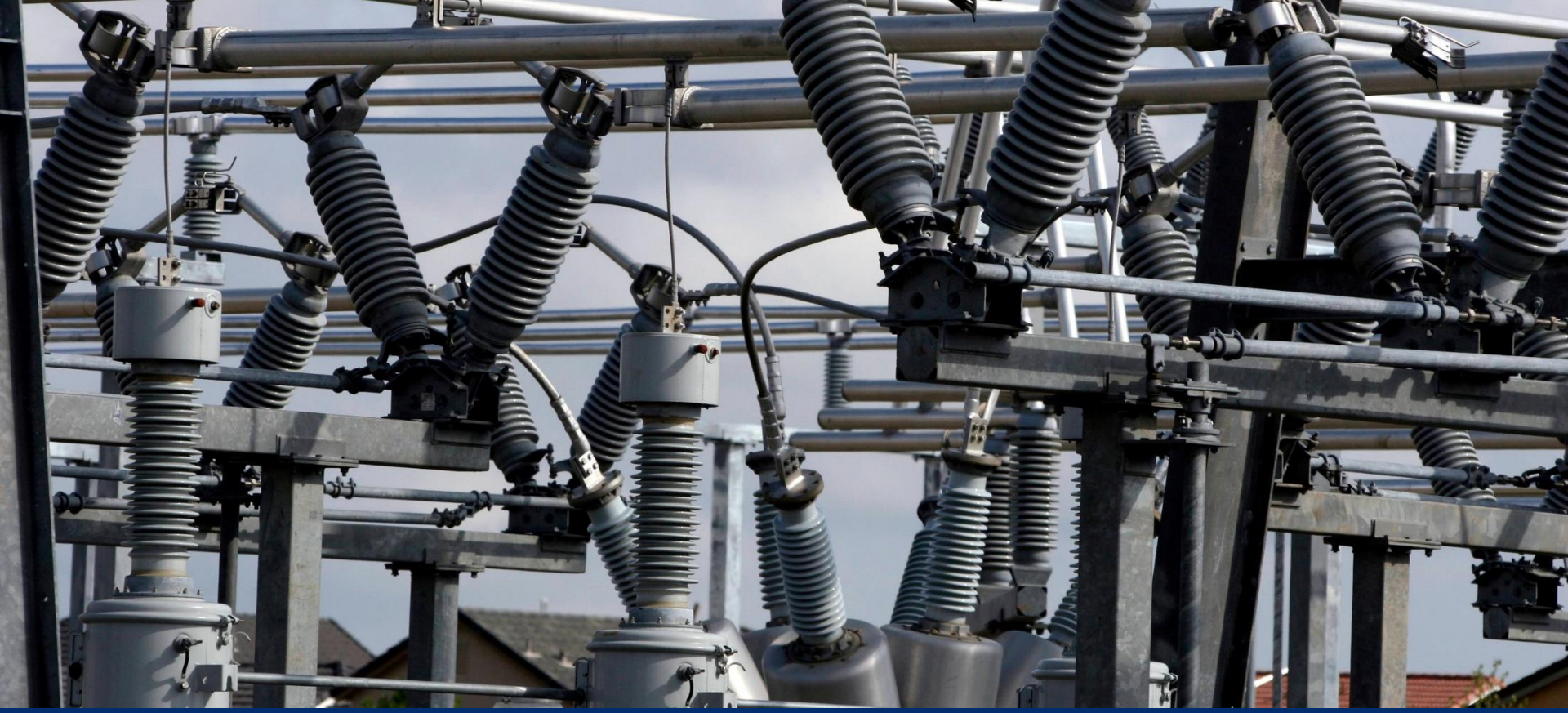


Using PFE for Term Trading Decisions

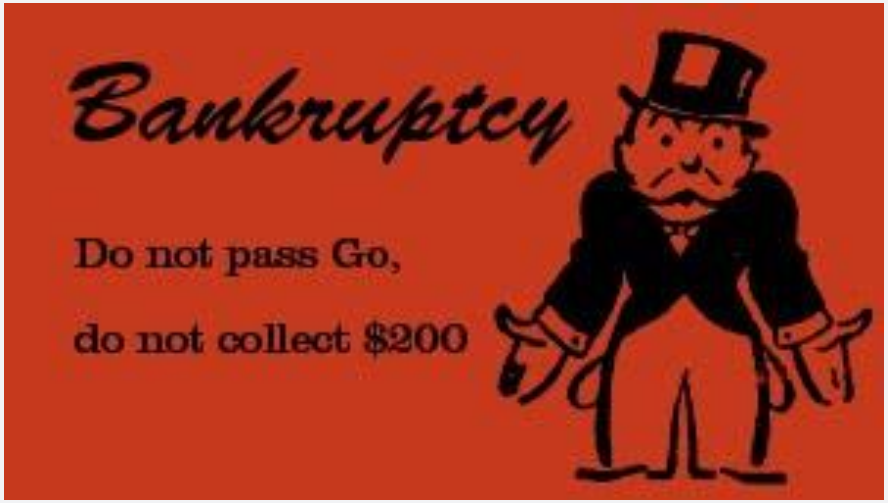
Todd White, Roseville Electric Utility

CITY OF ROSEVILLE CALIFORNIA

Risk Management

“The art of foreseeing hindsight” -Jos Berkemeijer

Perspective: Credit Risk Management

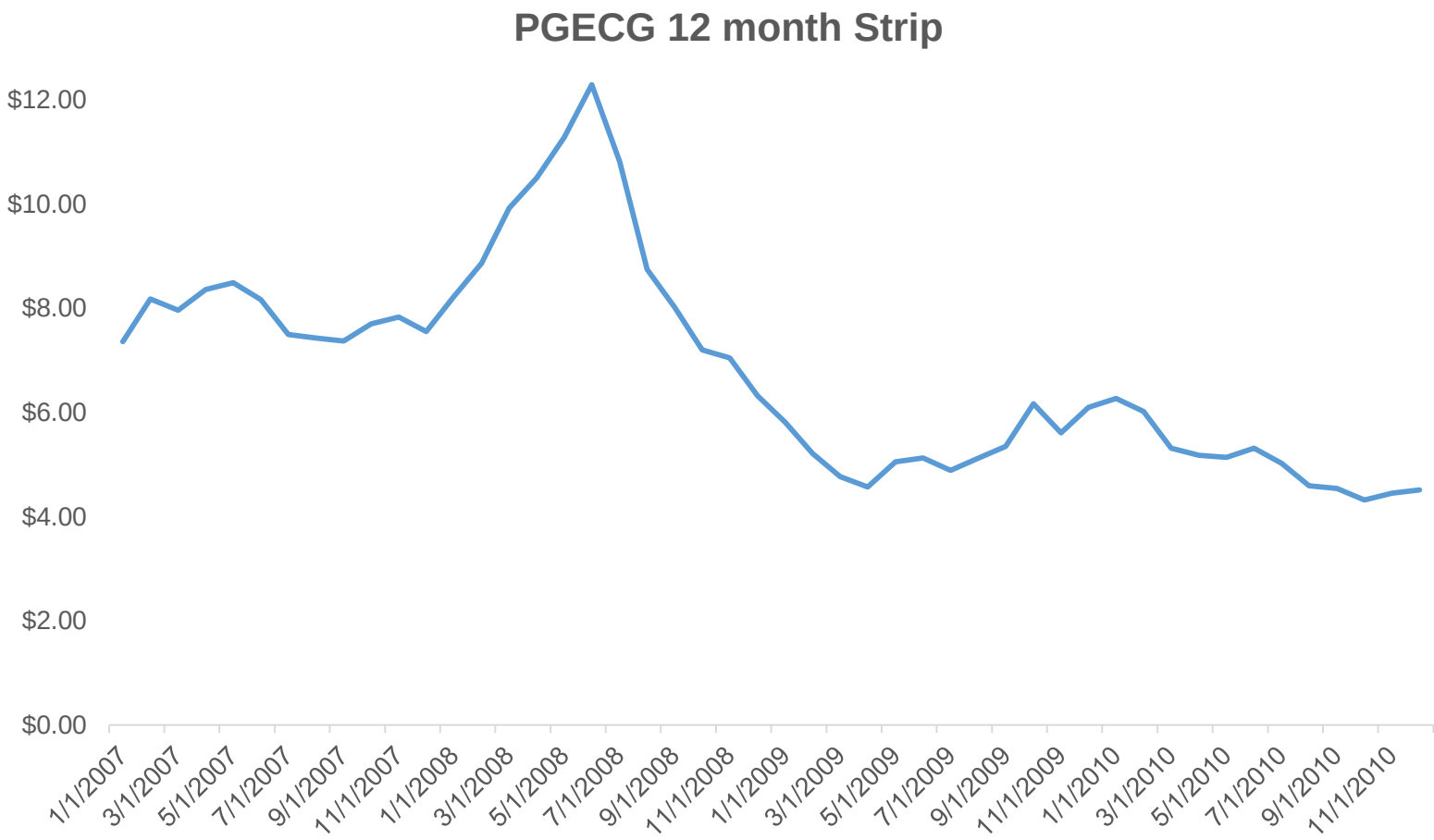


Credit Exposure **Default Probability**

Roseville Electric Utility

- Located in Northern California
- Population: approximately 130,000
- Over 57,000 customers
- High residential rooftop PV penetration
- Peak load: 330 MW in 2015
- Annual load: over 1.1 million MWh

