



**WECC Regional Planning
Pacific Northwest/Canada to Northern California
Transmission Project**

Stakeholder Meeting of August 2, 2007

Economic Analysis Committee Update

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Topics Covered

- Economic Analysis Committee Overview
- Economic Analysis
 - Screening Tool
 - Reference Case (starting point) and Ranges of Economic Input Data
 - Study Plan
- Sample Analysis Output
- Upcoming Work/Schedule



Economic Analysis Committee – Purpose

- Assess benefits and costs of Pacific Northwest/Canada-Northern California Line possibilities.
- Analytical objectives:
 - Identify the critical few variables that really matter.
 - Identify potential interactions that drive results.
 - Identify range of possible conditions.



Economic Analysis Committee – Process

- Regular scheduled web conference calls.
- Information exchange via email.
- Members:
 - Avista Corporation: Dave DeFelice
 - BCTC Rohan Soulsby
 - Flynn RCI: Pushkar Wagle
 - Northern Lights: Bill Hosie
 - PacifiCorp: Kurt Granat
 - PG&E: Curt Hatton, Robert Jenkins, Tom Miller, Todd Strauss, Manho Yeung
 - Sierra Pacific: Jim McMorran
 - Powerex: Gordon Dobson-Mack
 - TANC: Patrick Mealoy
 - Tollhouse Energy: Thom Fischer
 - Trans-Elect: Jerry Vannetti



FEAST Screening Tool

- Modified the FEAST screening tool for use by the Economic Committee.
- An Excel spreadsheet.
 - Quickly calculates economic results.
 - Facilitates quick evaluation of what-if scenarios.
 - Allows drop-in data from existing studies or stakeholder specified assumptions.
- Not a production cost tool.
 - Spreadsheet tool is intended for a first-step screening study.
- The screening tool is a simple tool for sophisticated users.



Screening Analysis Work Plan

- Evaluate the economic attractiveness of displacing resources at the sink location by resources at the source location assuming a particular transmission line alternative.
- Evaluate different resource scenarios or cases.
- Test sensitivities on key variables.
- To simplify the screening analysis, British Columbia is used as the source, and Northern California as the sink.

Screening Analysis Scenarios

- Scenarios or cases.

New Resources in BC				N. CA Resources to be Displaced
No.	Wind	Hydro	Biomass	
A	3000 MW or 1500 MW			1. Combined Cycle (CC) 2. Wind 3. Solar 4. Renewable Mix
B		3000 MW or 1500 MW		1. Combined Cycle (CC) 2. Wind 3. Solar 4. Renewable Mix
C			3000 MW or 1500 MW	1. Combined Cycle (CC) 2. Wind 3. Solar 4. Renewable Mix
D	1000 MW or 500 MW	1000 MW or 500 MW	1000 MW or 500 MW	1. Combined Cycle (CC) 2. Wind 3. Solar 4. Renewable Mix

Transmission Options

- Information from the Technical Committee.

Combinations		Capacity (MW)	Transmission Type	Estimated Installation Cost (in \$Million)
1	Canada 500 kV AC Double Circuit Tower Line	3000	500 kV AC	2,550
2	1500 MW from Canada and 1500 MW from PNW	3000	500 kV AC	2,300
3	1500 MW from Canada and 1500 MW from E. Nevada	3000	500 kV AC	2,850
4	1500 MW from Canada and 1500 MW from E. Nevada	3000	765 kV AC	4,250
5	PNW 500 kV AC Double Circuit Tower Line	3000	500 kV AC	1,750
6	Canada 500 kV AC Two Single Circuit Tower Lines	3000	500 kV AC	3,250
7	Canada 765 kV AC Single Circuit	3000	765 kV AC	3,050
8	Canada 500 kV AC Single Circuit	1500	500 kV AC	1,700
10	1600 MW HVDC from C/PNW to San Francisco	1600	500 kV DC	2,150
11	3000 MW HVDC from Canada (Overland route)	3000	500 kV DC	2,200
12	1500 MW HVDC from Canada (Overland route)	1500	500 kV DC	2,200
13	3000 MW Bi Pole HVDC from Selkirk to Ravens	3000	500 kV AC&DC	2,850

- Assumes 2015 In-Service Date and in 2006 US\$.

Generation Resources

- Reference Case (starting point) generation data.

		Starting Point Data			
		Installed Cost (\$/kW)	Capacity Factor (%)	Local Transmission (\$/kW)	Calculated Power Cost (\$/MWh)
BC	Biomass	2200	90	200	76
BC	Small Hydro	2000	44	200	69
BC	Wind	1700	48	200	57
BC	BC Mix (33/33/33)	-	-	-	69
CA	Combined Cycle	1000	78	0	73
CA	Geothermal	3600	95	0	74
CA	Solar (CSP)	3150	40	0	126
CA	Wind	1700	36	200	75
CA	RPS Mix (50/35/15)	-	-	-	100

- Assumes 2015 In-Service Date and in 2006 US\$.



