Cost of New Renewable and Fossil Fueled Generation Workshop

2013 IEPR Workshop

Hearing Room A

March 7, 2013

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INTRODUCTION AND OVERVIEW

Introduction

Topics to Cover:

- Key Concepts
- Overview of Cost Project
- Todays Agenda

Key Concepts

- "How Much Does it Cost to Build New Generation in California?"
- Answer is – IT DEPENDS
  - Location
  - Technology
  - Operational Profile
  - Just Build? Or Build and Operate?

Costs for Planning

- Costs used in planning context
- Cost of new generation –
  - Cost to build and operate a central station power plant
- Estimate cost of generation portfolios for planning
- Anticipate possible investment decisions

Levelized Cost

- Investors use discounting to value streams of costs and revenue
- Levelizing costs turns fluctuating costs over time into single cost value
  - Results in same lifetime cost
  - Usually expressed as Cost per unit of energy
  - $/MWh or ¢/kWh

Generation Cost Project Scope

- Estimate cost to build and operate new central station technologies over next decade
- Focus on likely technologies in California
  - Removed technologies not being built in California
  - Technologies in development stage removed

Stakeholder Feedback Key

- Focus on component costs
- Address system cost issue
  - Utility cost of energy includes system costs
- Debt Service Coverage Ratio
- Carbon and Emissions Cost Issues

General Approach

- Publish and discuss component costs
- Focus on cost of new generation in this iteration
  - Investigate system (cost of delivered energy) costs in future iteration
- Add DSCR flag to model results
- Included carbon costs in model

Other Changes in 2013

- Evaluate ranges using Analytica
- Simplify user interface
- Tax equity financing

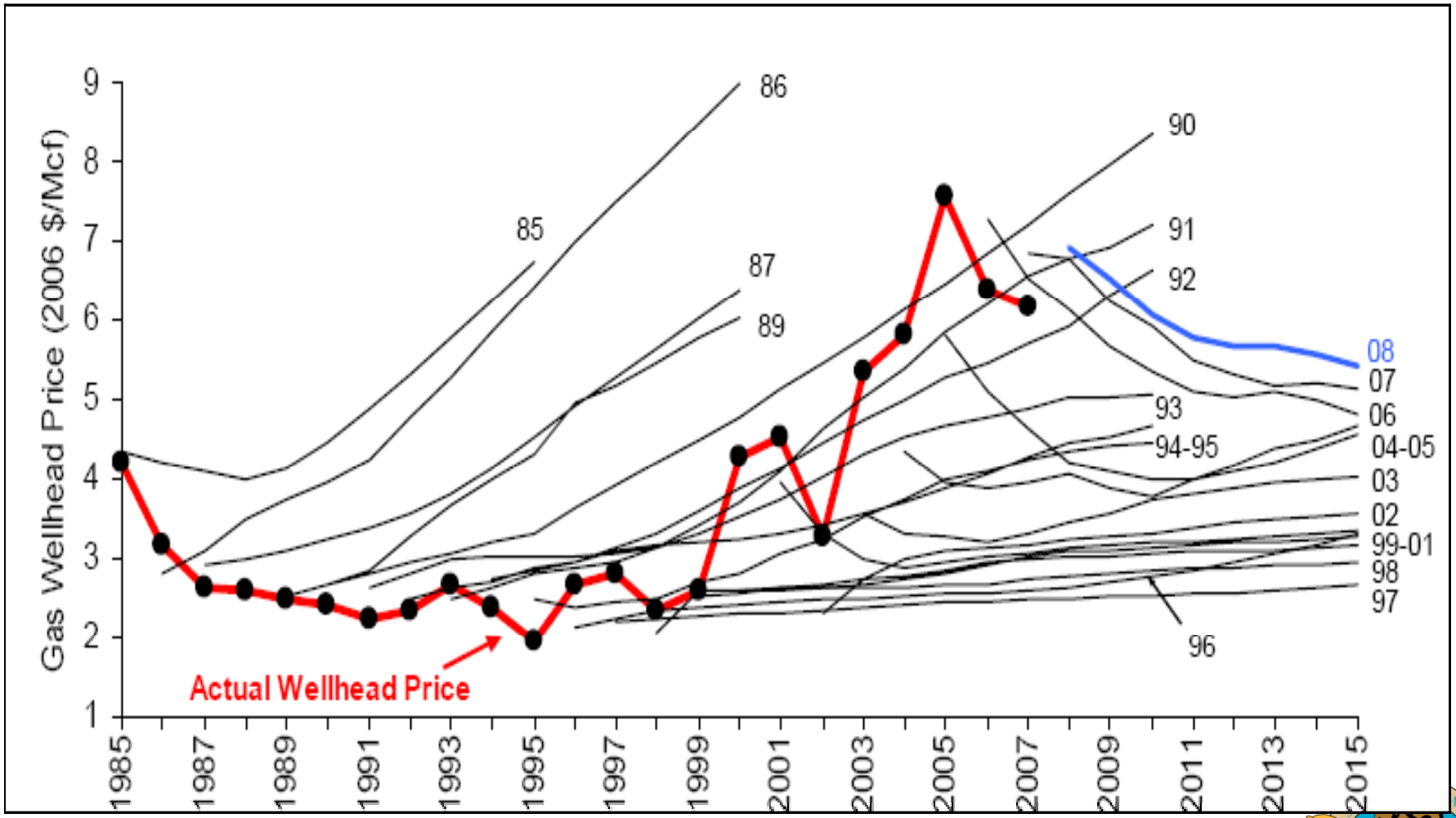
Questions?