Motivation


PGECG 12 month Strip
$12.00
$10.00
$8.00
$6.00
$4.00
$2.00
$0.00
1/1/2007
3/1/2007
5/1/2007
7/1/2007
9/1/2007
11/1/2007
1/1/2008
3/1/2008
5/1/2008
7/1/2008
9/1/2008
11/1/2008
1/1/2009
3/1/2009
5/1/2009
7/1/2009
9/1/2009
11/1/2009
1/1/2010
3/1/2010
5/1/2010
7/1/2010
9/1/2010
11/1/2010

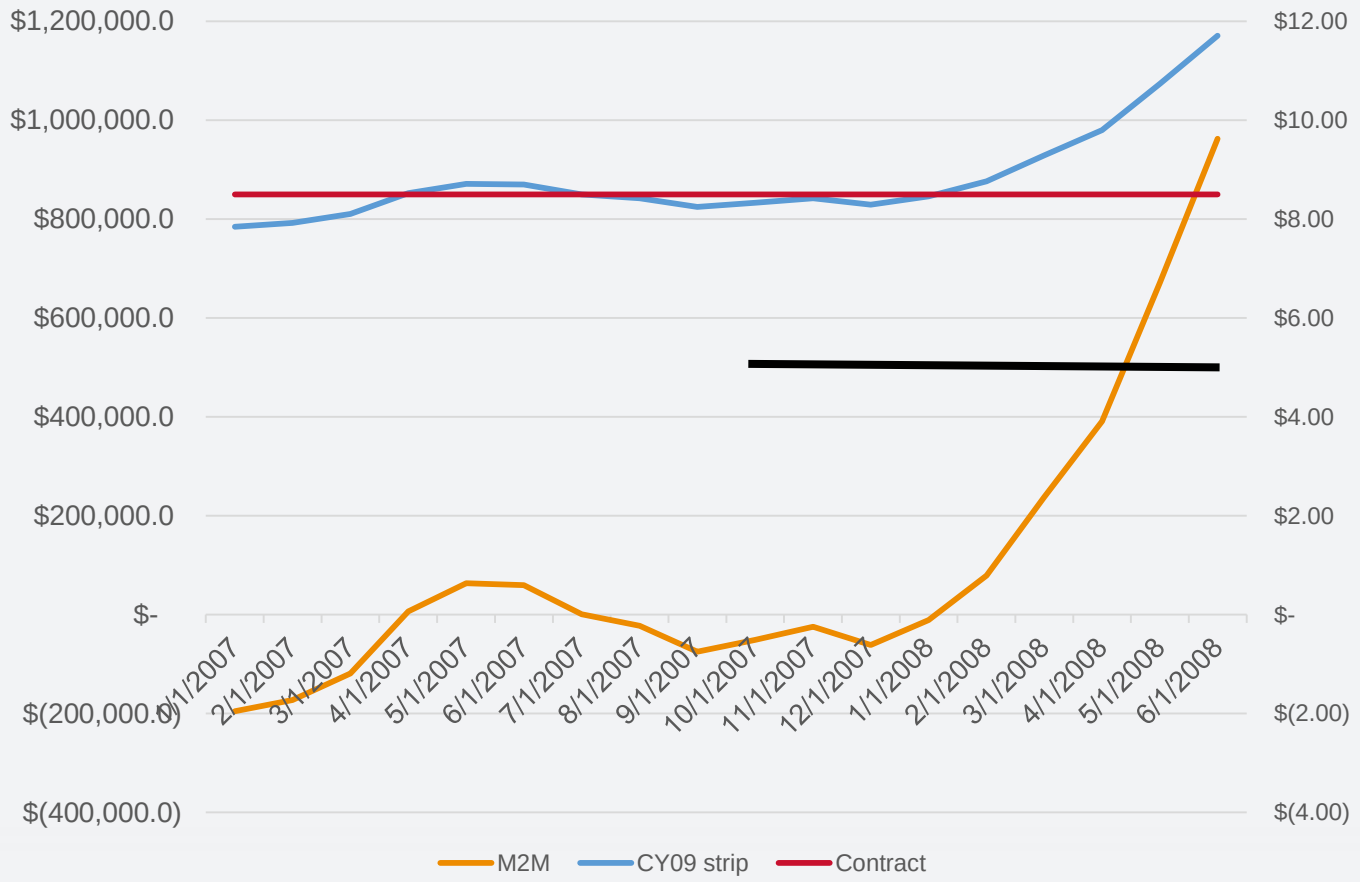
Roseville Today

- Debt Service Coverage = 2.9
- Cash on Hand = 275 days
- Bonds upgraded to AA- by rating agencies
  - City already AA
- 3 year fixed price hedging policy