Natural Gas Price and Greenhouse Gas Cost

- Natural Gas Price:
 - Range: \$4.50 to \$10.00/MMBtu
 - Reference Case: \$7.00/MMBtu

- Greenhouse Gas Cost:
 - Range: \$10 to \$90/Ton
 - Reference Case: \$20/Ton



Seasonal Exchange

- Peak electric demand in British Columbia occurs during winter months.
- A new British Columbia-California transmission line could allow reliability firming from CA to BC during winter months.
- Modified FEAST to add an option to account for this potential benefit.



Screening Analysis

A Sample Case

Case A4: BC Wind vs. CA Renewable Mix

- Source: BC Wind
 - Installed capacity = 3,000 MW, Capacity Factor = 48%
- Sink: CA Renewable Mix
 - Solar = 1,790 MW, Wind = 1,400 MW, Geo = 231 MW

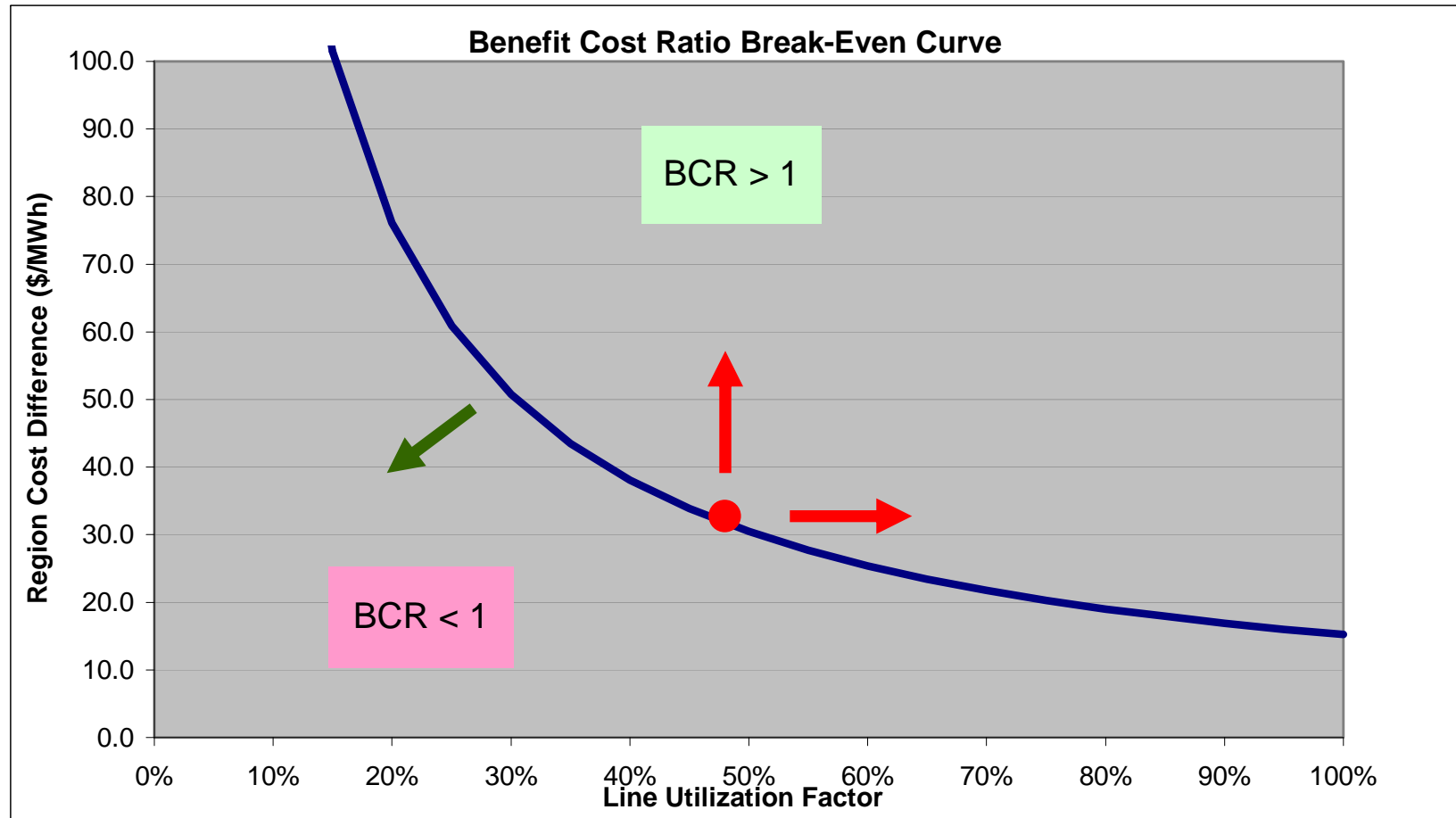
	Financing	Installed Capacity MW	Energy GWh
Wind - BC Wind	Merchant	3,000	12,614
Wind - California	Merchant	1,400	4,355
Geothermal - CA	Merchant	231	1,922
Solar Concen. - CA	Merchant	1,790	6,336