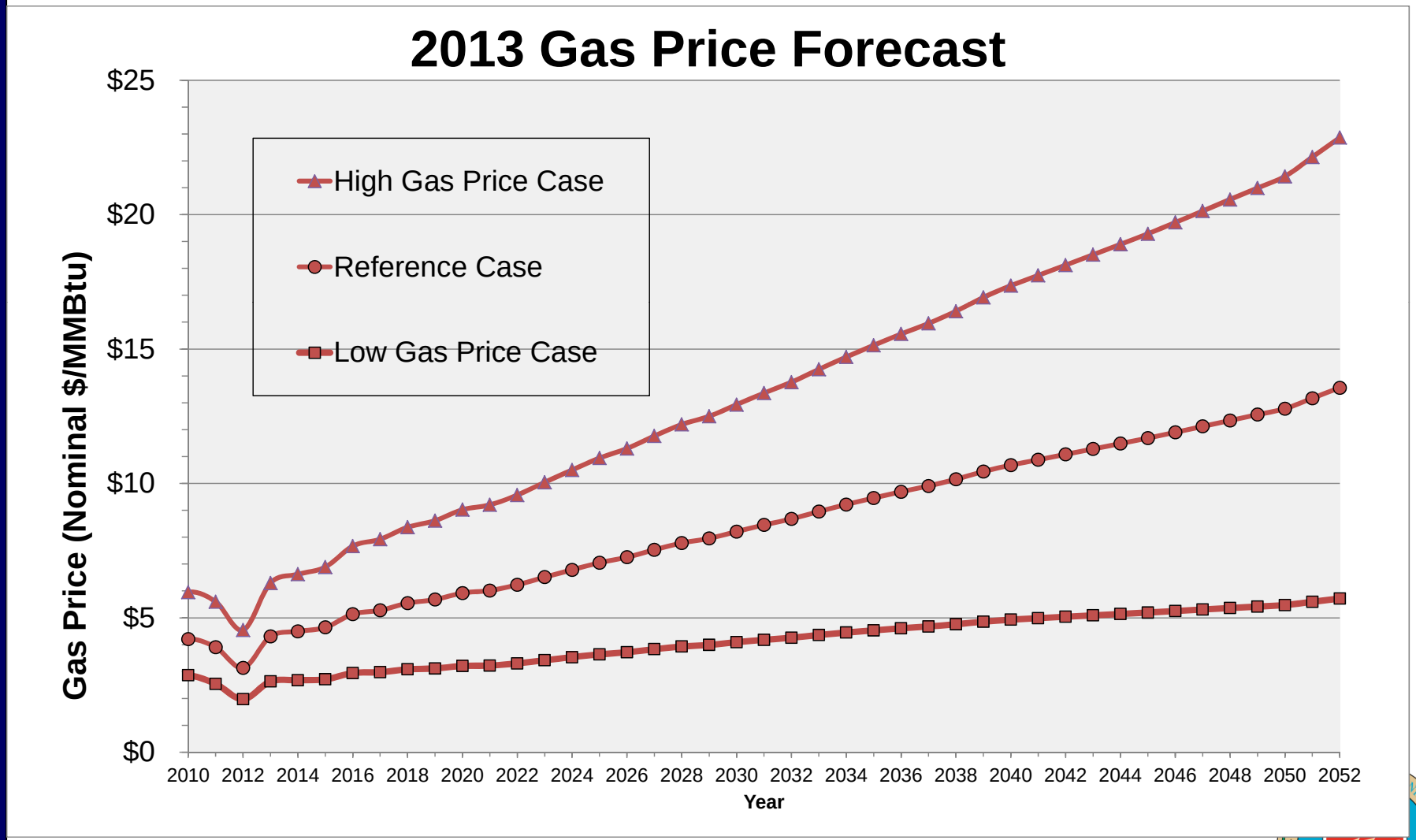
NATURAL GAS PRICE METHODOLOGY AND ESTIMATES

