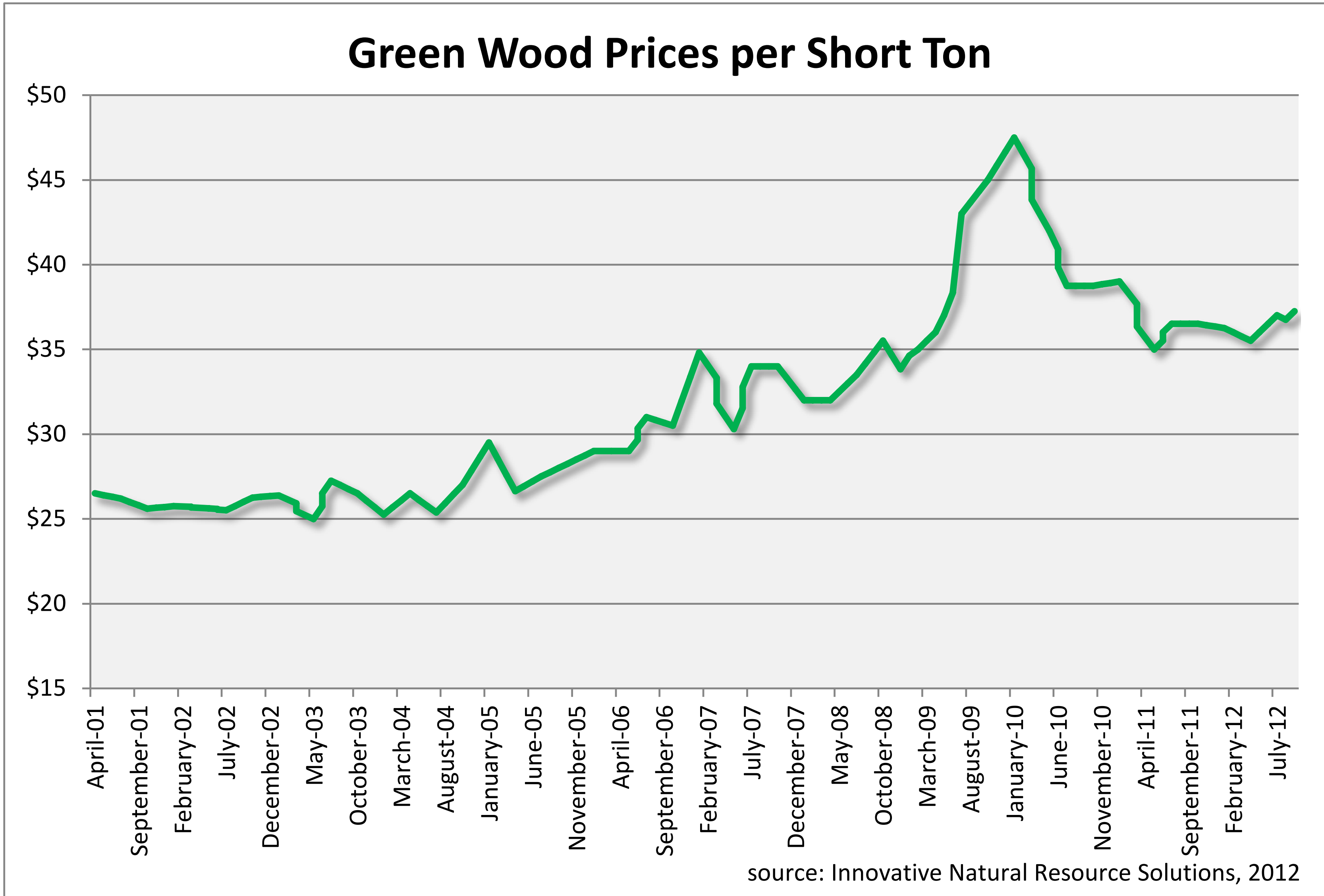
In Monte Carlo simulation, uncertain inputs in a model are represented using ranges of possible values known as probability distributions.

By using probability distributions, variables can have different probabilities of different outcomes occurring.

Probability distributions are a much more realistic way of describing uncertainty in variables of a risk analysis.

Monte Carlo simulation provides the decision-maker with a range of possible outcomes and the probabilities they will occur.

Wood Prices are about 55% to 65% of the Cost of Production of Pellets

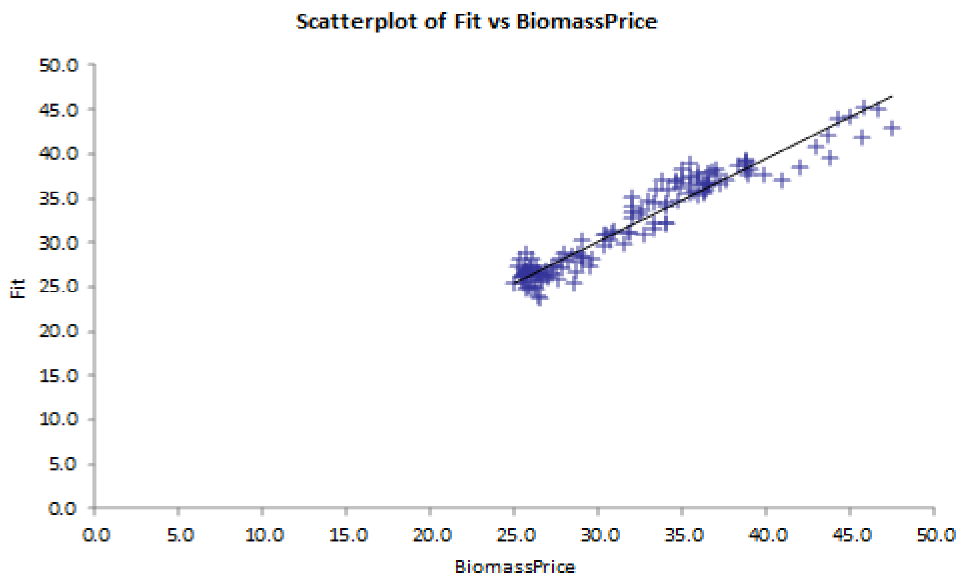


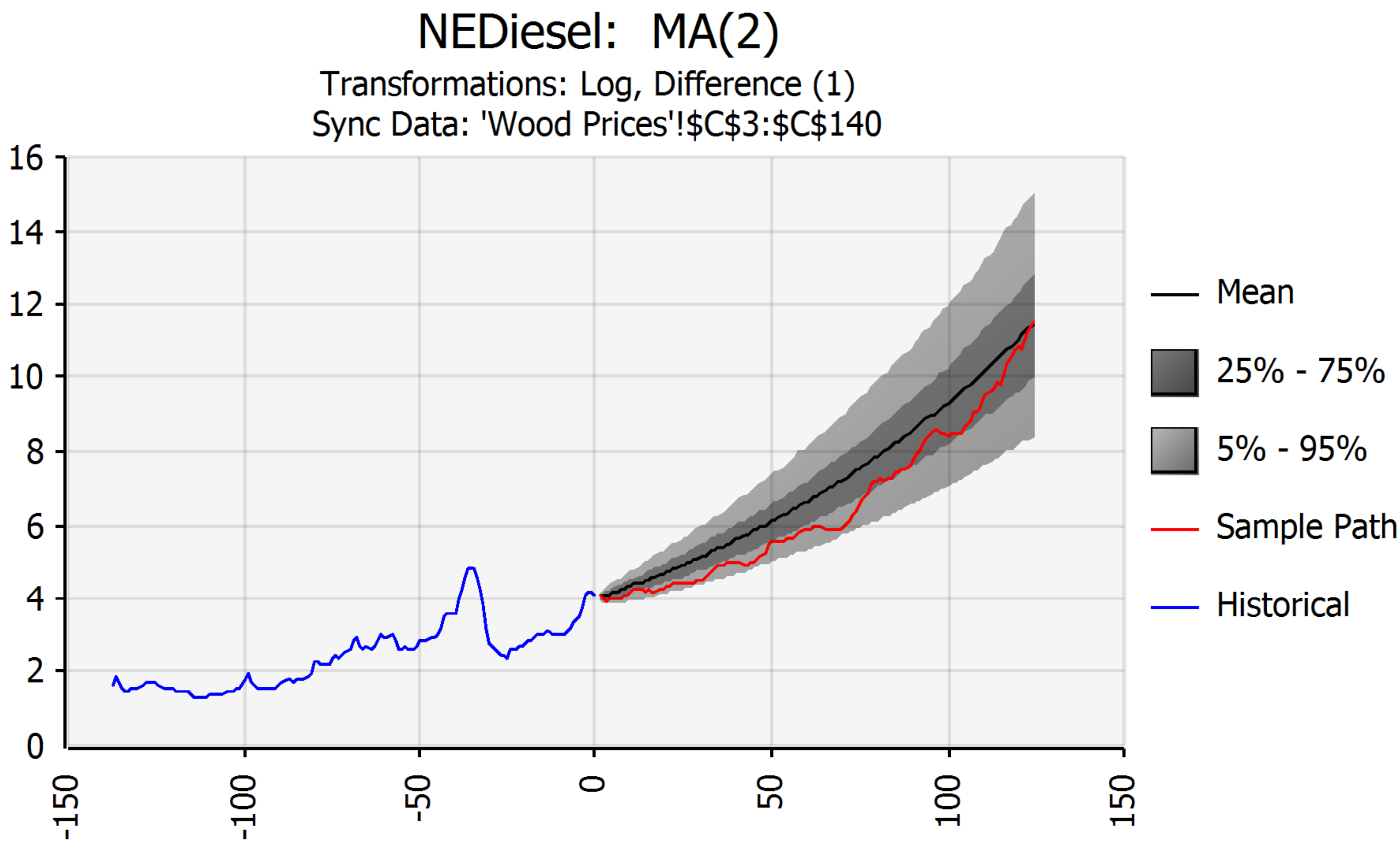
Wood Prices

Multiple Regression for BiomassPrice Summary	Multiple R	R-Square	Adjusted R-Square	StErr of Estimate
	0.9643	0.9300	0.9273	1.548191307