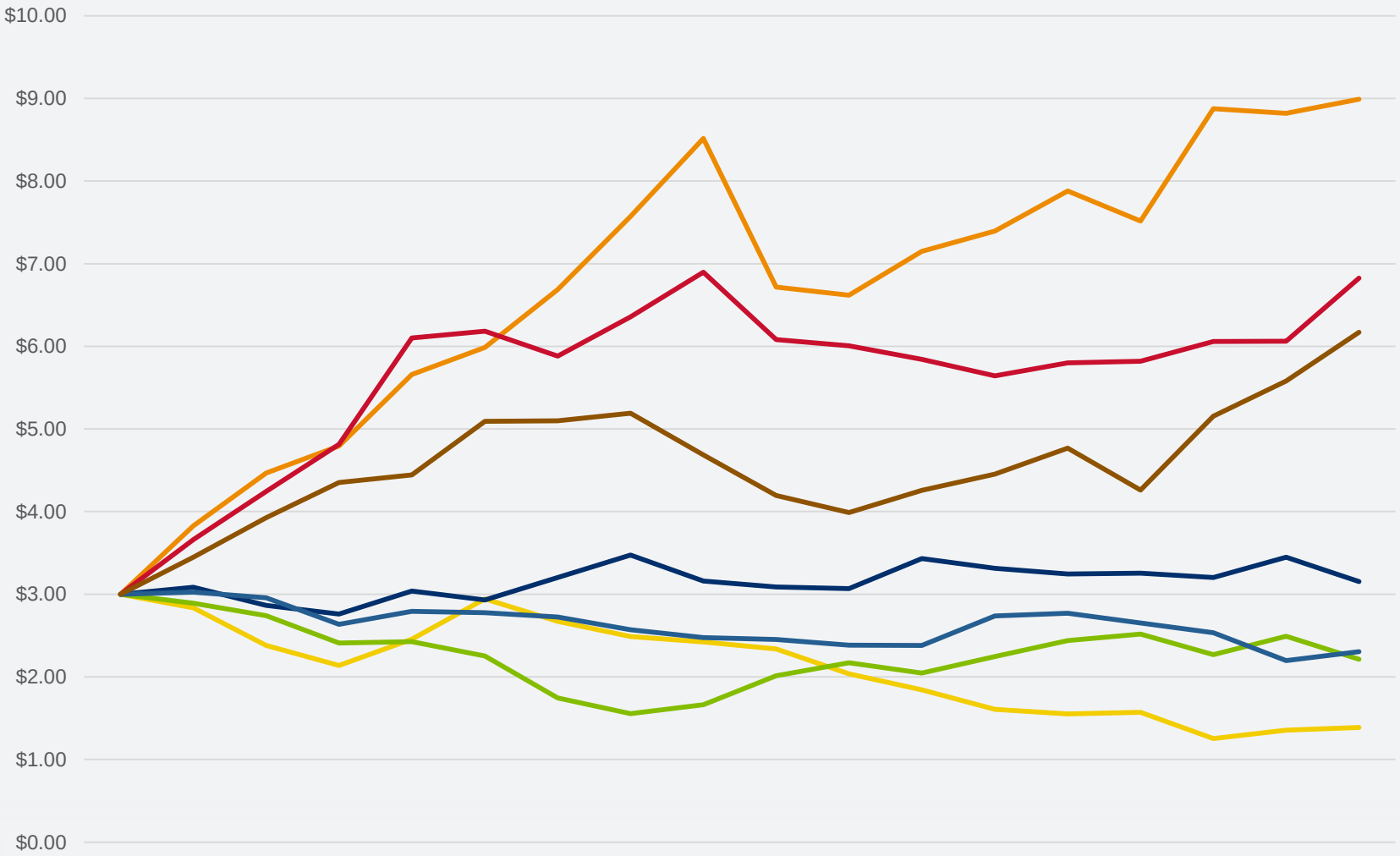
Managing Tradeoffs

PFE Overview—Future M2M

- 25,000 MMBtu/day, Calendar 2009

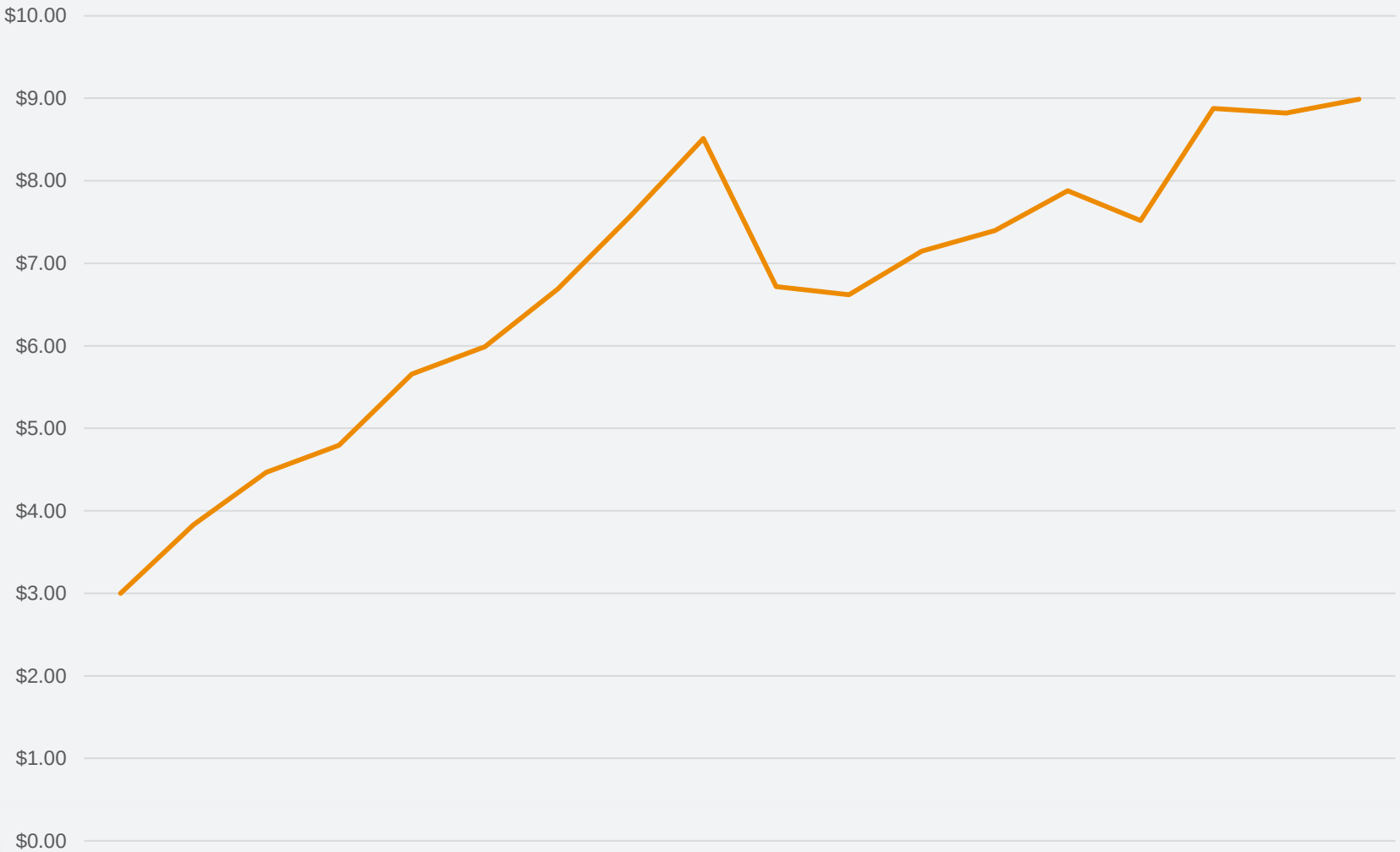


Simulated Future Spot Market



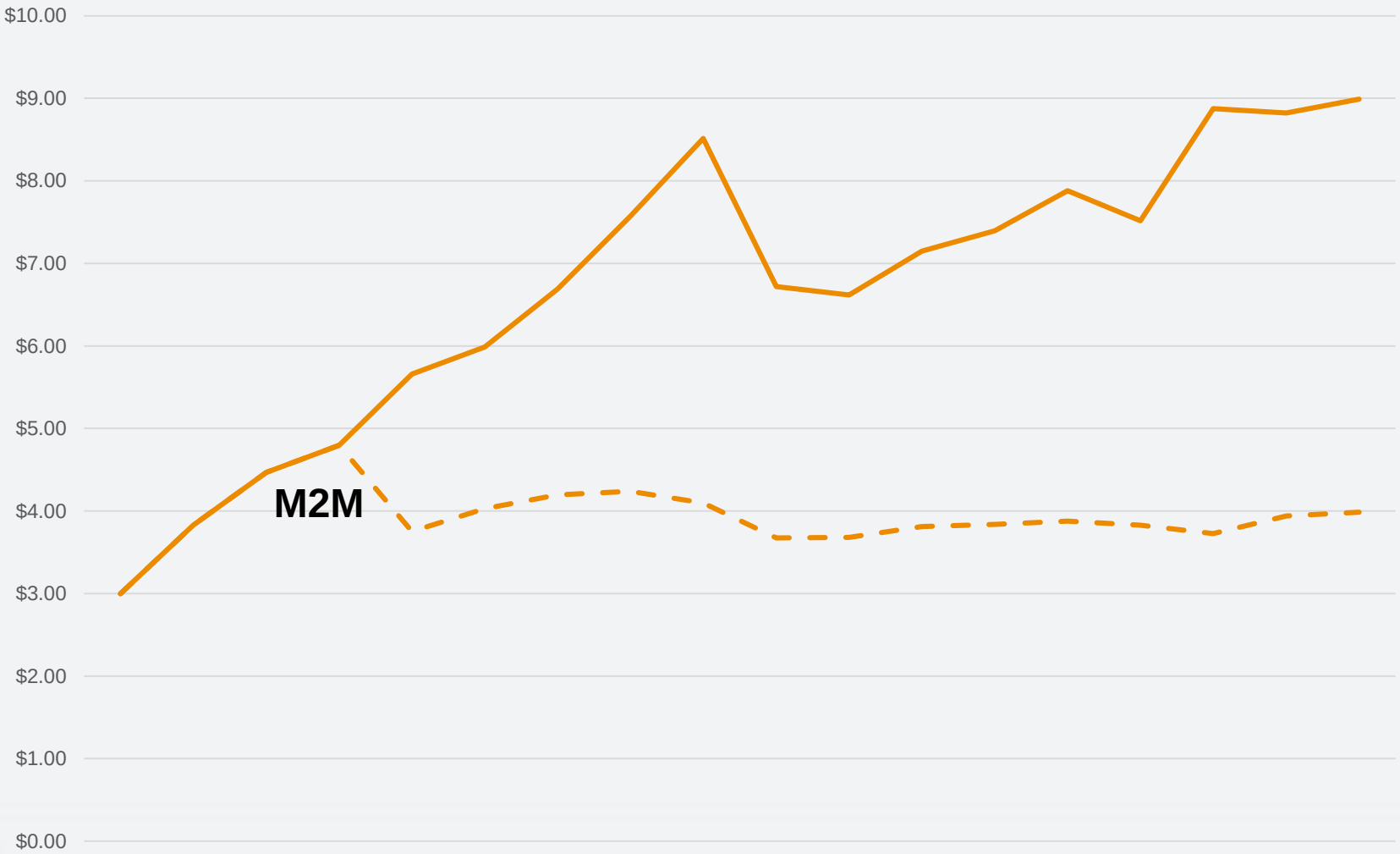
CITY OF ROSEVILLE CALIFORNIA

Simulated Future Spot Market



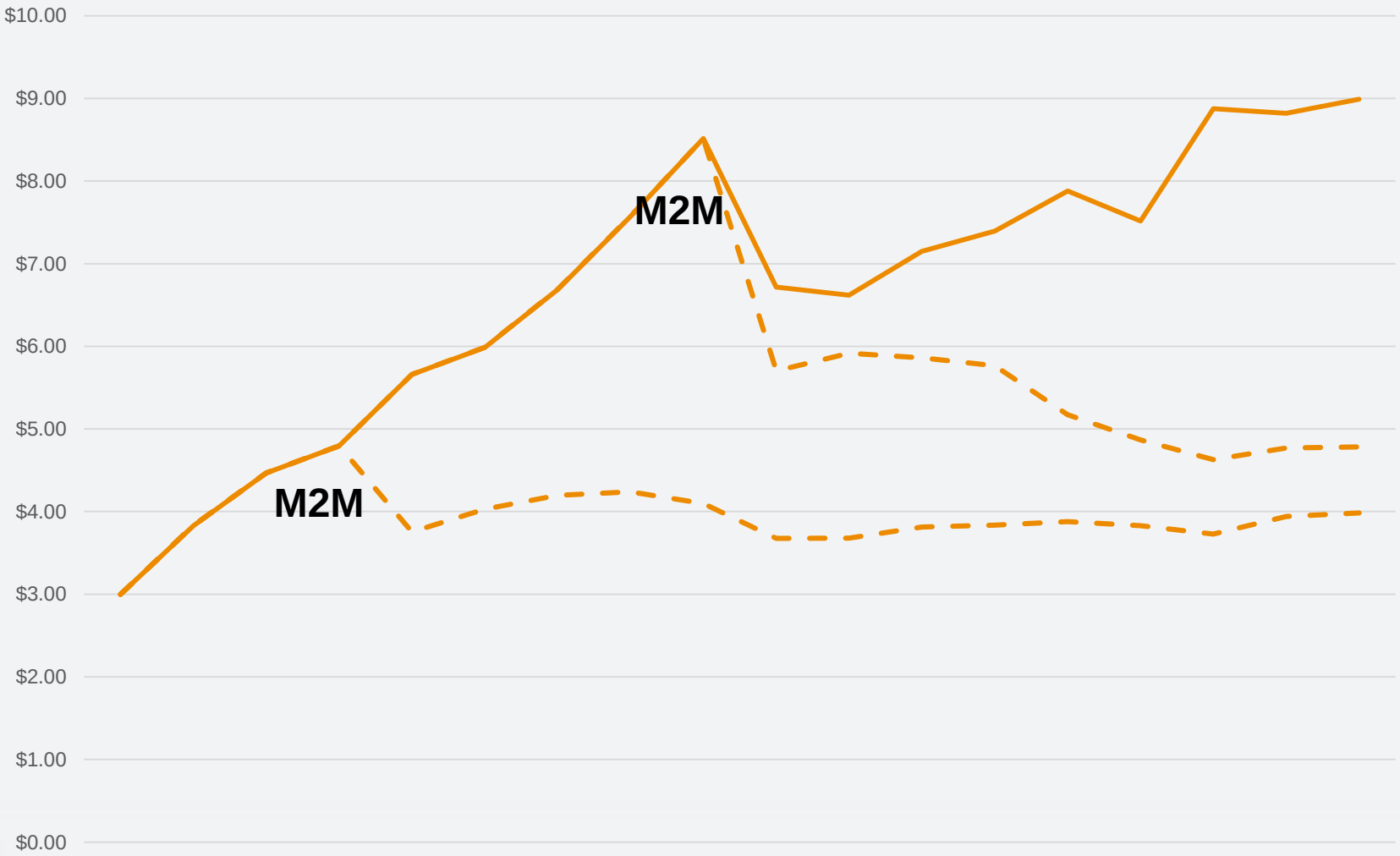
CITY OF ROSEVILLE CALIFORNIA