Natural Gas Price Assumptions

- Reference Price – Mid Case Natural presented February 19th Workshop
- High & Low Prices – Mid price scaled based on EIA Forecasting Errors Data:
- Assumed CEC forecasting errors comparable to EIA forecasting.
- Assumed future errors similar to the past
- Adjusted to burner tip from hub prices

EIA FORECASTING ERRORS




2013 Gas Price Forecast
Gas Price (Nominal $/MMBtu)
$25
$20
$15
$10
$5
$0
High Gas Price Case
Reference Case
Low Gas Price Case
2010 2012 2014 2016 2018 2020 2022 2024 2026 2028 2030 2032 2034 2036 2038 2040 2042 2044 2046 2048 2050 2052
Year

Questions?

LEVELIZED COST ESTIMATES AND RANGES

In Search of a Cost Range

- Previous model introduced High and Low Values – all values applied simultaneously
- Subsequent effort to recognize only the single highest and lowest cost factors
- Present effort is to derive these values from probabilistic analysis: Analytica

A First Step

Simultaneous Highs & Lows

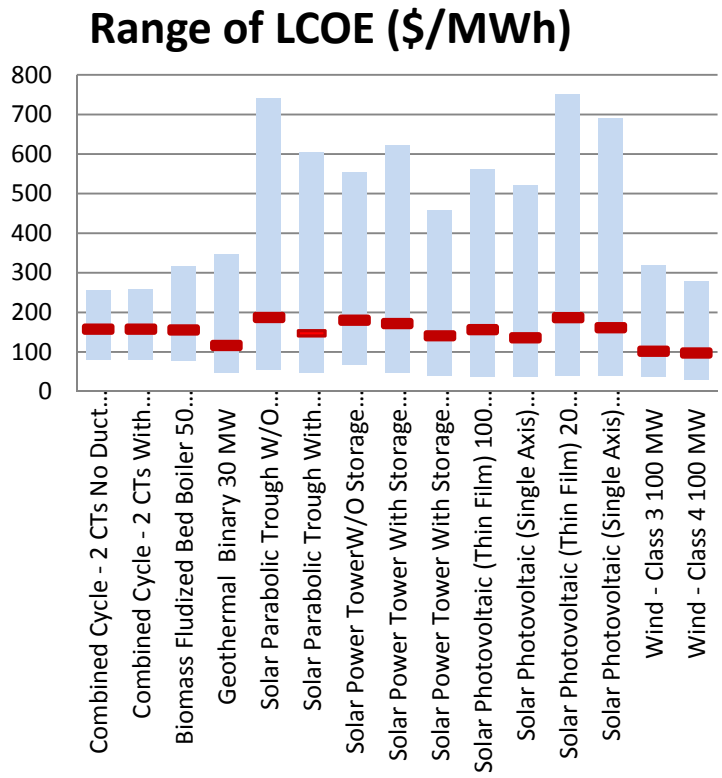
All High and Low Inputs	LCOE ($/MWh)		
In-Service Year = 2013	High	Low	Mid
Combined Cycle - 2 CTs No Duct Firing 500 MW	256.6	79.7	157.6
Combined Cycle - 2 CTs With Duct Firing 550 MW	257.6	79.7	157.9
Biomass Fludized Bed Boiler 50 MW	317.2	77.3	155.7
Geothermal Binary 30 MW	348.1	46.6	116.5
Solar Parabolic Trough W/O Storage 250 MW	741.7	55.5	187.4
Solar Parabolic Trough With Storage 250 MW	605.6	46.3	147.0