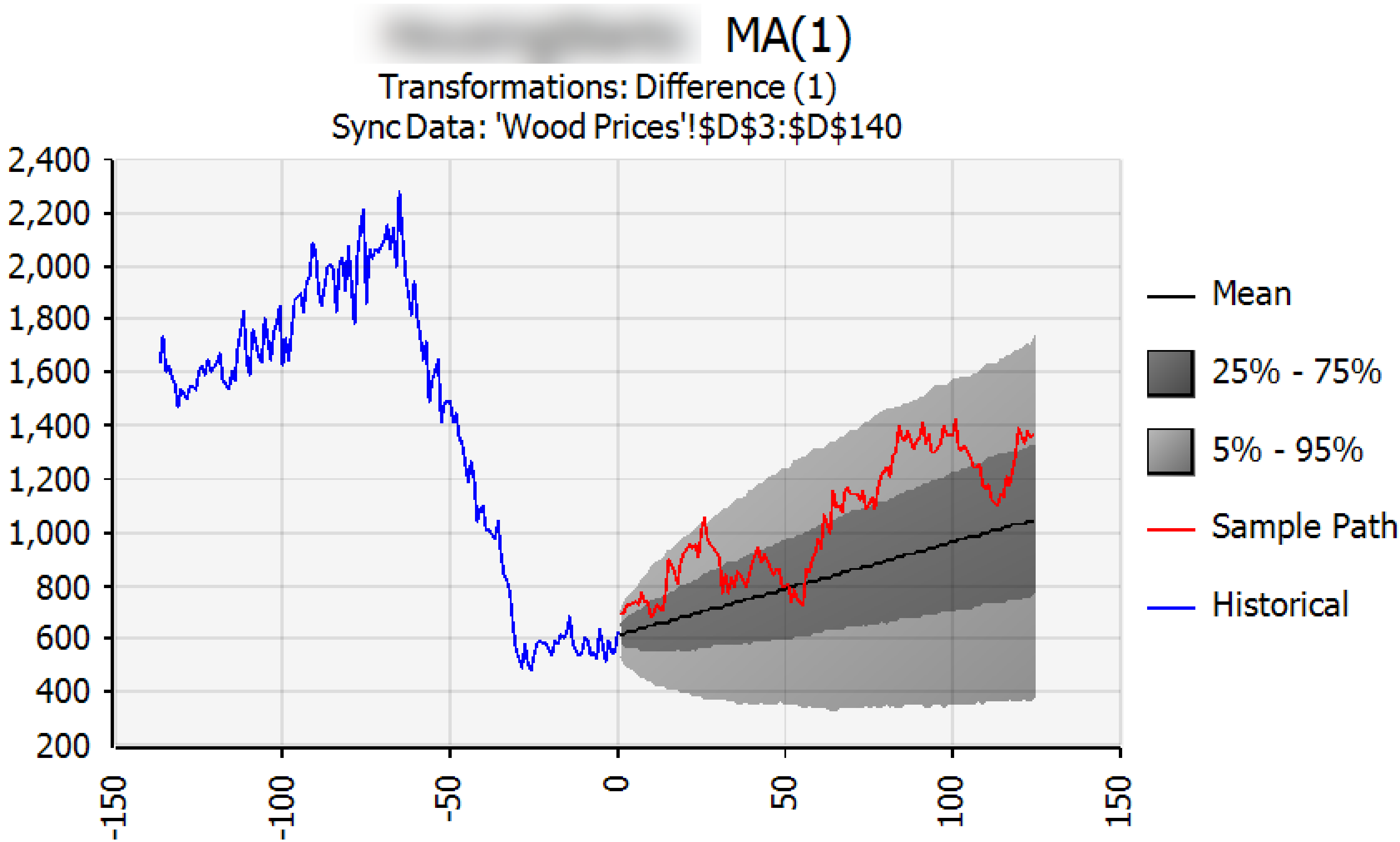
ANOVA Table	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value
Explained	5	4200.762555	840.152511	350.5168	< 0.0001
Unexplained	132	316.3903145	2.396896322		

Regression Table	Coefficient	Standard Error	t-Value	p-Value	Confidence Interval 95% Lower	Confidence Interval 95% Upper
Constant	-27.37722908	4.710130762	-5.8124	< 0.0001	-36.69433328	-18.06012487
NEDiesel	2.507788569	0.345409663	7.2603	< 0.0001	1.824534114	3.191043023
[illegible]	-0.005467499	0.000471013	-11.6080	< 0.0001	-0.006399209	-0.004535789
[illegible]	0.212217848	0.073118831	2.9024	0.0043	0.067581573	0.356854123
XXXX	0.353280366	0.029156265	12.1168	< 0.0001	0.295606392	0.41095434
YYYY	-0.015230028	0.001316519	-11.5684	< 0.0001	-0.017834234	-0.012625823