Simulated Future Forward Curves

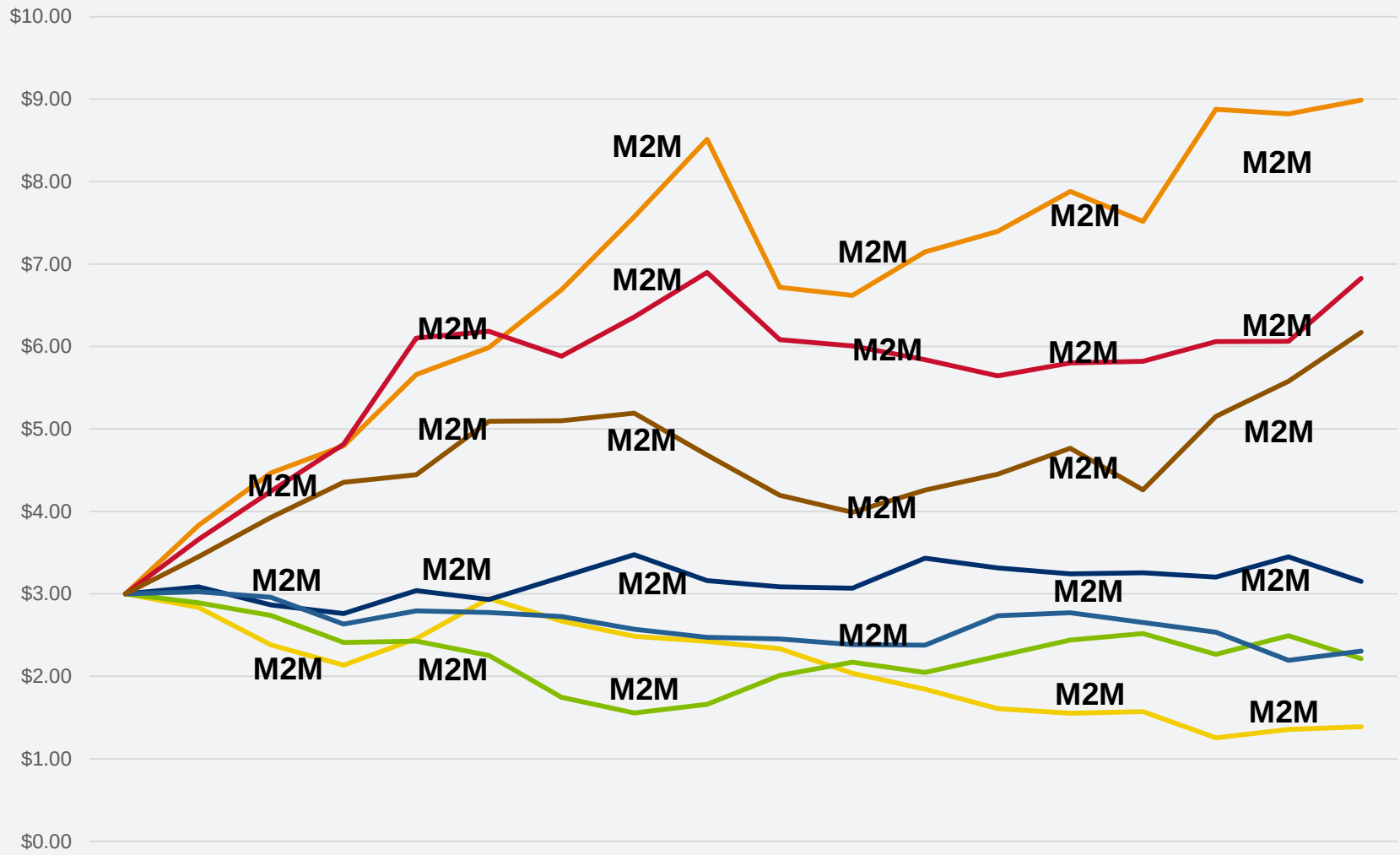


CITY OF ROSEVILLE CALIFORNIA

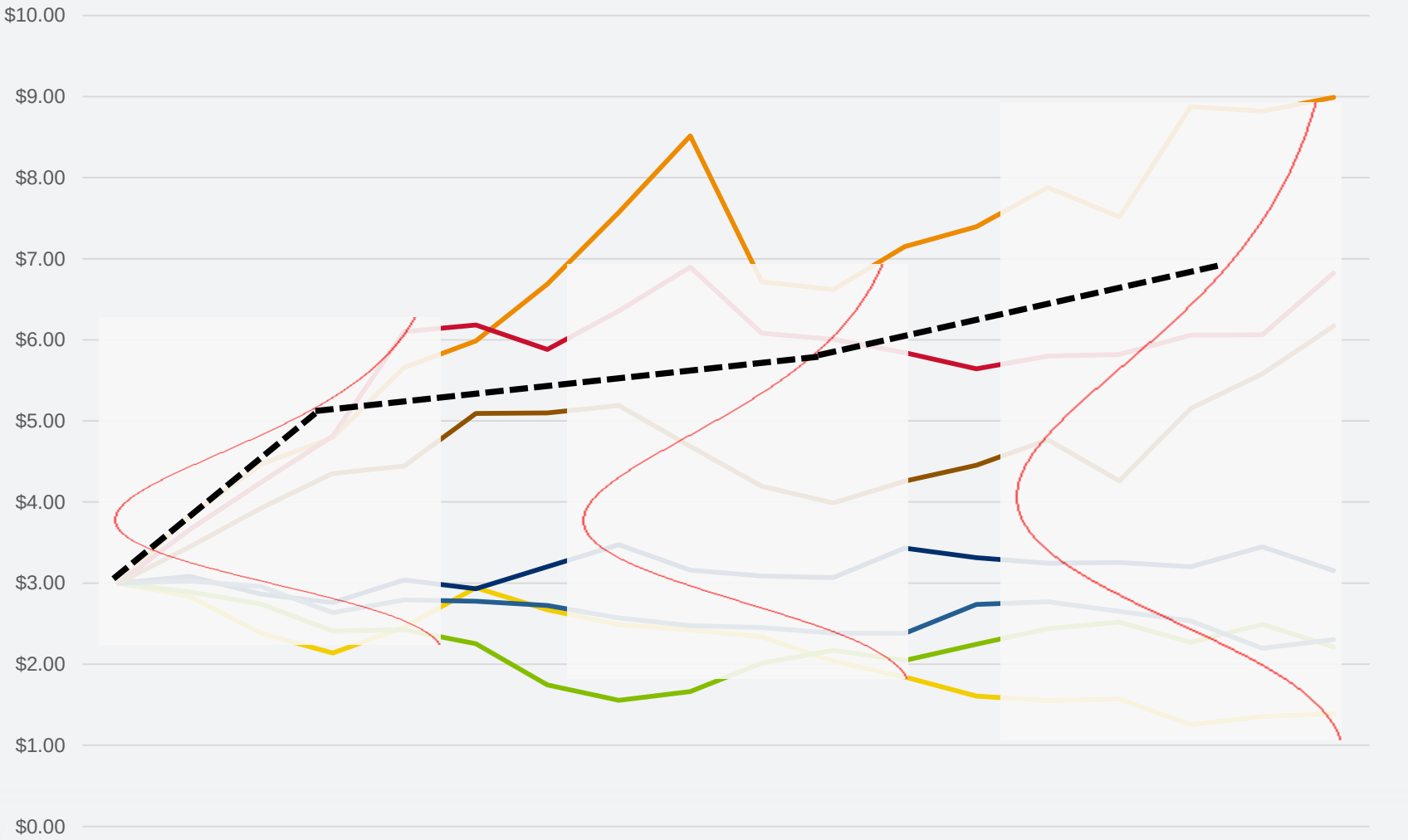
Simulated Future Forward Curves



Future M2M

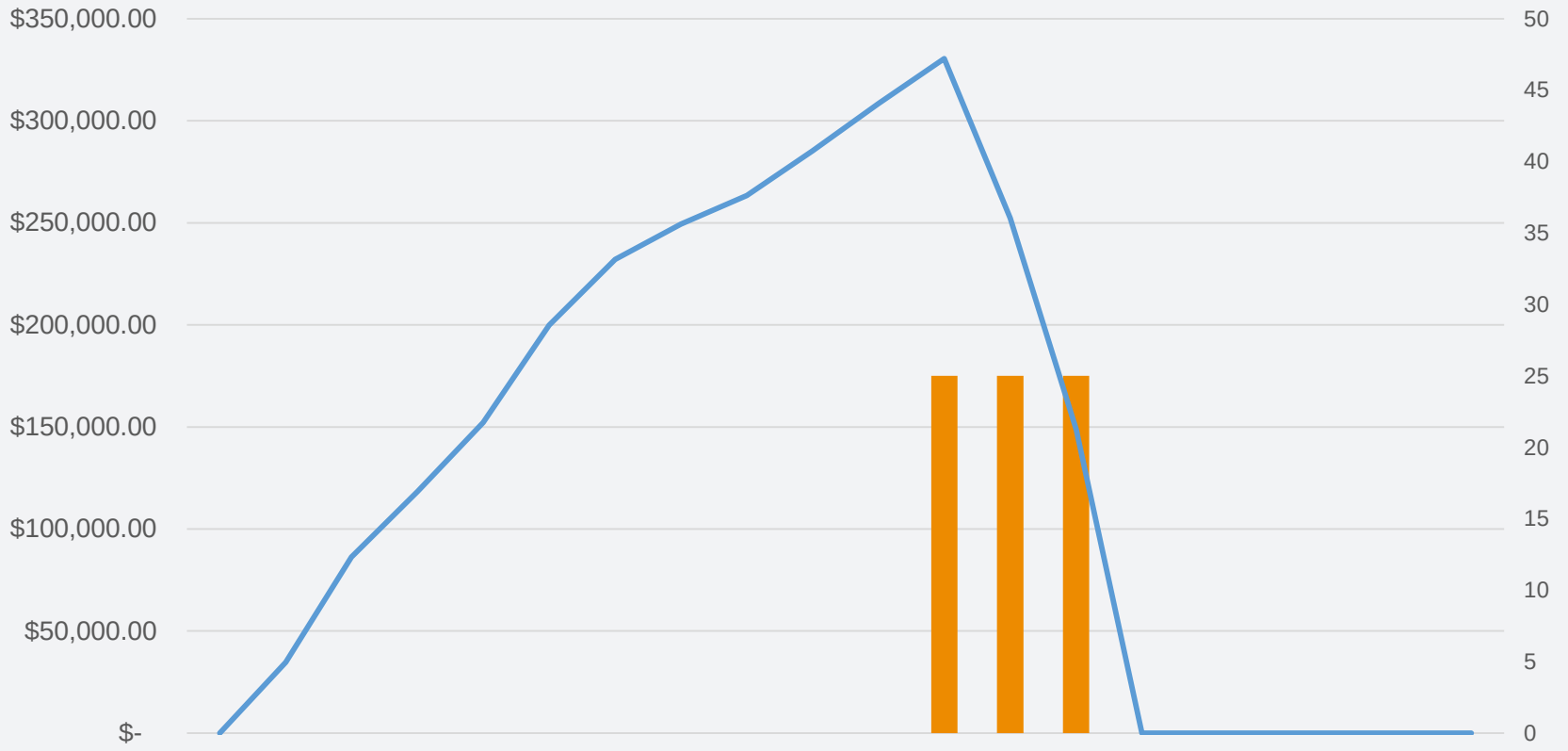


M2M Distributions



Transaction PFE

- 25 MW 7x24 Q4 2017, 80% PFE



Counterparty PFE

Roseville Credit Management

- Trade power and natural gas
- WSPP, NAESB for short-term
  - With one exception, uncollateralized
- ISDA w/ PA/GA for long term
  - Almost all with collateral threshold table
- No exchange trading
- 3rd party provides counterparty evaluations and credit recommendations
- Often results in working credit limit < contract collateral threshold