Solar Power TowerW/O Storage 100 MW	554.6	67.5	180.5
Solar Power Tower With Storage 100 MW 6 HRs	622.5	46.7	171.9
Solar Power Tower With Storage 100 MW 11 HRs	458.1	41.1	141.0
Solar Photovoltaic (Thin Film) 100 MW	562.4	36.1	156.5
Solar Photovoltaic (Single Axis) 100 MW	520.3	36.2	136.1
Solar Photovoltaic (Thin Film) 20 MW	749.9	39.6	186.7
Solar Photovoltaic (Single Axis) 20 MW	691.0	40.6	161.5
Wind - Class 3 100 MW	320.5	38.4	102.1
Wind - Class 4 100 MW	278.8	30.3	97.4

Single Highs & Lows

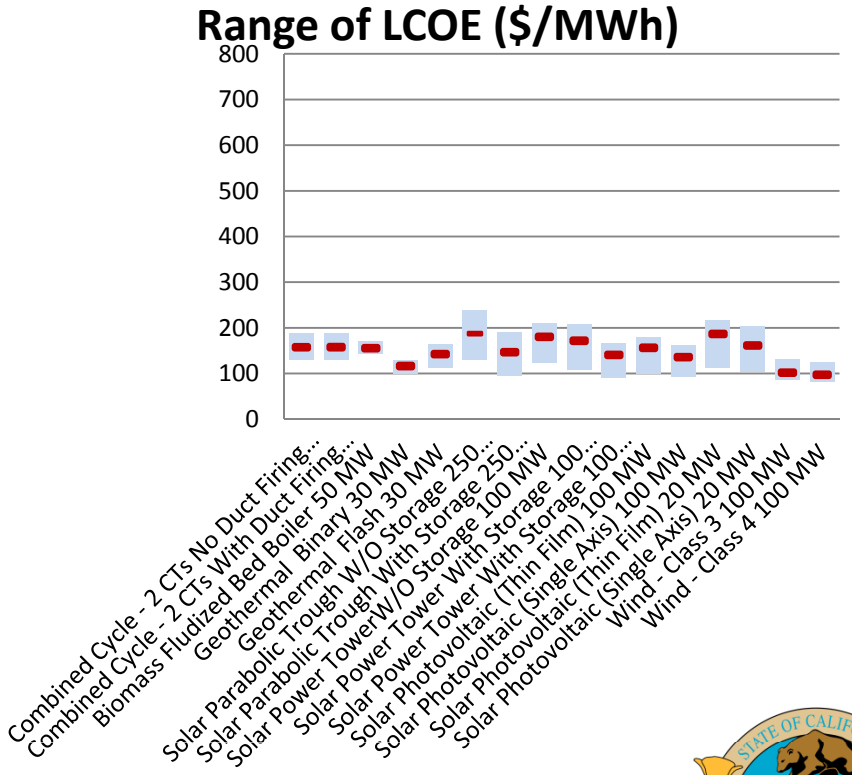
1 High and 1 Low	LCOE ($/MWh)		
In-Service Year = 2013	High	Low	Mid
Combined Cycle - 2 CTs No Duct Firing 500 MW	189.1	130.3	157.6
Combined Cycle - 2 CTs With Duct Firing 550 MW	189.3	130.5	157.9
Biomass Fludized Bed Boiler 50 MW	170.1	143.4	155.7
Geothermal Binary 30 MW	129.8	100.4	116.5
Geothermal Flash 30 MW	162.9	111.9	142.6
Solar Parabolic Trough W/O Storage 250 MW	239.6	129.4	187.4
Solar Parabolic Trough With Storage 250 MW	190.6	95.7	147.0
Solar Power TowerW/O Storage 100 MW	209.3	122.8	180.5
Solar Power Tower With Storage 100 MW 6 HRs	208.0	108.4	171.9
Solar Power Tower With Storage 100 MW 11 HRs	166.9	90.9	141.0
Solar Photovoltaic (Thin Film) 100 MW	179.2	99.1	156.5
Solar Photovoltaic (Single Axis) 100 MW	161.6	91.9	136.1
Solar Photovoltaic (Thin Film) 20 MW	216.1	112.4	186.7
Solar Photovoltaic (Single Axis) 20 MW	204.5	103.2	161.5
Wind - Class 3 100 MW	130.8	86.3	102.1
Wind - Class 4 100 MW	125.5	82.8	97.4