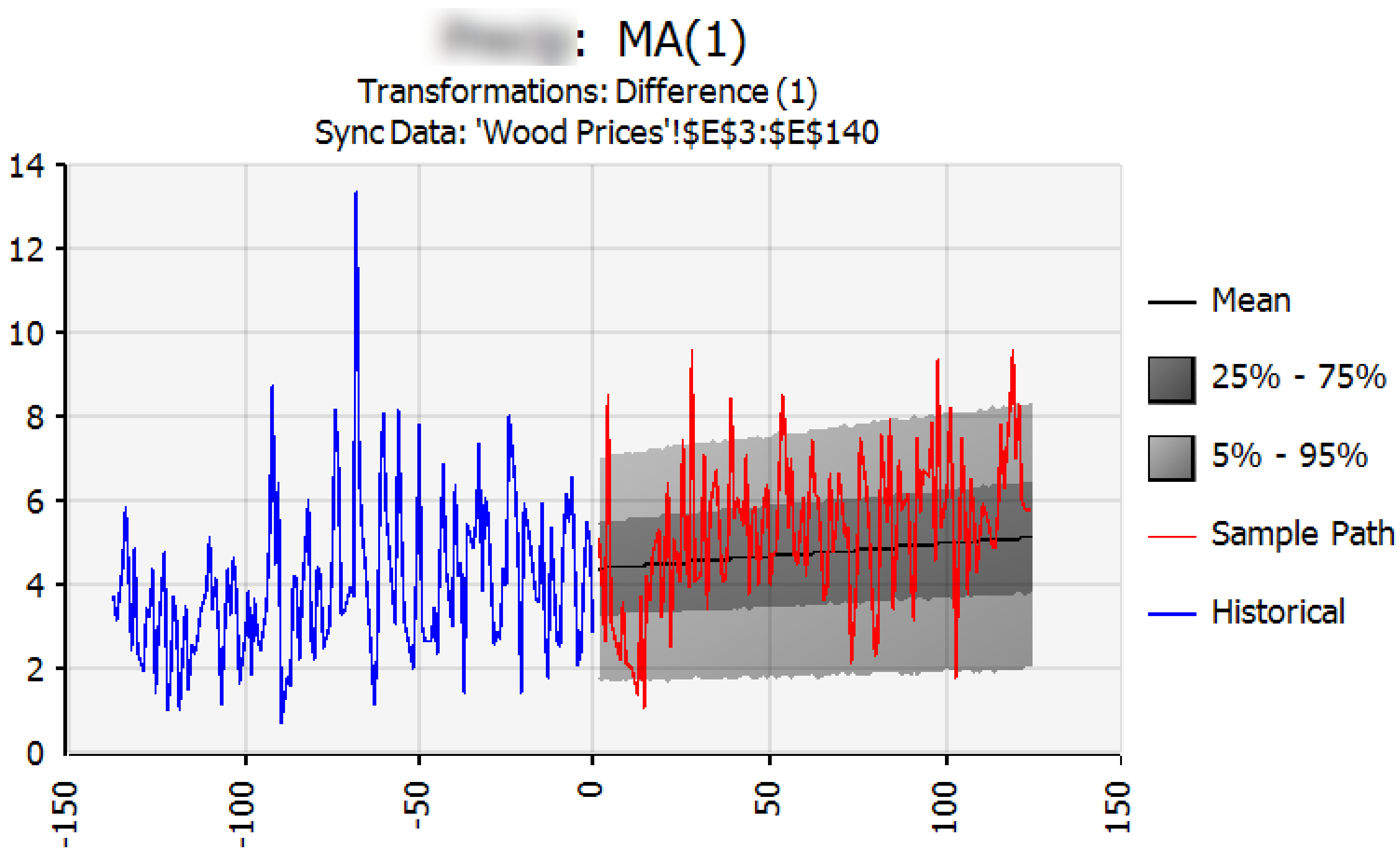




X- axis is months – 10 year forecast

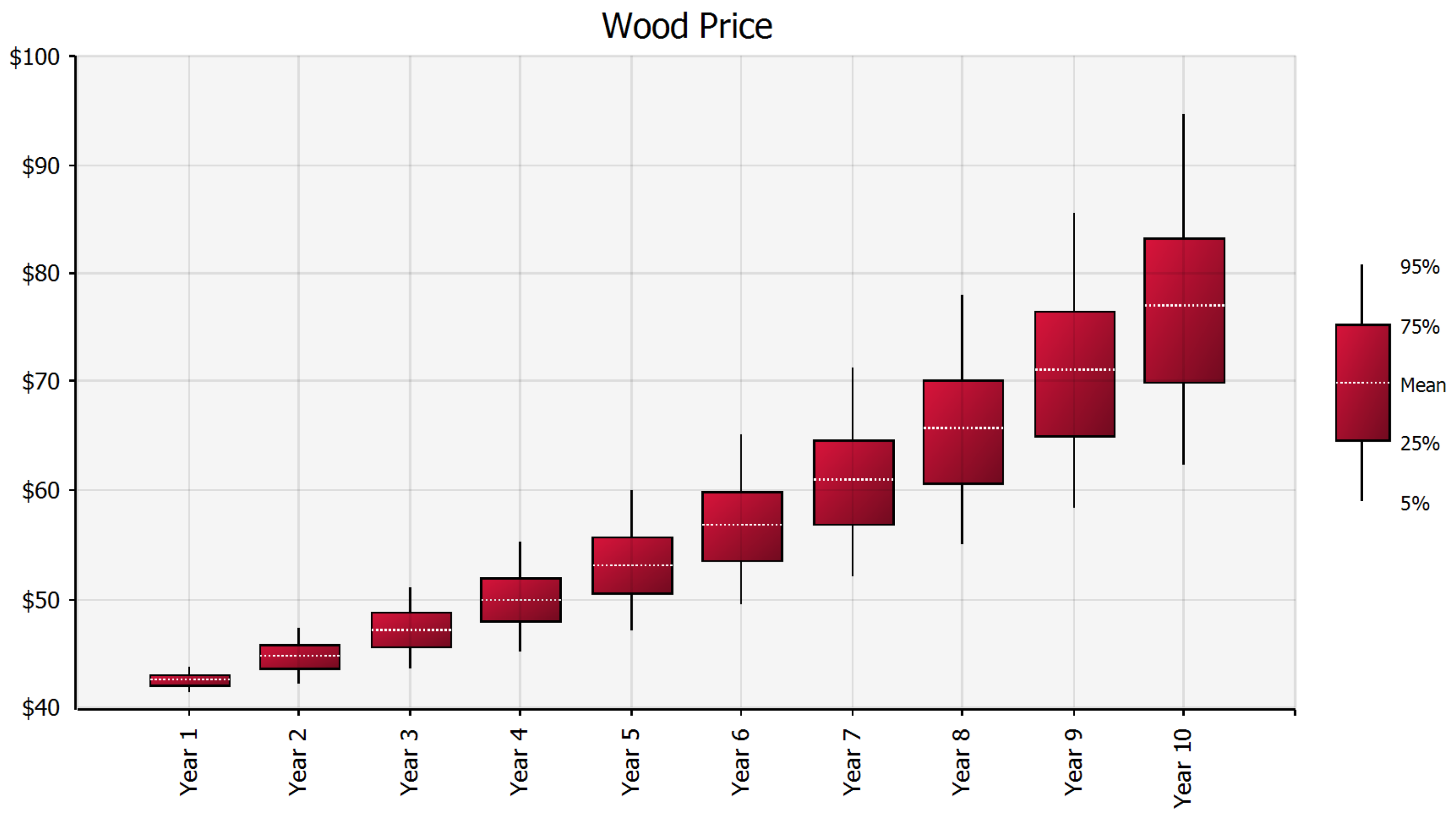


MA(1)
Transformations: Difference (1)
Sync Data: 'Wood Prices'!$D$3:$D$140
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
-150
-100
-50
0
50
100
150
Mean
25% - 75%
5% - 95%
Sample Path
Historical

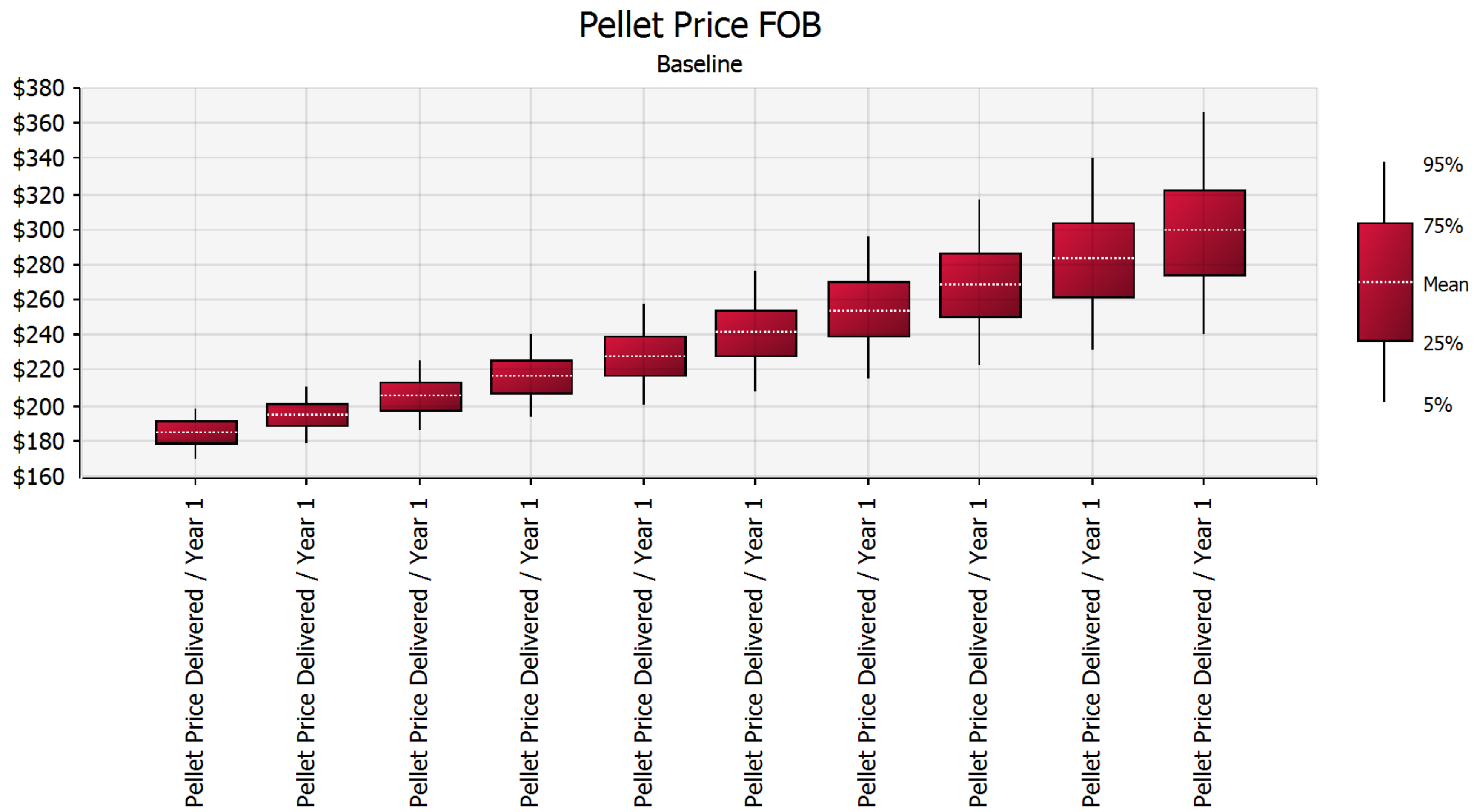


: MA(1)
Transformations: Difference (1)
Sync Data: 'Wood Prices'!$E$3:$E$140
14
12
10
8
6
4
2
0
-150
-100
-50
0
50
100
150
Mean
25% - 75%
5% - 95%
Sample Path
Historical