CITY OF ROSEVILLE CALIFORNIA

Sample Hedge

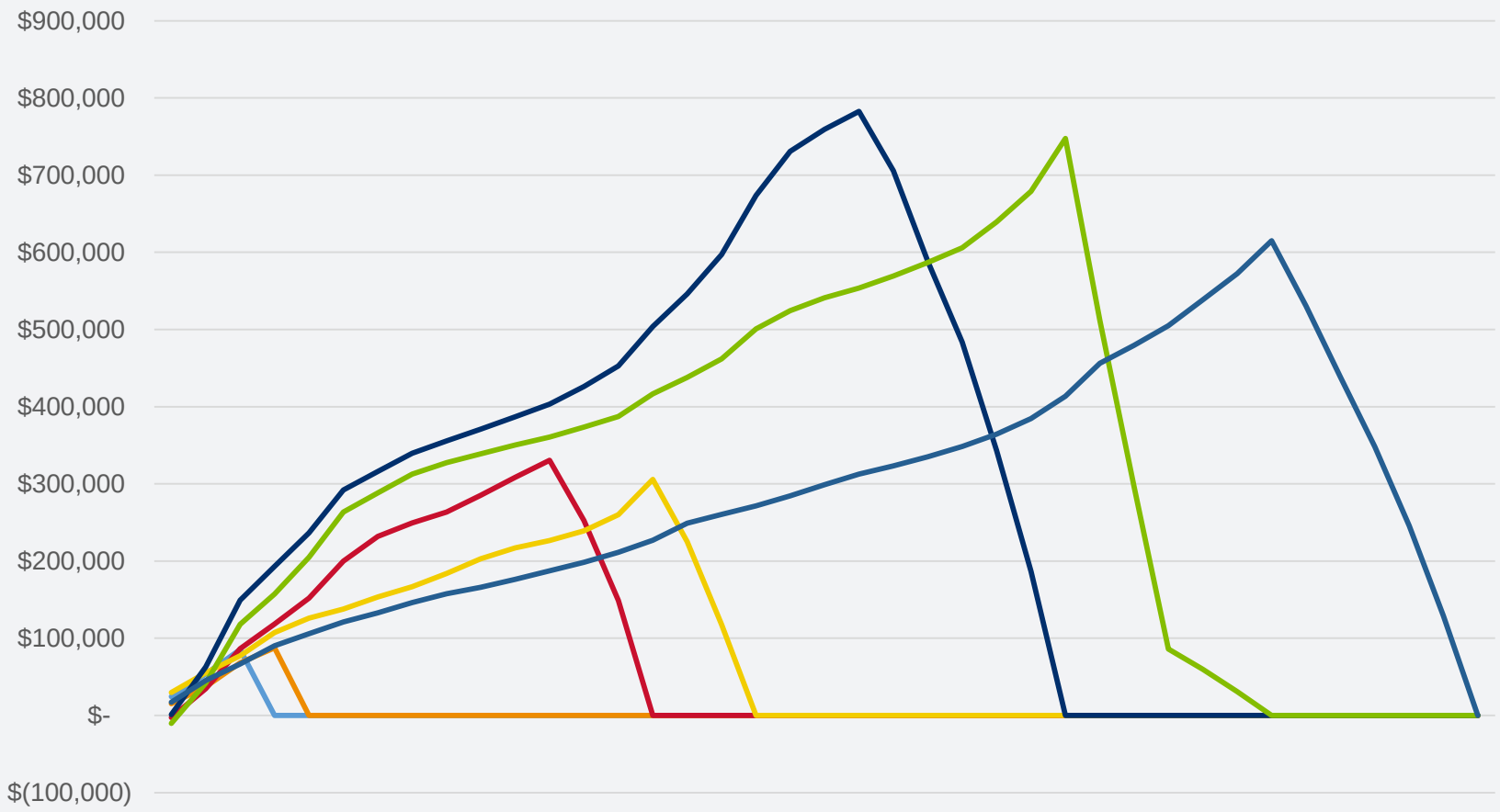
Time Period	Product	Quantity	Units	Total Volume	Units	Unit Price	Estimated Cost
Jan-2017	Elec	25	MW (7x24)	18,600	MWh	$40.542	$754,072
Feb-2017	Elec	25	MW (7x24)	16,800	MWh	$38.140	$640,744
Q4 2017	Elec	25	MW (7x24)	55,200	MWh	$36.870	$2,035,224
Q1 2018	Elec	25	MW (HLH)	30,800	MWh	$39.000	$1,201,200
Q3-Q4 2018	Elec	25	MW (7x24)	110,400	MWh	$36.070	$3,982,128
Q1-Q2 2019	Elec	25	MW (7x24)	108,600	MWh	$31.450	$3,415,470
Q3 2019	Gas	5,000	MMBtu/day	460,000	MMBtu	$3.240	$1,490,400
			Total Electricity	340,400			$12,028,838
			Total Gas	460,000			$1,490,400
						Grand Total	$13,519,238

CITY OF ROSEVILLE CALIFORNIA

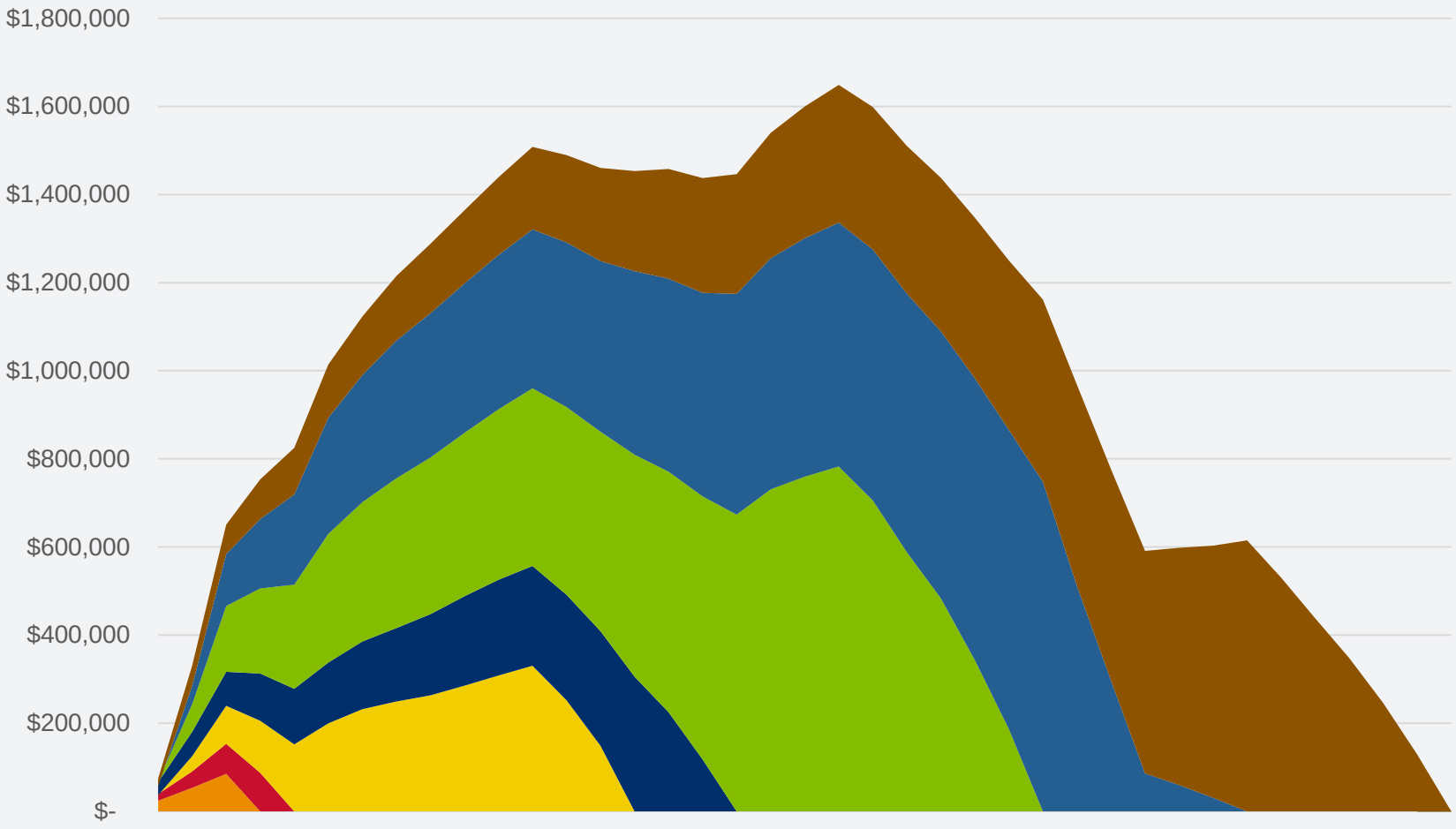
Previous Credit Processes

- Credit Management 1.0: Old School
  - Stop trading when M2M > working credit limit (if uncollateralized)
  - Stop trading if we're getting "close" to posting
- Credit Management 1.1: PFE lite
  - Add 1 standard deviation to forward curve
  - Don't award CP tranches if tranche + 1 SD causes to exceed working credit limit
- Credit Management 2.0: PFE pilot
  - Optimization model assigns awards