Same – As a Figure

Simultaneous Highs & Lows
Highs too High & Lows too Low

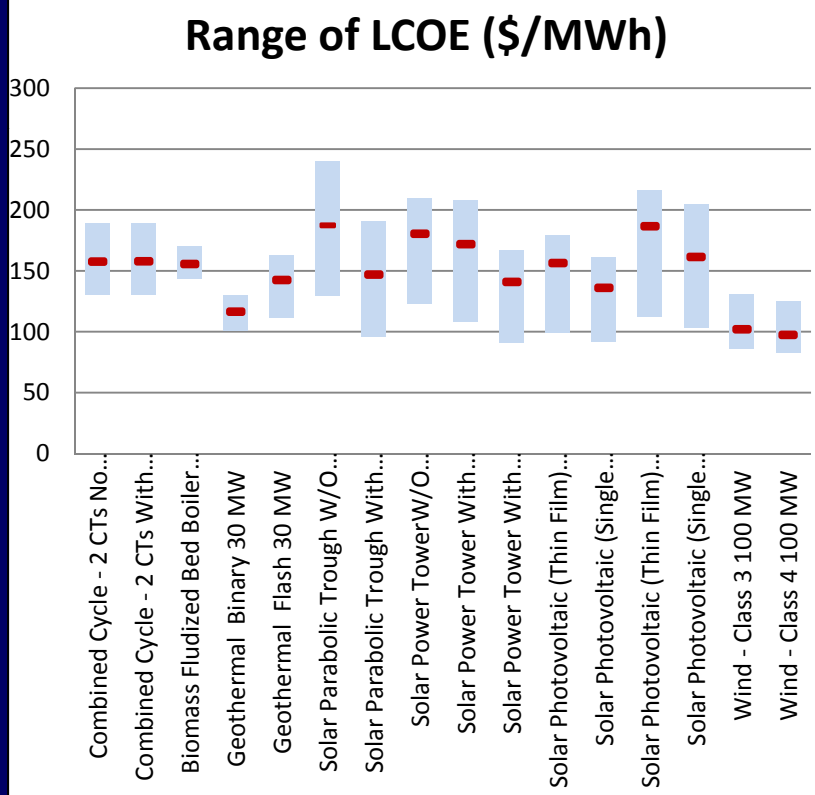


Single Cost Factor Highs & Lows
More Realistic Highs & Lows

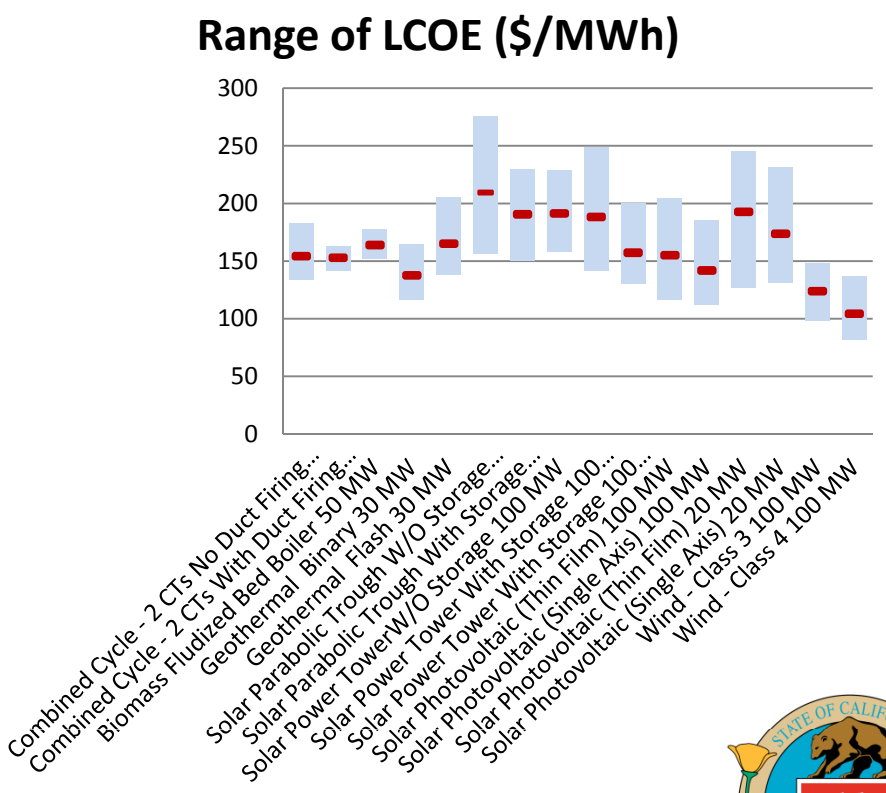


Step 2 - ACAT

Single Highs & Lows



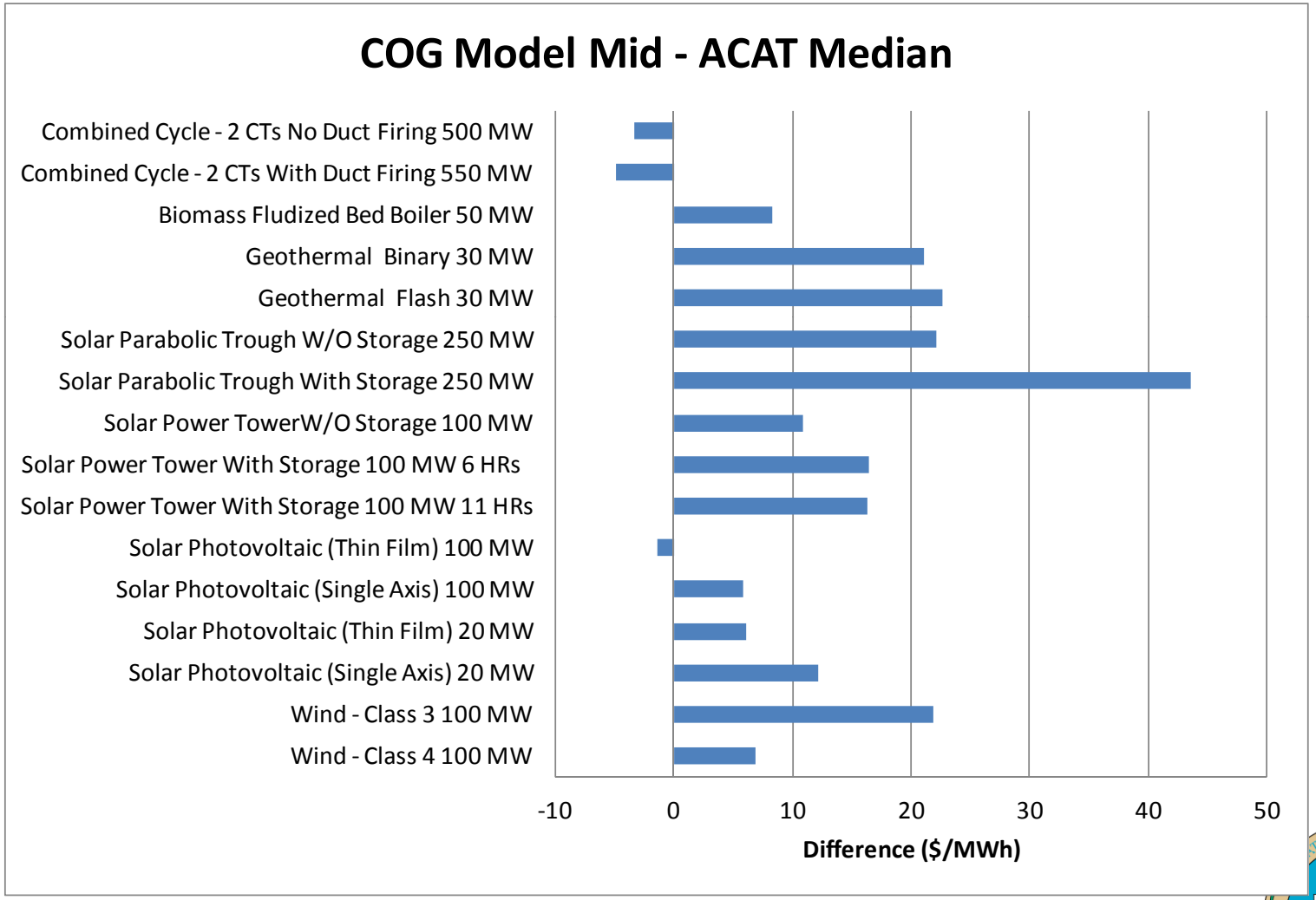
Probabilistic ACAT



Improving Mid Cost Using ACAT

Comparison of Mids	LCOE ($/MWh)		
In-Service Year = 2013	COG	ACAT	Diff
Combined Cycle - 2 CTs No Duct Firing 500 MW	158	154	-3
Combined Cycle - 2 CTs With Duct Firing 550 MW	158	153	-5