Wood Price Forecast

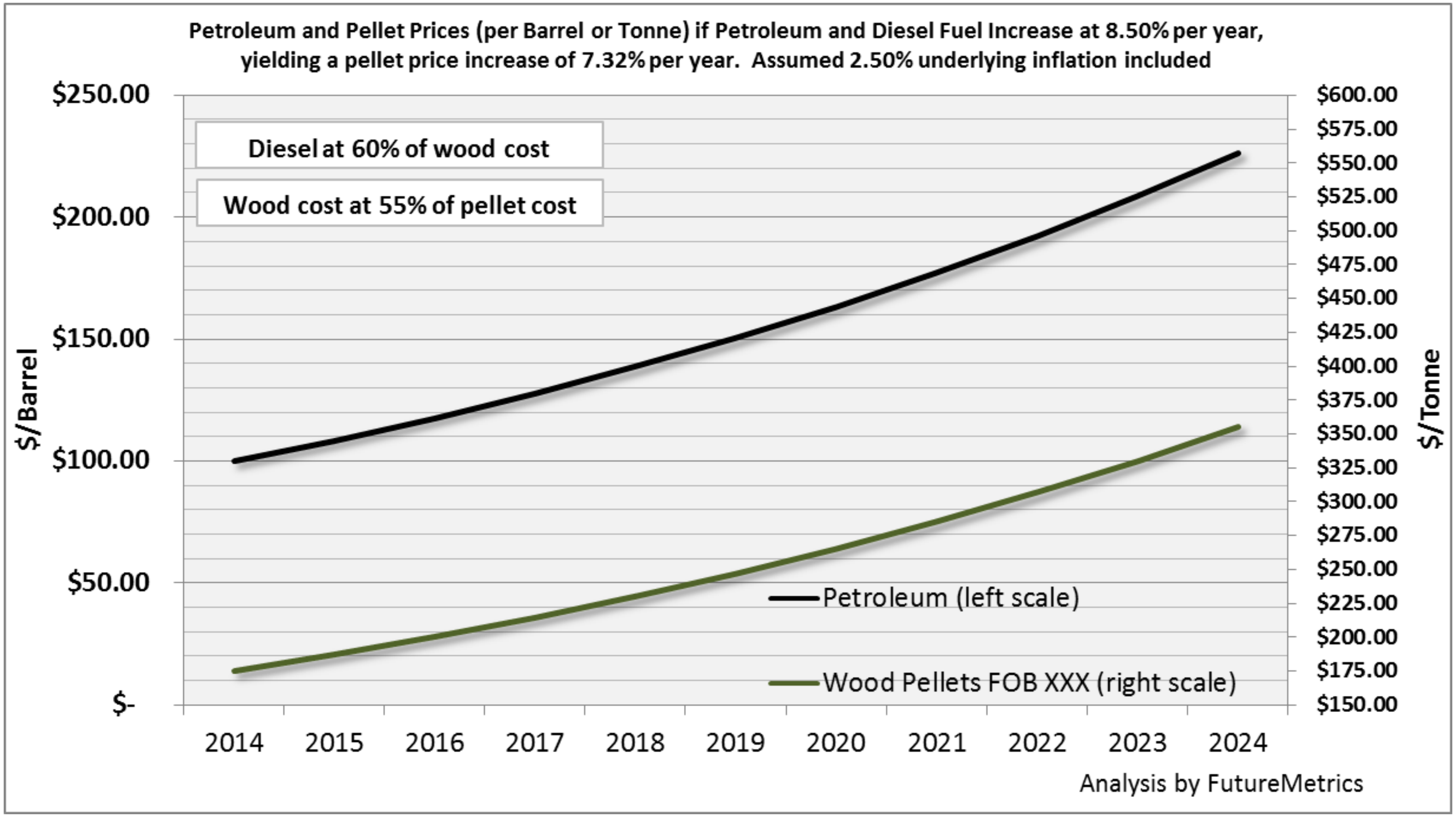


Another Key Variable for the Cash Flow Model is the Price of the Pellets

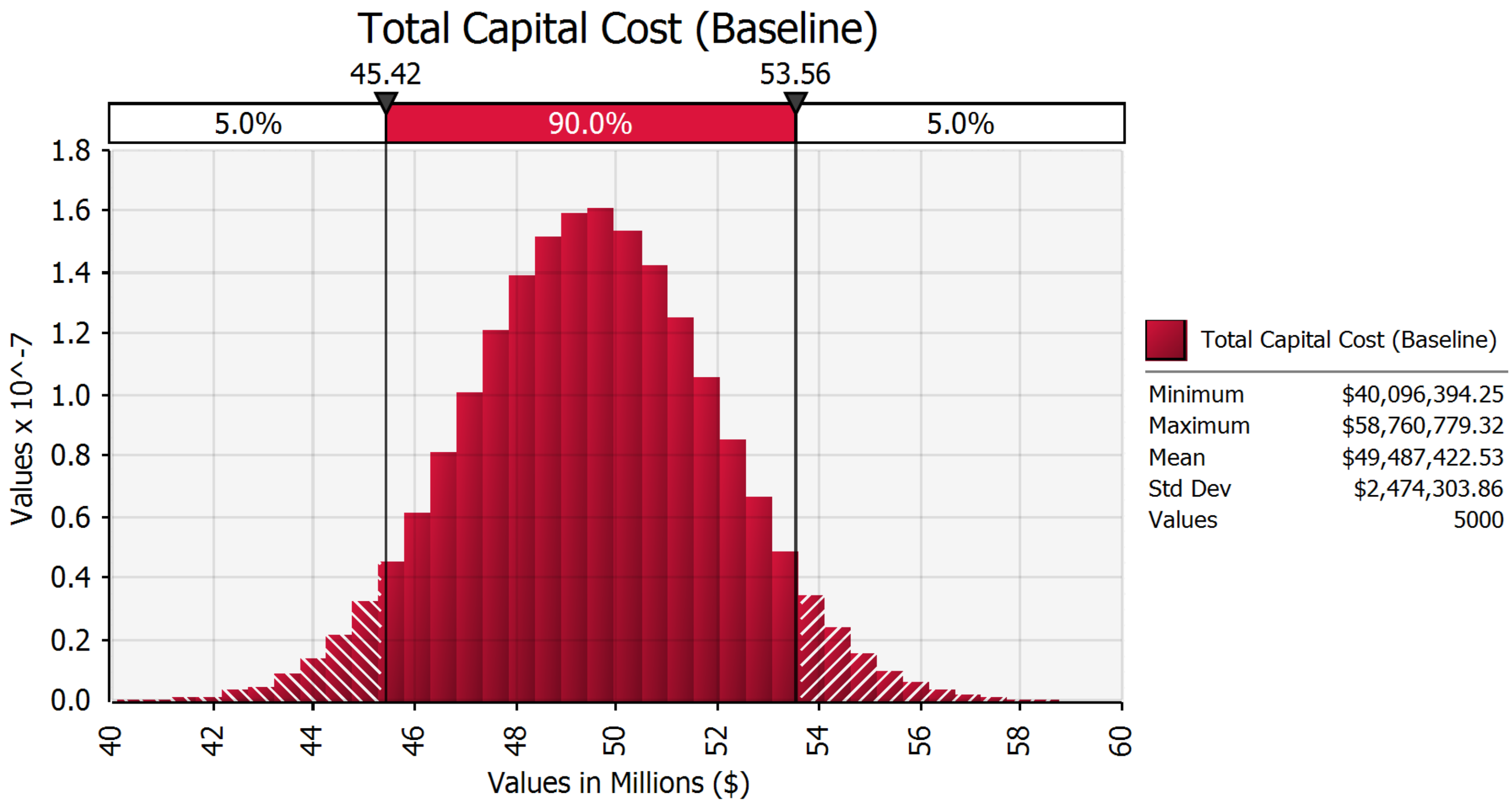


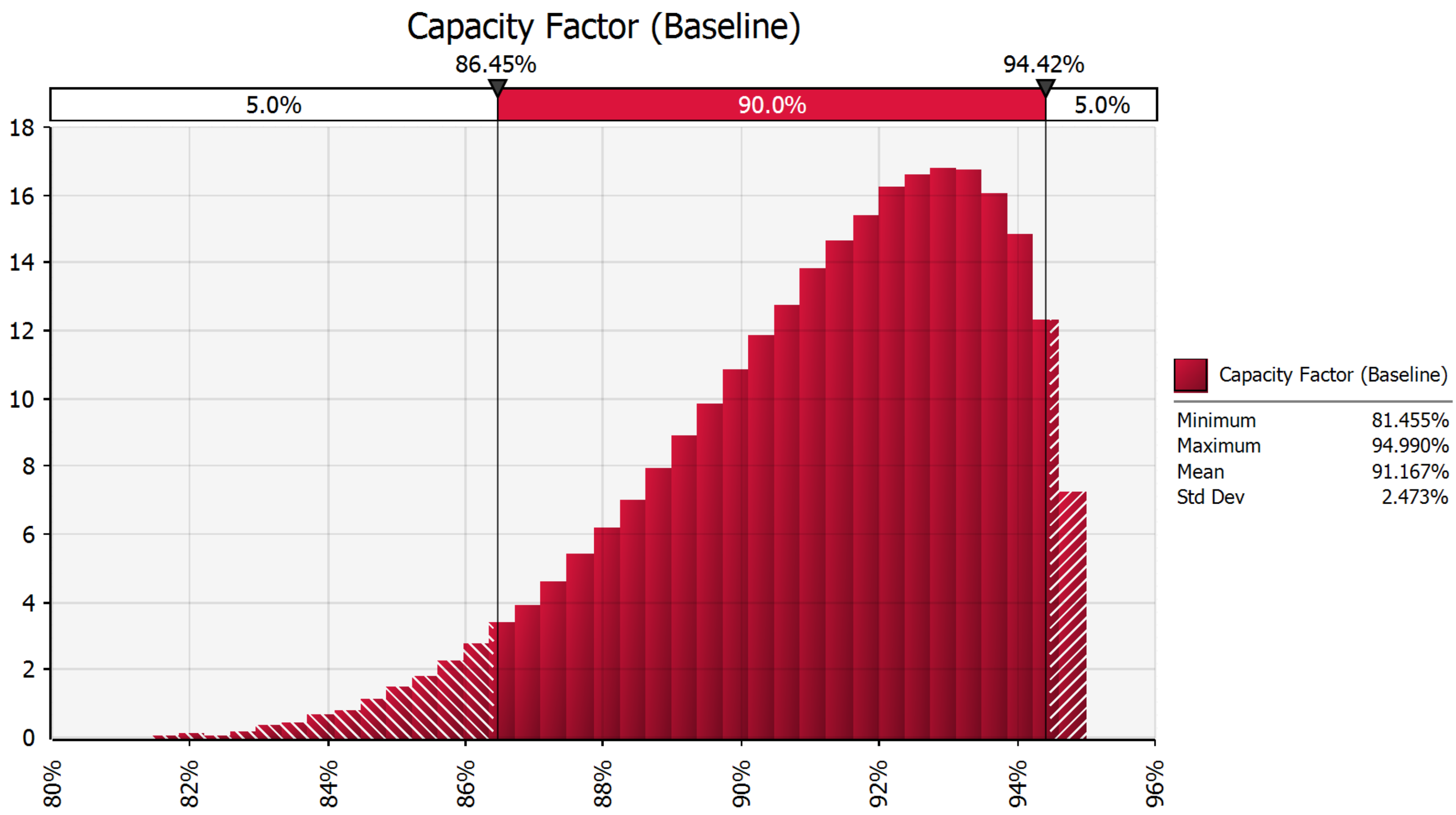
FOB Spot Prices October15, 2012 (from Argus Biomass Markets)

US domestic price (industrial wood pellets)				$/t
Location	**Delivery period**	**Bid**	**Ask**	**Change**
Portland, Maine	spot	150.00	157.00	-1.50
Camden, New Jersey	spot	142.00	147.00	-0.50
Wilmington, North Carolina	spot	133.00	138.00	-1.00
Port Everglades, Florida	spot	132.00	138.00	-0.50
Mobile, Alabama	spot	125.00	132.00	-1.00
Chicago, Illinois	spot	114.00	124.00	0.0
Seattle-Tacoma, Washington	spot	125.00	132.00	-0.50