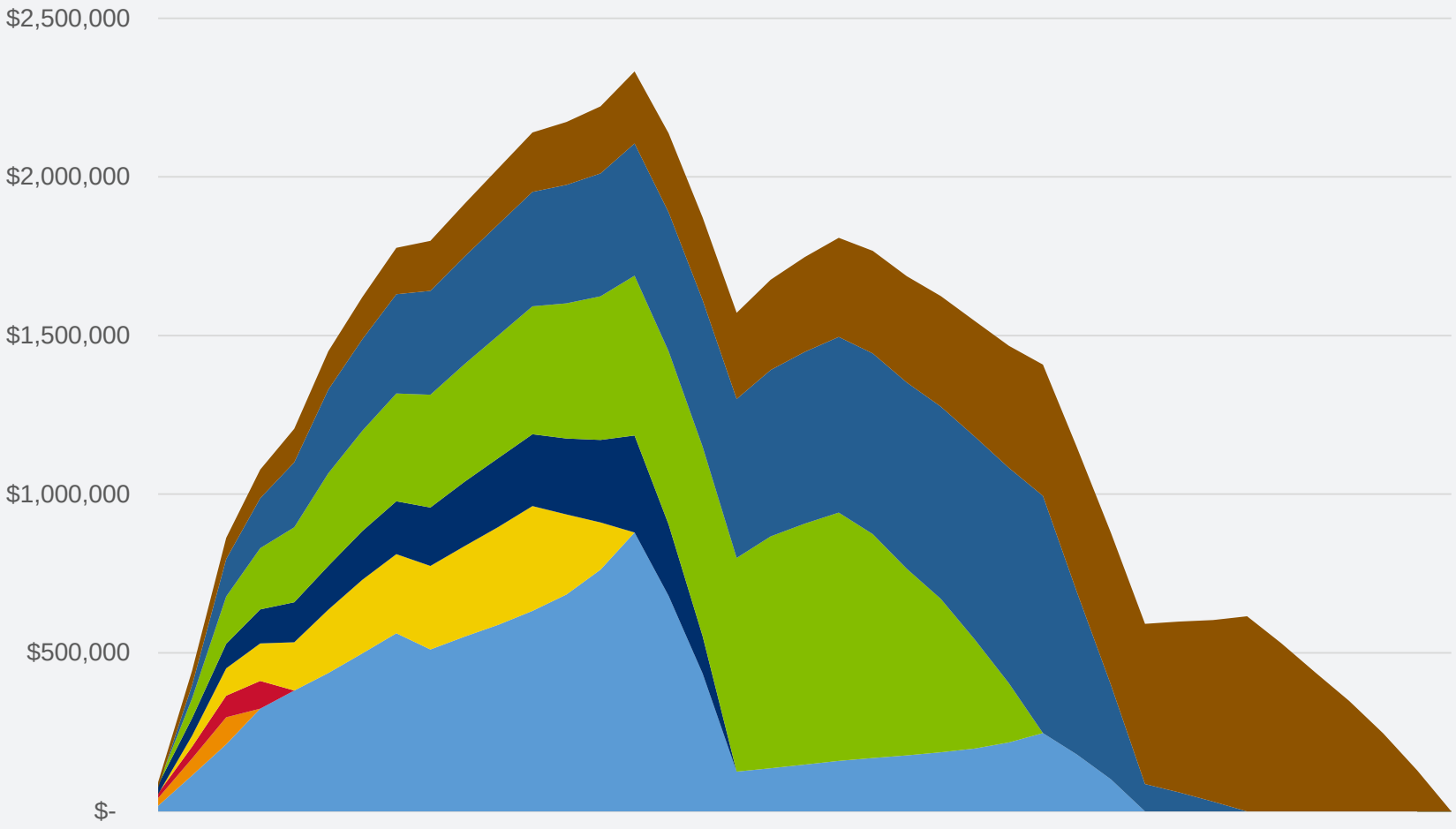
Tranche PFEs



Tranche PFEs Stacked



Counterparty PFE + Tranche PFEs



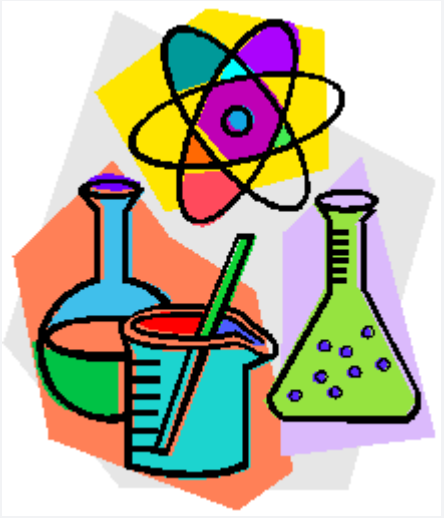
Optimization Problem

- If Counterparty PFE + awarded tranche PFEs exceeds credit limit
  - Which tranches to award
  - Who to award the other tranches to
- Optimization
  - Linear program
  - Minimize cost of all awards
  - Award all tranches to one (and only one) CP
  - CP PFE + awarded tranche PFEs don’t violate high or low credit limit

Pilot Program

- Executed one trade using the system
- Worked smoothly
- No constraints were violated by bids
  - Optimization unnecessary
  - Had it been necessary, model could tell the cost of the credit constraints
- Will continue to use and refine

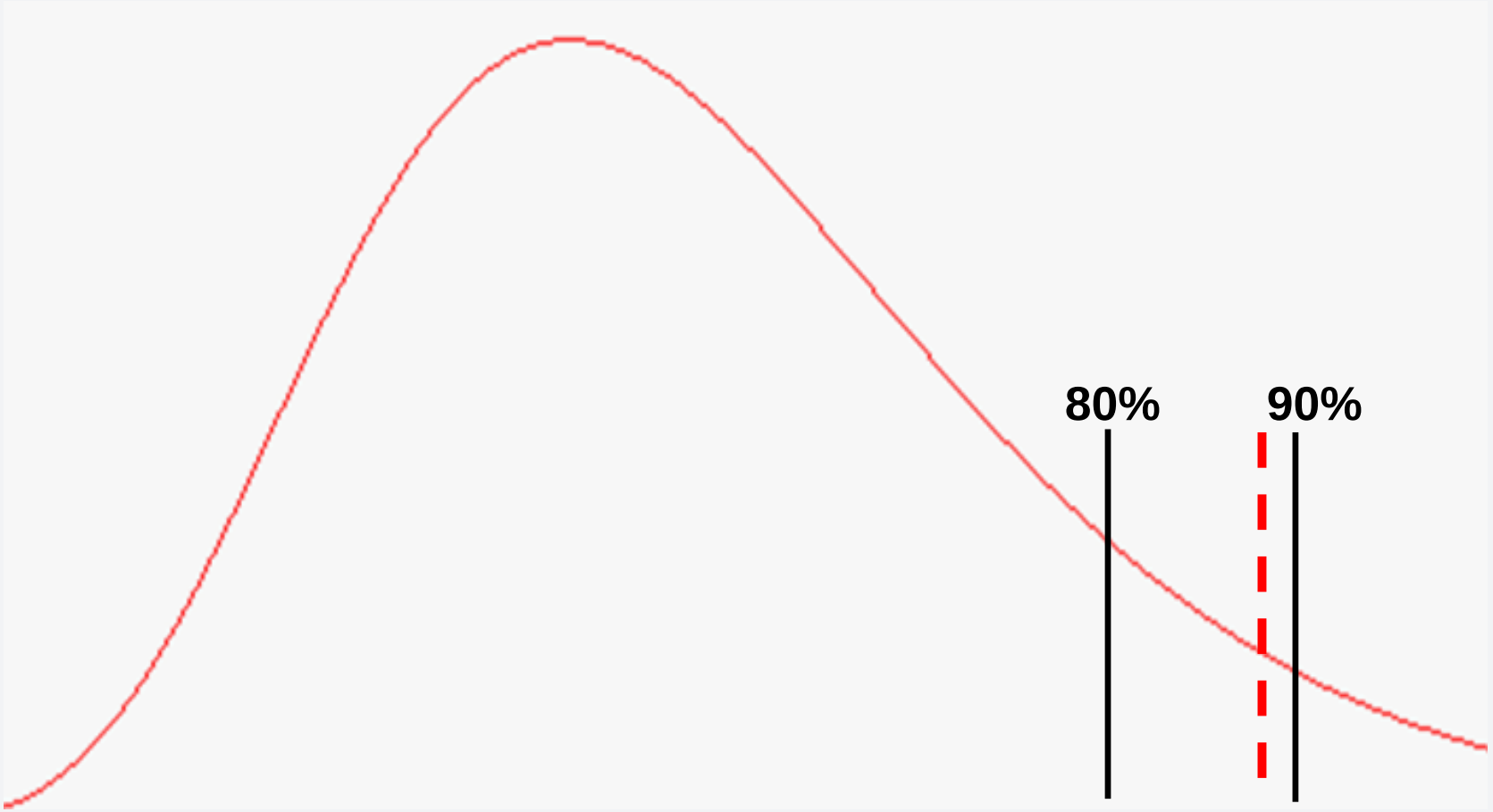
Art vs. Science



- Market simulation
  - Principle components analysis
- Exposure calculations
- Optimization