Biomass Fludized Bed Boiler 50 MW	156	164	8
Geothermal Binary 30 MW	117	138	21
Geothermal Flash 30 MW	143	165	23
Solar Parabolic Trough W/O Storage 250 MW	187	209	22
Solar Parabolic Trough With Storage 250 MW	147	191	44
Solar Power TowerW/O Storage 100 MW	181	191	11
Solar Power Tower With Storage 100 MW 6 HRs	172	188	16
Solar Power Tower With Storage 100 MW 11 HRs	141	157	16
Solar Photovoltaic (Thin Film) 100 MW	156	155	-1
Solar Photovoltaic (Single Axis) 100 MW	136	142	6
Solar Photovoltaic (Thin Film) 20 MW	187	193	6
Solar Photovoltaic (Single Axis) 20 MW	162	174	12
Wind - Class 3 100 MW	102	124	22
Wind - Class 4 100 MW	97	104	7

ACAT vs COG MODEL



Questions?

CLOSING AND NEXT STEPS

Comments

- **Due March 21, 2013**
- **Docket 13-IEP-1B**
- **Cost of New Generation in the subject line**
- **docket@energy.ca.gov and copy the technical lead staff at Ivin.Rhyne@energy.ca.gov.**

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 13-IEP-1B
1516 Ninth Street
Sacramento, CA 95814-5512