A few of the many inputs to the model follow

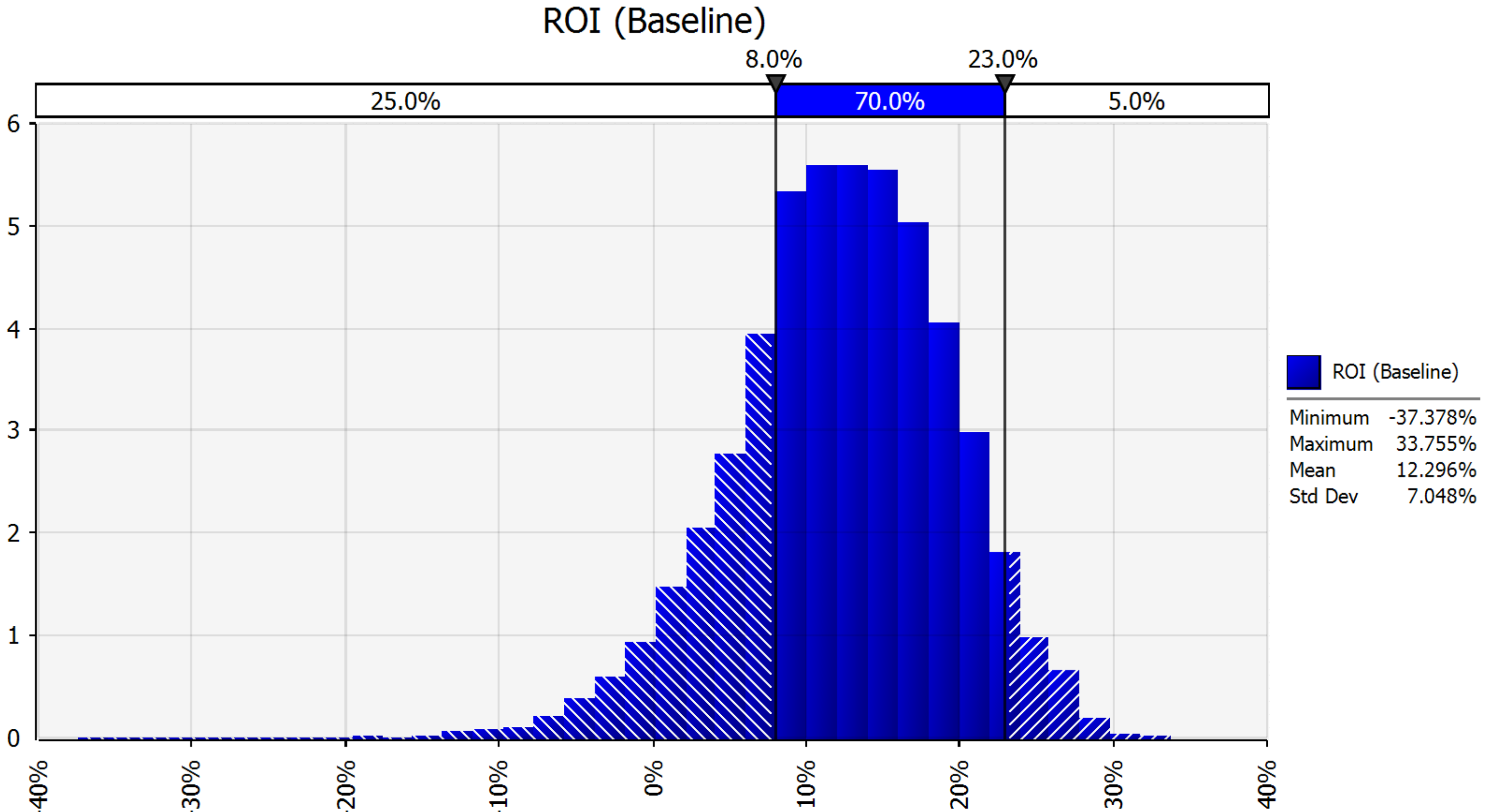




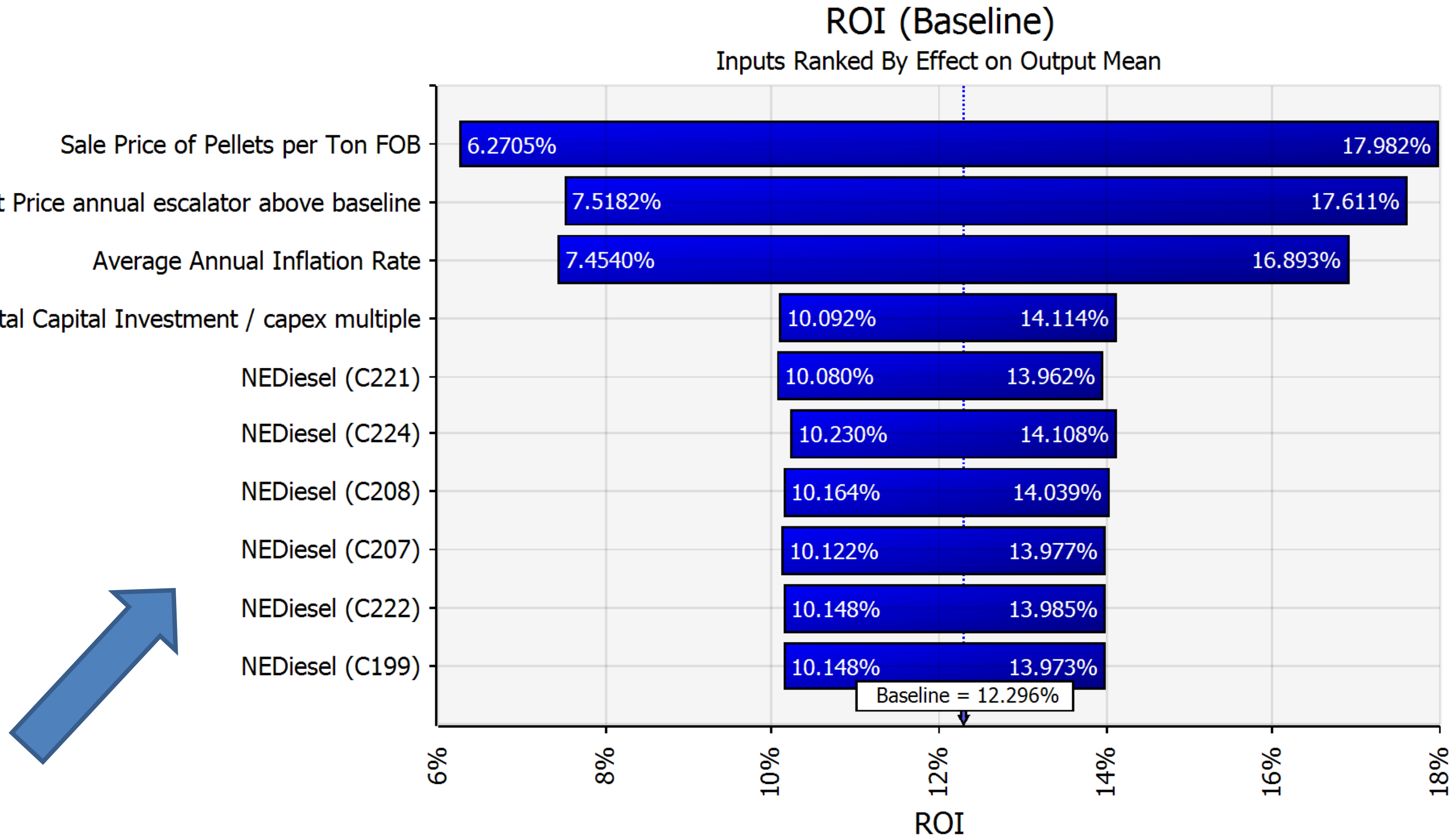
Capacity Factor (Baseline)
86.45%
94.42%
5.0%
90.0%
5.0%
18
16
14
12
10
8
6
4
2
0
80%
82%
84%
86%
88%
90%
92%
94%
96%
Capacity Factor (Baseline)
Minimum 81.455%
Maximum 94.990%
Mean 91.167%
Std Dev 2.473%

The first metric we will look at is Return on Investment (ROI)

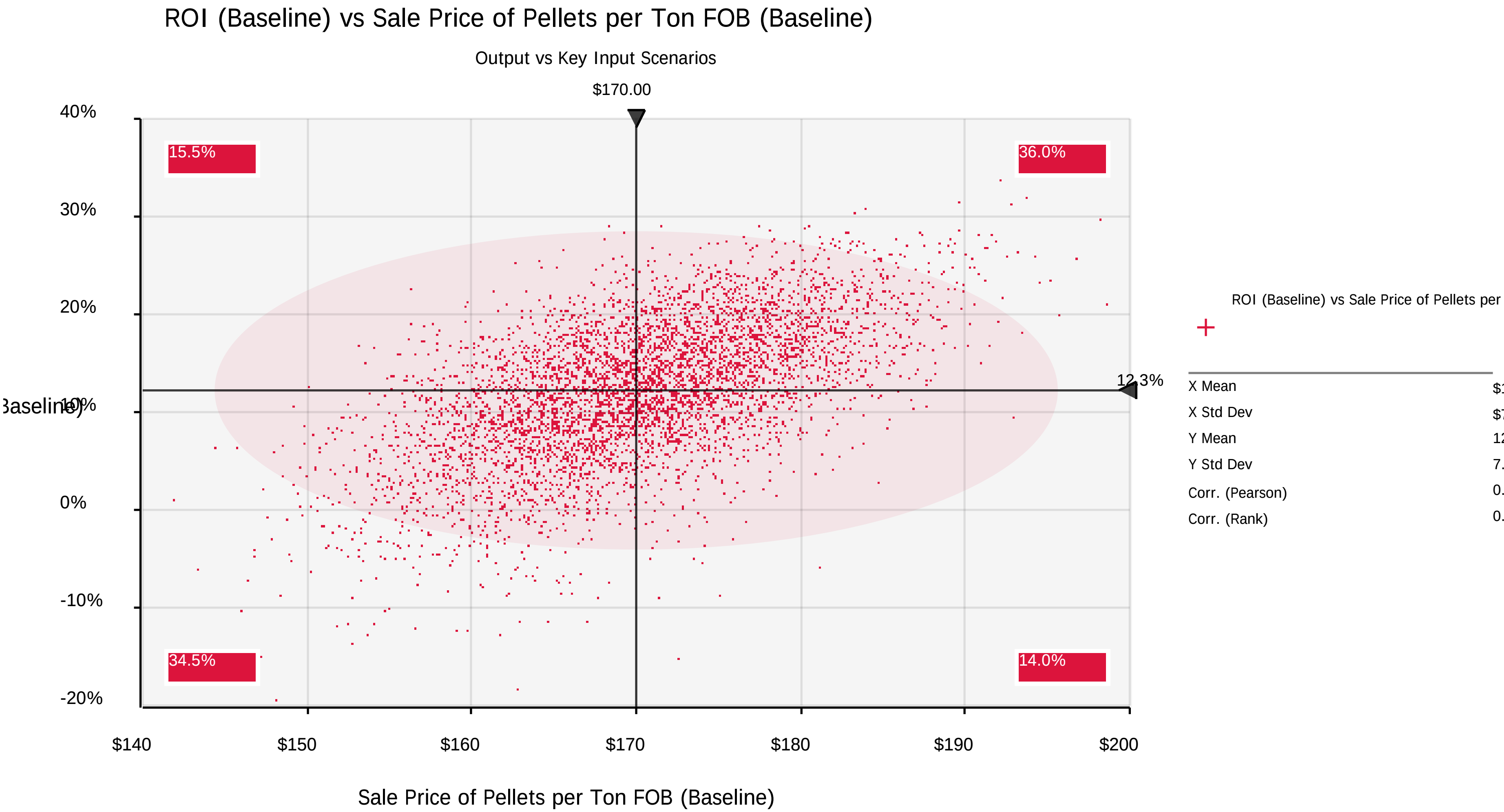
This is the full capital cost including contingencies, working capital needs, etc, compared to the future net operating cash flows. The ROI is the internal rate of return (IRR) from these cash flows over 10 years.
<u>The mean of the simulated returns is 12.296%</u>



The project has a 25.0% probability of returning an ROI of less than 8%.
And notice the long tail to the left!