- Credit limits
- Percentile to use
- Hard vs. soft constraints

Percentiles and Credit Limits

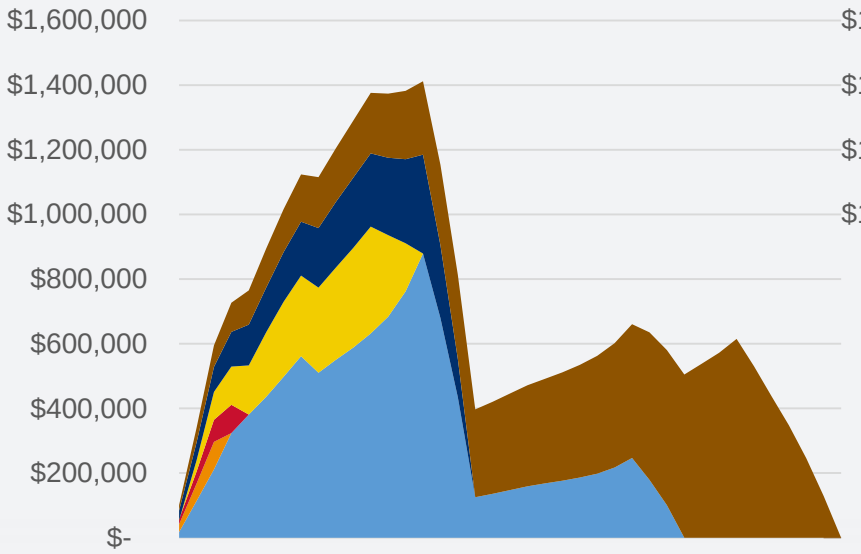


Understanding Risk Tolerance

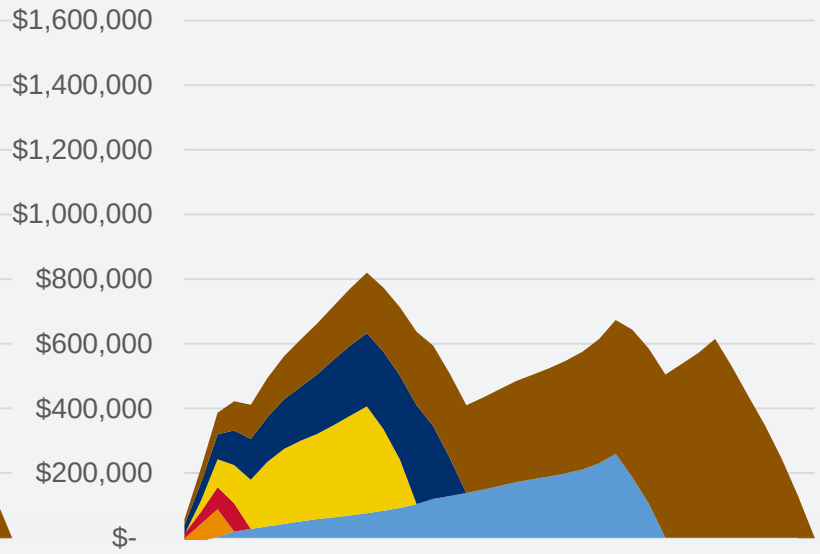
- Need to align exposure * default risk with enterprise risk tolerance
- Hard to ask decision-makers what their risk tolerance is
- Explicit
  - Policies and procedures
  - Insurance, etc.
- Implicit
  - Revealed through behaviors/decisions
- Remember the tradeoffs

Is There Value to Credit Headroom?

- Two counterparties, each w/ $1.5M limit
- Counterparty A wins all tranches by $1000 ea.
- Award them all to A?
- Is there value to keeping A in play for the future?



A

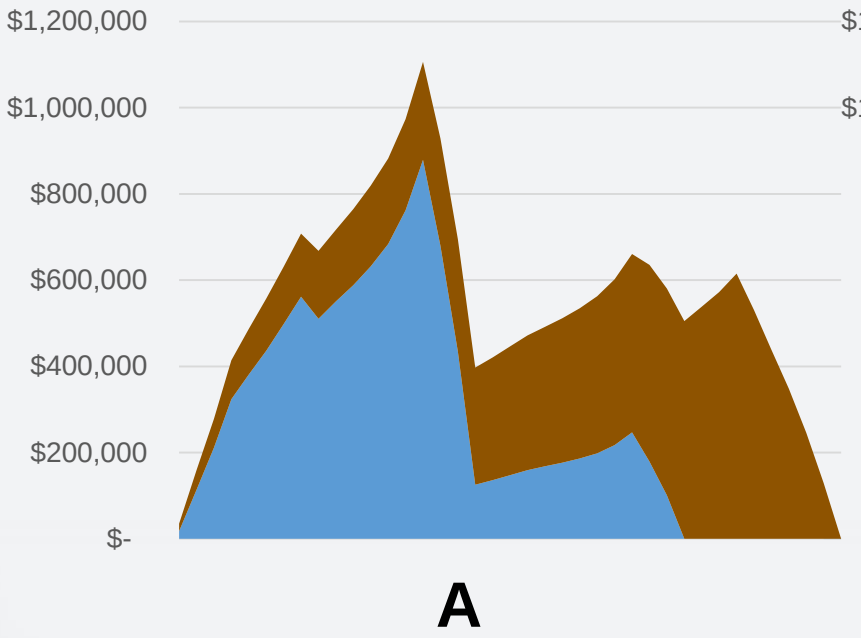


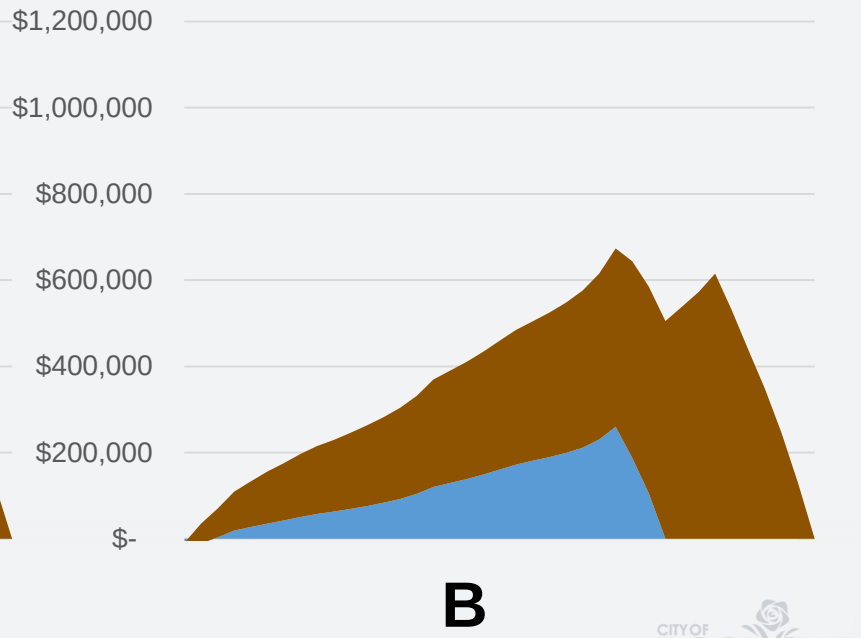
B

CITY OF ROSEVILLE CALIFORNIA

How to Trade Off Against Price?

- Two counterparties, each w/ $1M limit
- Counterparty A wins the one tranche by $100,000
- Award to B because A is slightly over 80% PFE?





What's Next?

- Continue pilot program
- Continue to explore the "art"
- Talk to interested colleagues
- Formalize process and update risk policies, as necessary