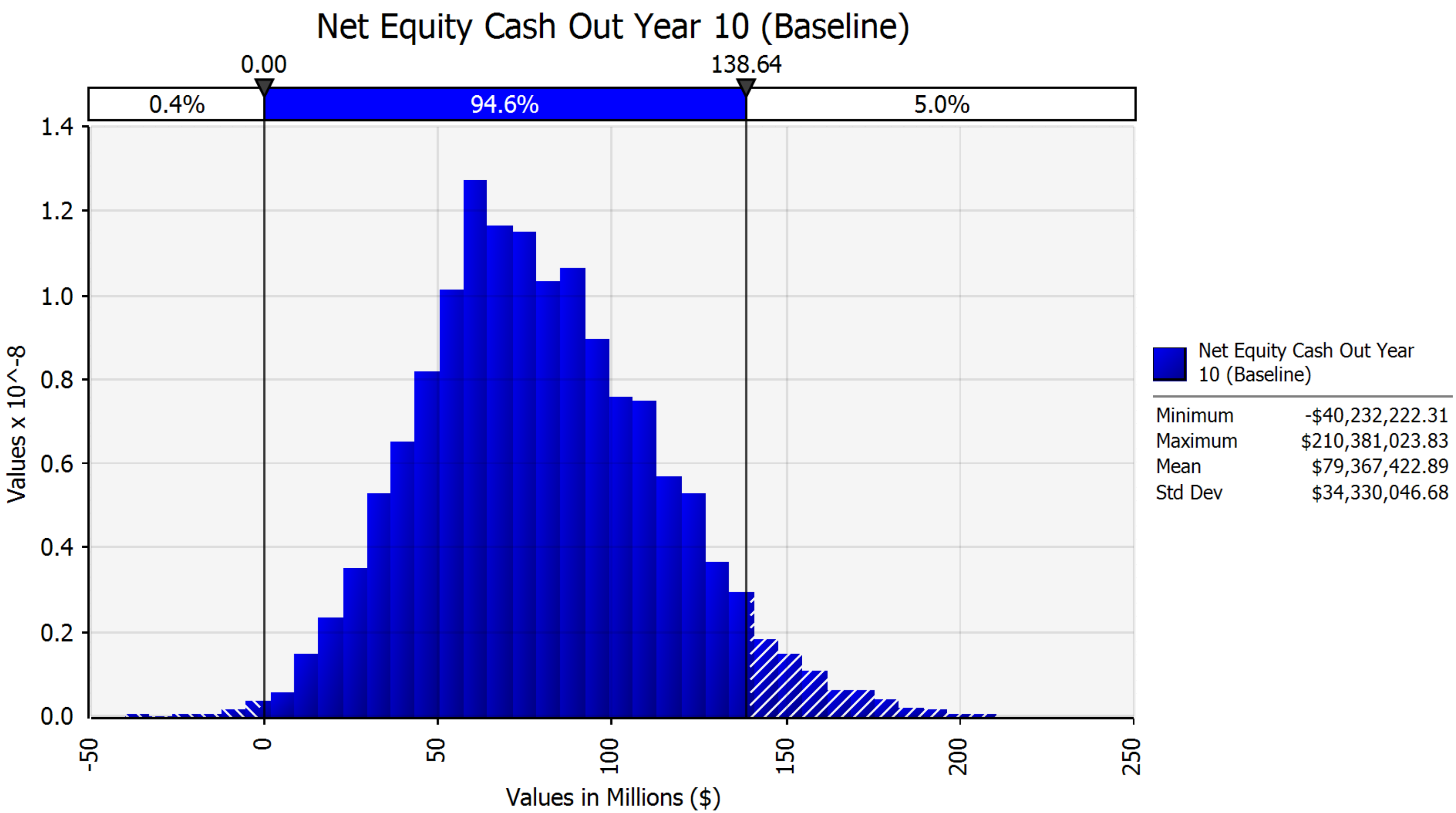


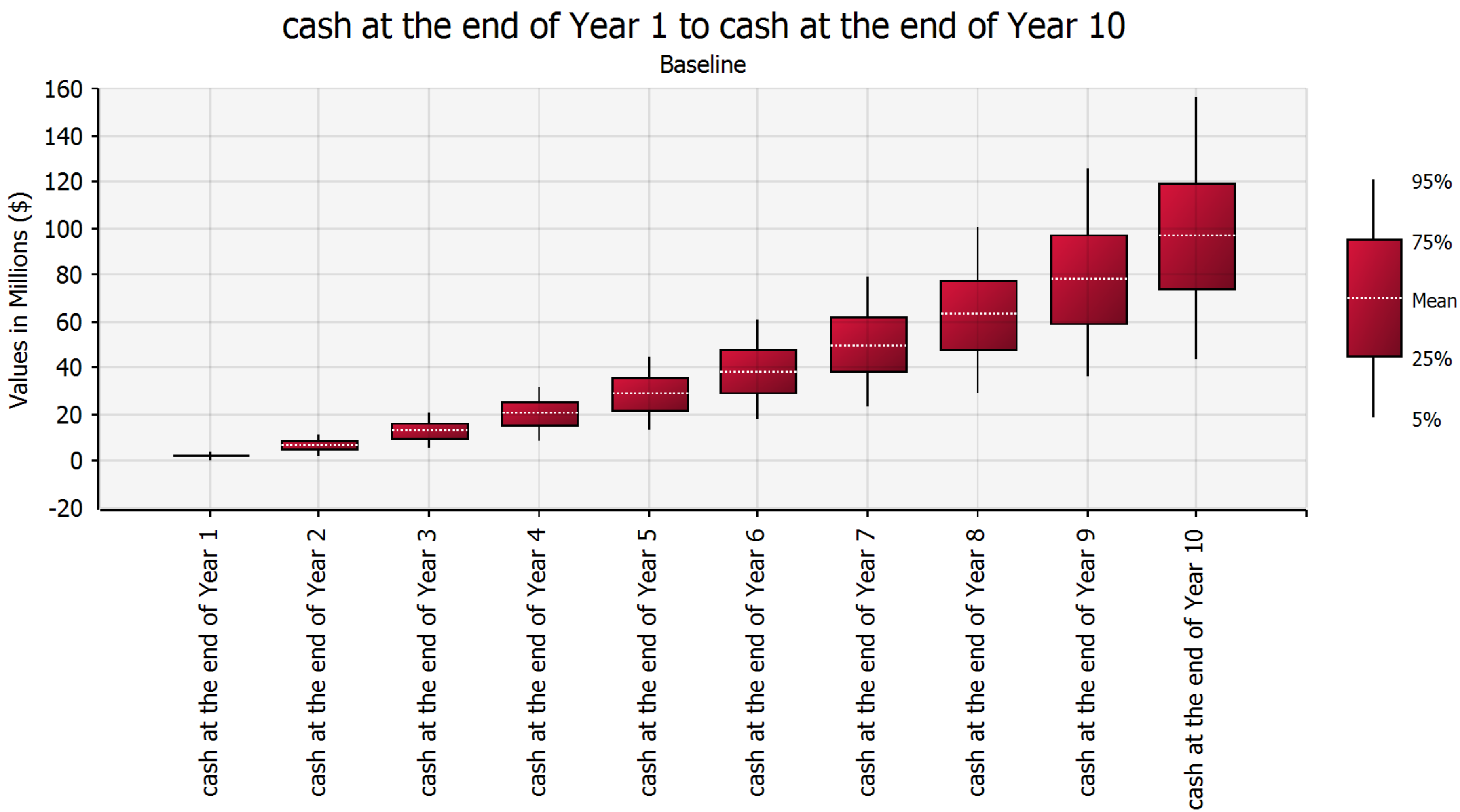
Diesel is the primary forcing factor for wood prices. These are from the time series array that varies with each iteration of the Monte Carlo simulation,


ROI (Baseline) vs Sale Price of Pellets per Ton FOB (Baseline)
Output vs Key Input Scenarios
$170.00
40%
30%
20%
10%
0%
-10%
-20%
Baseline)
15.5%
36.0%
34.5%
14.0%
12.3%
$140
$150
$160
$170
$180
$190
$200
Sale Price of Pellets per Ton FOB (Baseline)
ROI (Baseline) vs Sale Price of Pellets per T
X Mean
X Std Dev
Y Mean
Y Std Dev
Corr. (Pearson)
Corr. (Rank)

The net equity cash out is the value of the accumulated excess cash flows in year ten net of the equity investment (40% of CAPEX).

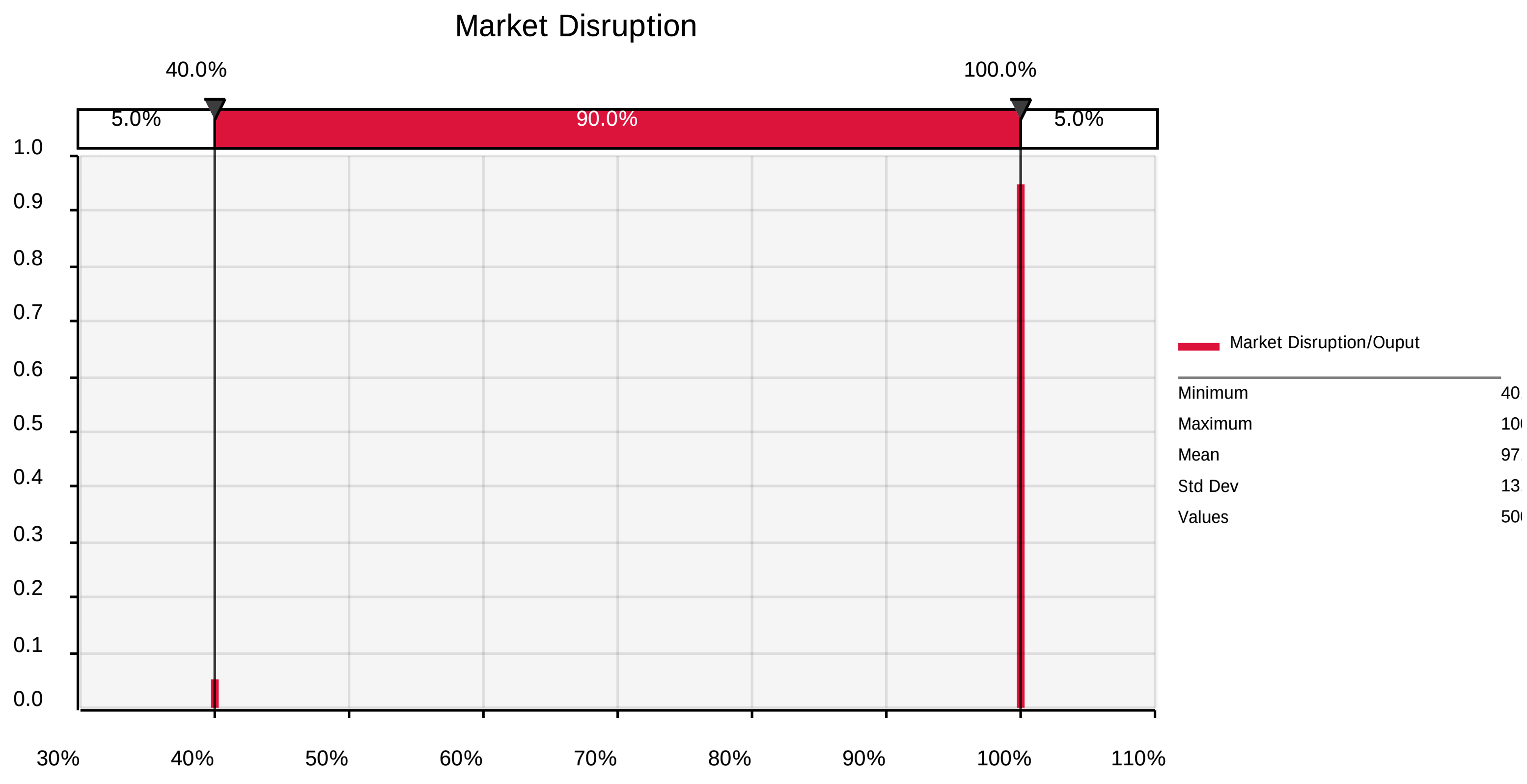
In year ten the mean value is $79.3 million. There is a nearly a 0% chance it will be zero dollars or less.



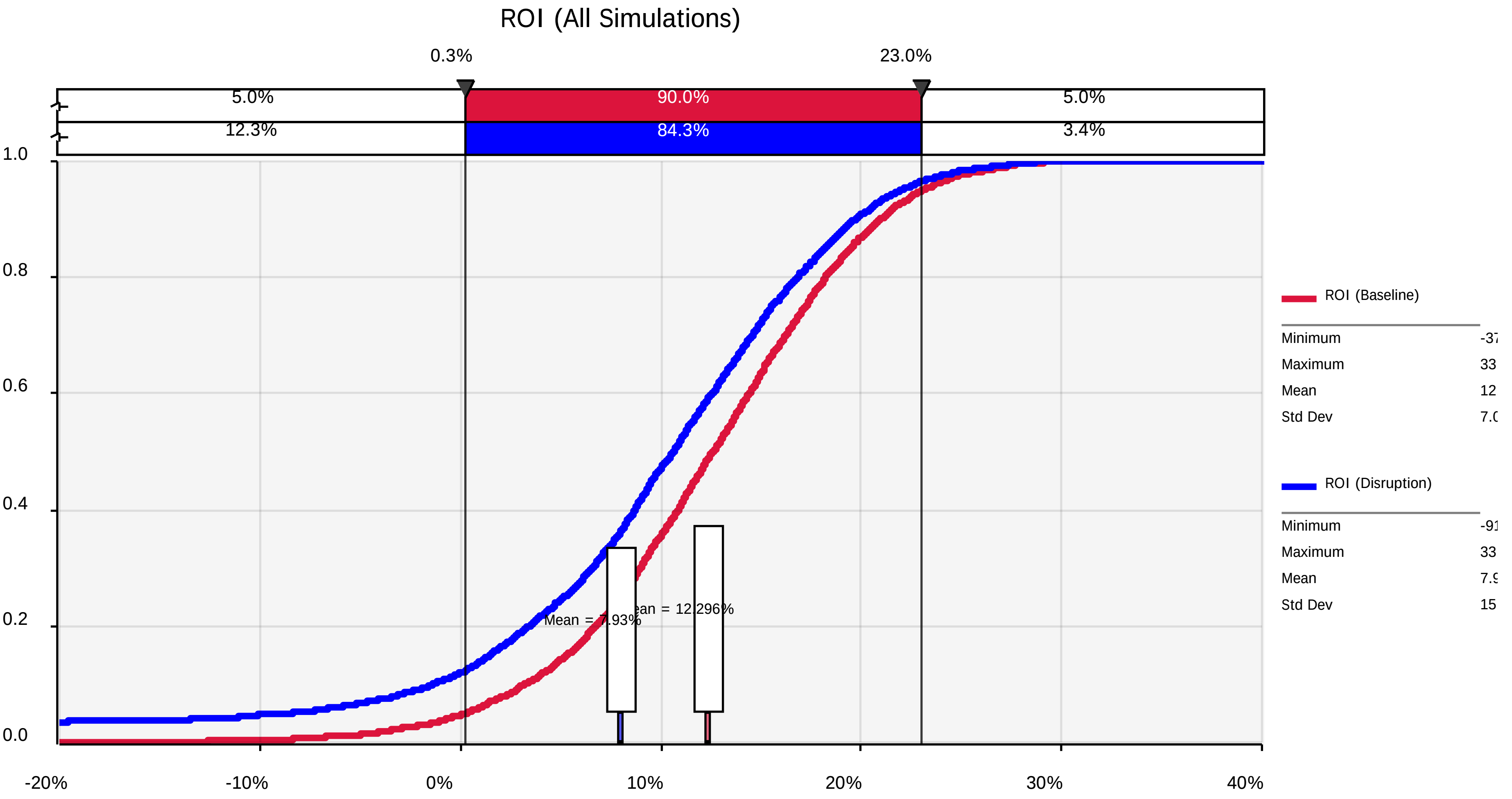

cash at the end of Year 1 to cash at the end of Year 10
Baseline
Values in Millions ($)
160
140
120
100
80
60
40
20
0
-20
cash at the end of Year 1
cash at the end of Year 2
cash at the end of Year 3
cash at the end of Year 4
cash at the end of Year 5
cash at the end of Year 6
cash at the end of Year 7
cash at the end of Year 8
cash at the end of Year 9
cash at the end of Year 10
95%
75%
Mean
25%
5%

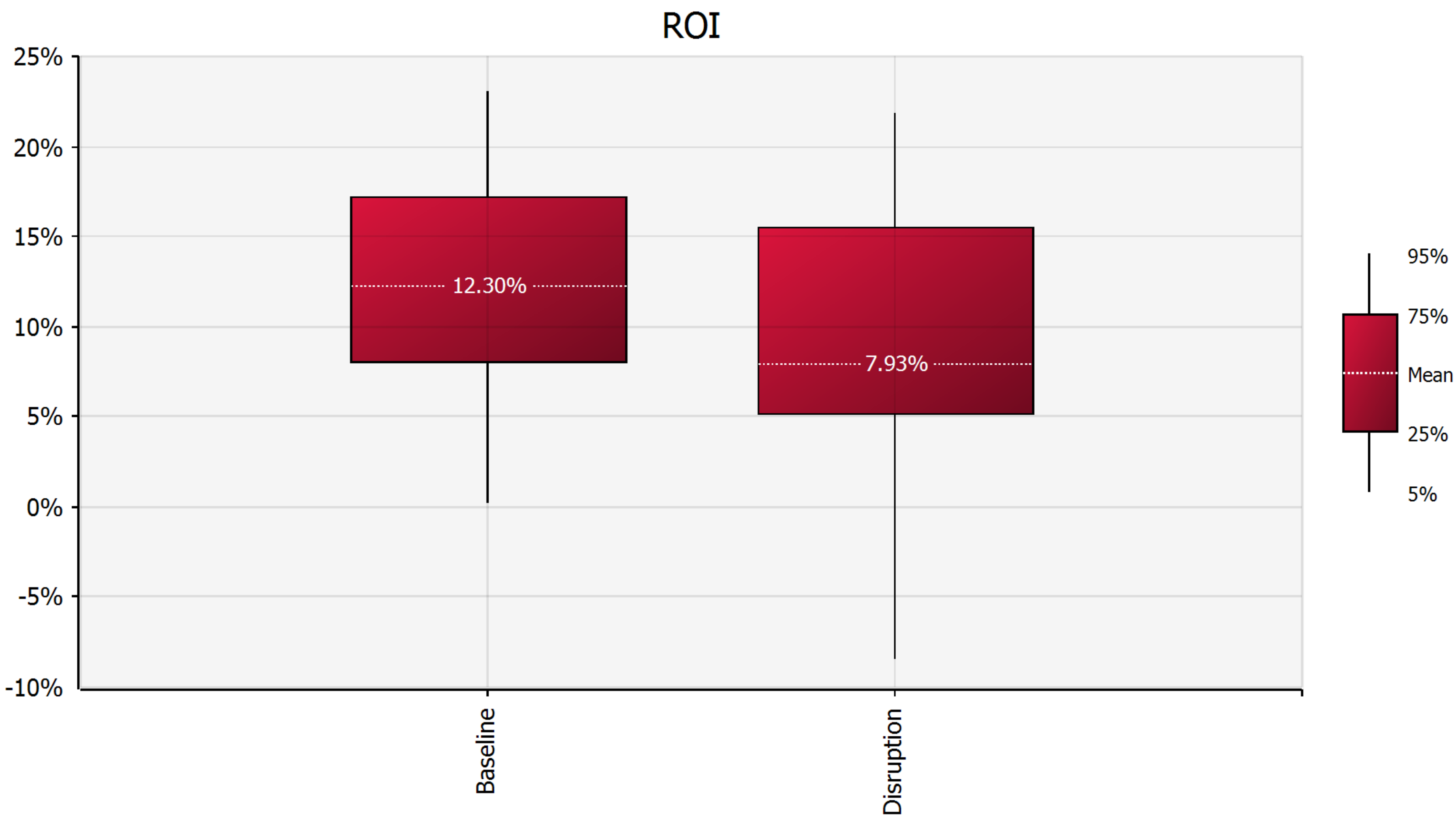
Let's simulate the Tilbury Effect with a discrete probability distribution.

In this case, there is a 5% chance any given year that production will be 40% of the normal output. In those years, prices will be 80% of normal.

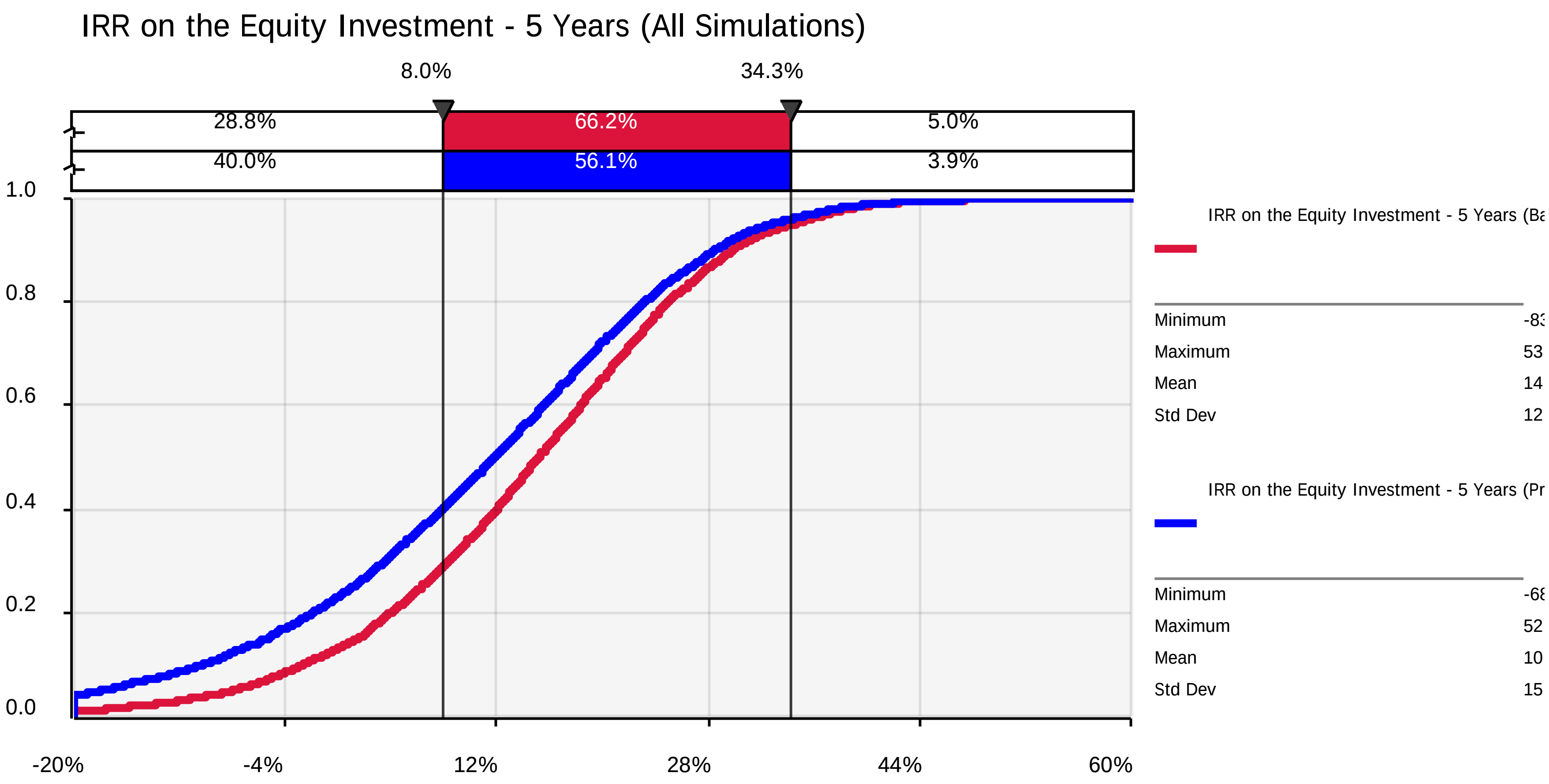


Two simulations: Blue line is with the potential for the “Tilbury” effect.

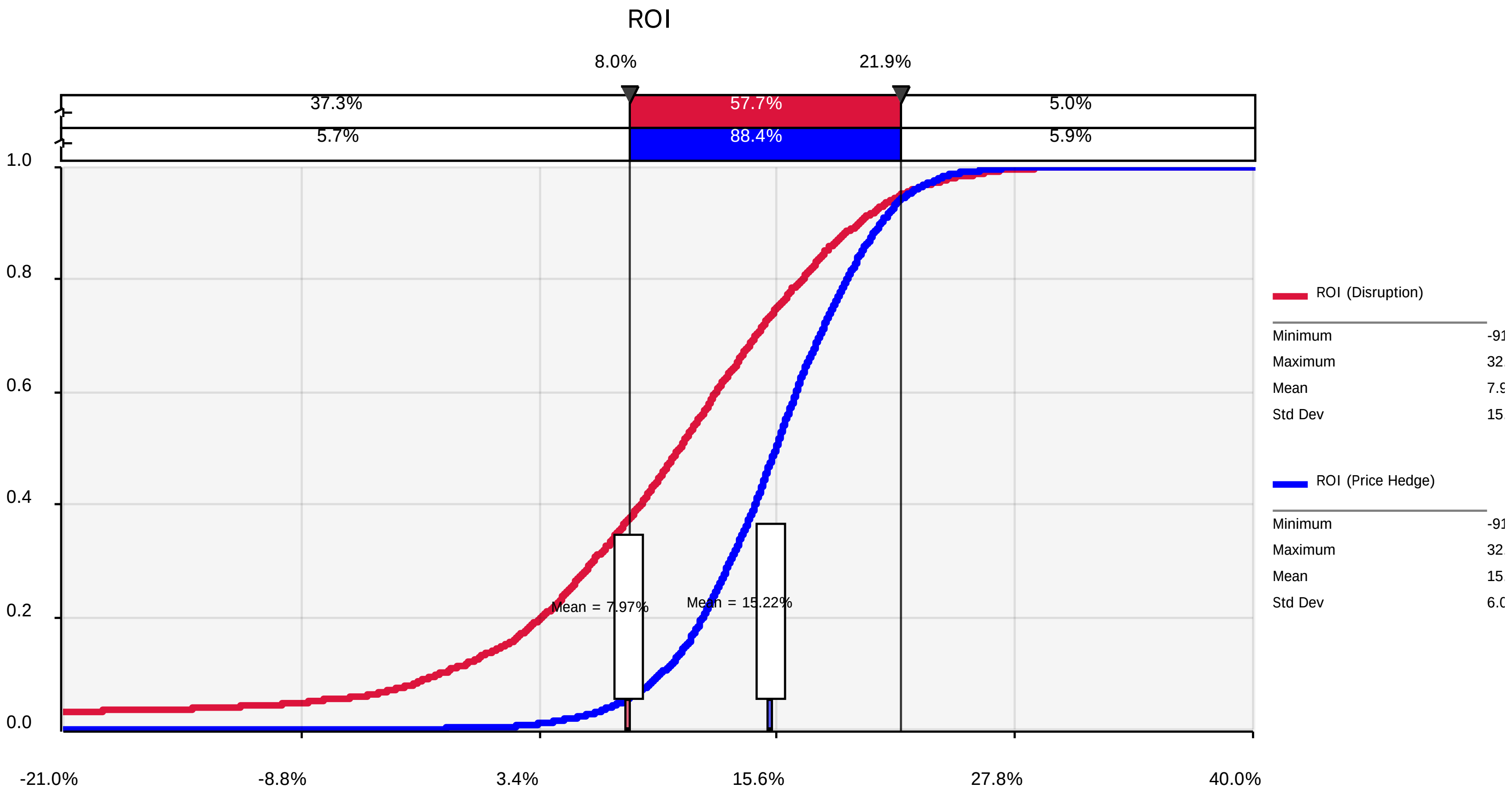



ROI
25%
20%
15%
10%
5%
0%
-5%
-10%
12.30%
7.93%
Baseline
Disruption
95%
75%
Mean
25%
5%

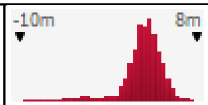
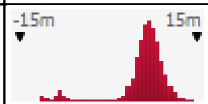
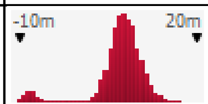
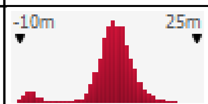
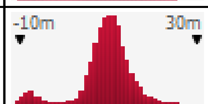
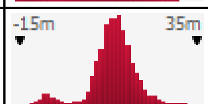
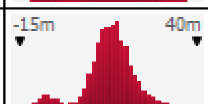
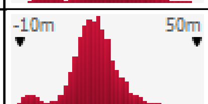
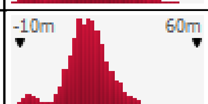
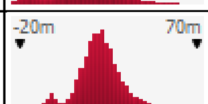
Note that the probability of poor IRR increases from 29% to 40% with the simulated "Tilbury Effect"



In this simulation the Tilbury disruption is still in place however now the project has an offtake agreement that links the price paid for pellets to the cost of wood. The pricing link is modeled after a real pellet export project in Georgia that uses a diesel pricing adjuster and fiber cost escalator. Note that the "risk" or standard deviation of the key metric is lowered by 63% and the probability of a poor outcome is cut from 37% to 6%.



What would the minimum to insure against the loss without the offtake pricing contract?

@RISK Output Results		Min	Mean	Max	1 Percentile	Conditional Loss @ 1%	Max Loss @ 0.5%
Net Operating Cash Flows / Year 1		($8,883,319)	$2,514,061	$7,296,538	($4,205,495)	($42,055)	($44,417)
Net Operating Cash Flows / Year 2		($10,408,470)	$6,039,077	$13,743,060	($9,521,915)	($95,219)	($52,042)
Net Operating Cash Flows / Year 3		($9,079,773)	$7,193,847	$16,652,870	($7,659,356)	($76,594)	($45,399)
Net Operating Cash Flows / Year 4		($8,999,861)	$8,527,611	$20,672,080	($7,462,313)	($74,623)	($44,999)
Net Operating Cash Flows / Year 5		($9,291,595)	$10,039,350	$25,476,680	($7,156,102)	($71,561)	($46,458)
Net Operating Cash Flows / Year 6		($10,416,580)	$11,717,080	$31,144,630	($6,754,933)	($67,549)	($52,083)
Net Operating Cash Flows / Year 7		($10,281,890)	$13,628,480	$37,253,310	($6,410,493)	($64,105)	($51,409)
Net Operating Cash Flows / Year 8		($9,855,405)	$15,744,070	$43,292,900	($5,950,661)	($59,507)	($49,277)
Net Operating Cash Flows / Year 9		($9,715,582)	$18,018,130	$51,488,910	($5,611,576)	($56,116)	($48,578)
Net Operating Cash Flows / Year 10		($9,929,715)	$21,618,630	$61,848,370	($3,219,717)	($32,197)	($49,649)
		Average ==>	$11,504,034			**($639,526)**	**($484,311)**

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