Case A4: BC Wind vs. CA Renewable Mix

TOTAL SYSTEM				
Trans Option No.	1	Installed Cost (\$Million)		4,050
		Capacity (MW)		3,000
Description	Canada 500 kV AC Double Circuit Tower Line			
Line Utilization	48%			

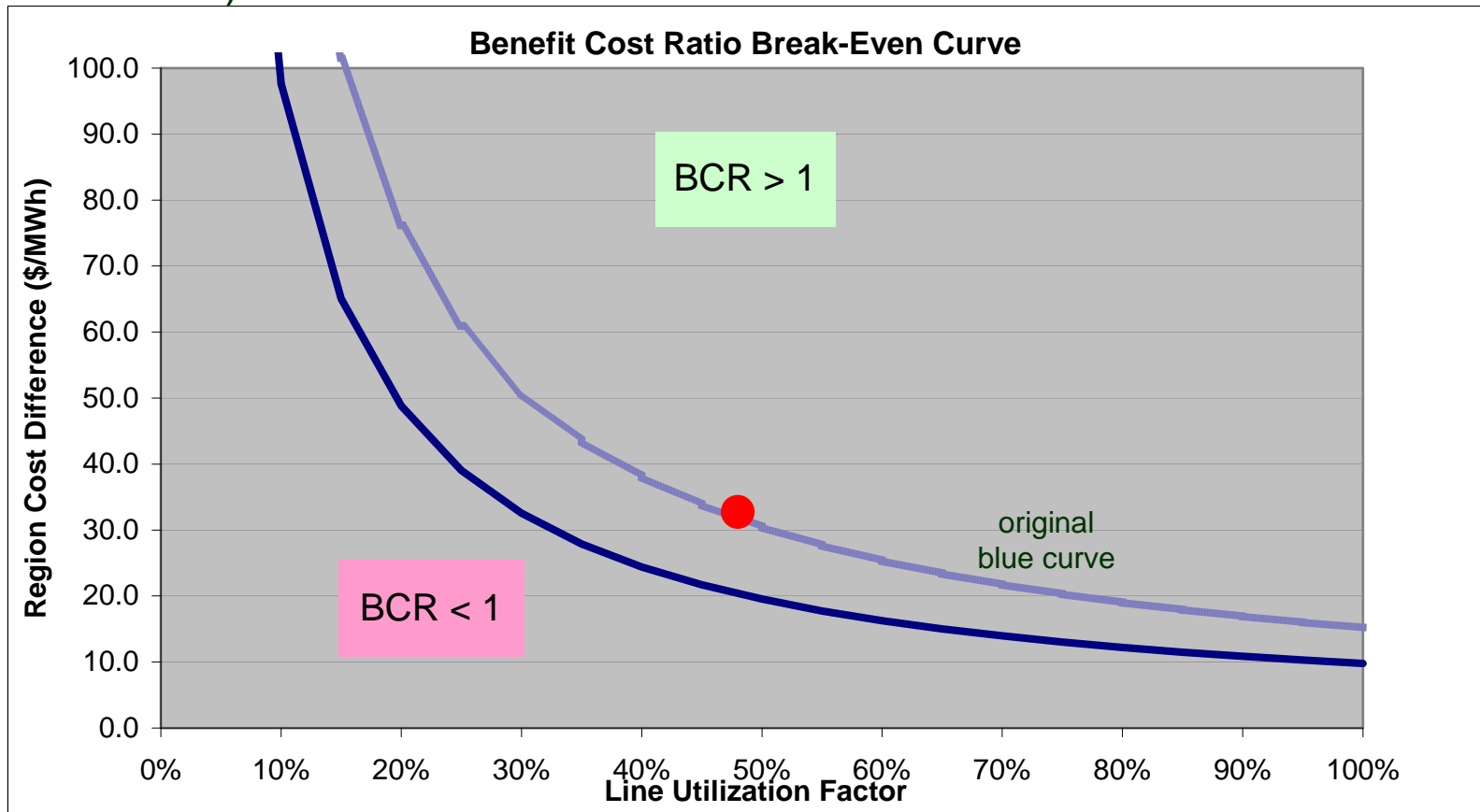
	(\$/MWh)	Regional Difference			Annual Benefits (\$Million)	Annual Cost (\$Million)
		Source (\$/MWh)	Sink (\$/MWh)	Diff (\$/MWh)		
Line Cost	31.7				400	
Power Cost		56.6	100.6	44.0	554	
GHG Adder		0.0	0.0	0.0	0	
CO2 for EOR		0.0	0.0	0.0	0	
Renewable Credit		0.0	0.0	0.0	0	
System Integration		3.0	1.0	-2.0	-25	
Prod Tax Credit		0.0	0.0	0.0	0	
Losses		4.6		-4.6	-59	
Grid Eff		0.0		0.0	0	
Dependable Cap Value			-4.6	-4.6	-58	
Winter Cap Return Value		0.0		0.0	0	
TOTAL		64.3	97.0	32.7	413	
Benefit to Cost Ratio	1.03				400	

Case A4: BC Wind vs. CA Renewable Mix



Case A4 Sensitivity: Transmission Cost

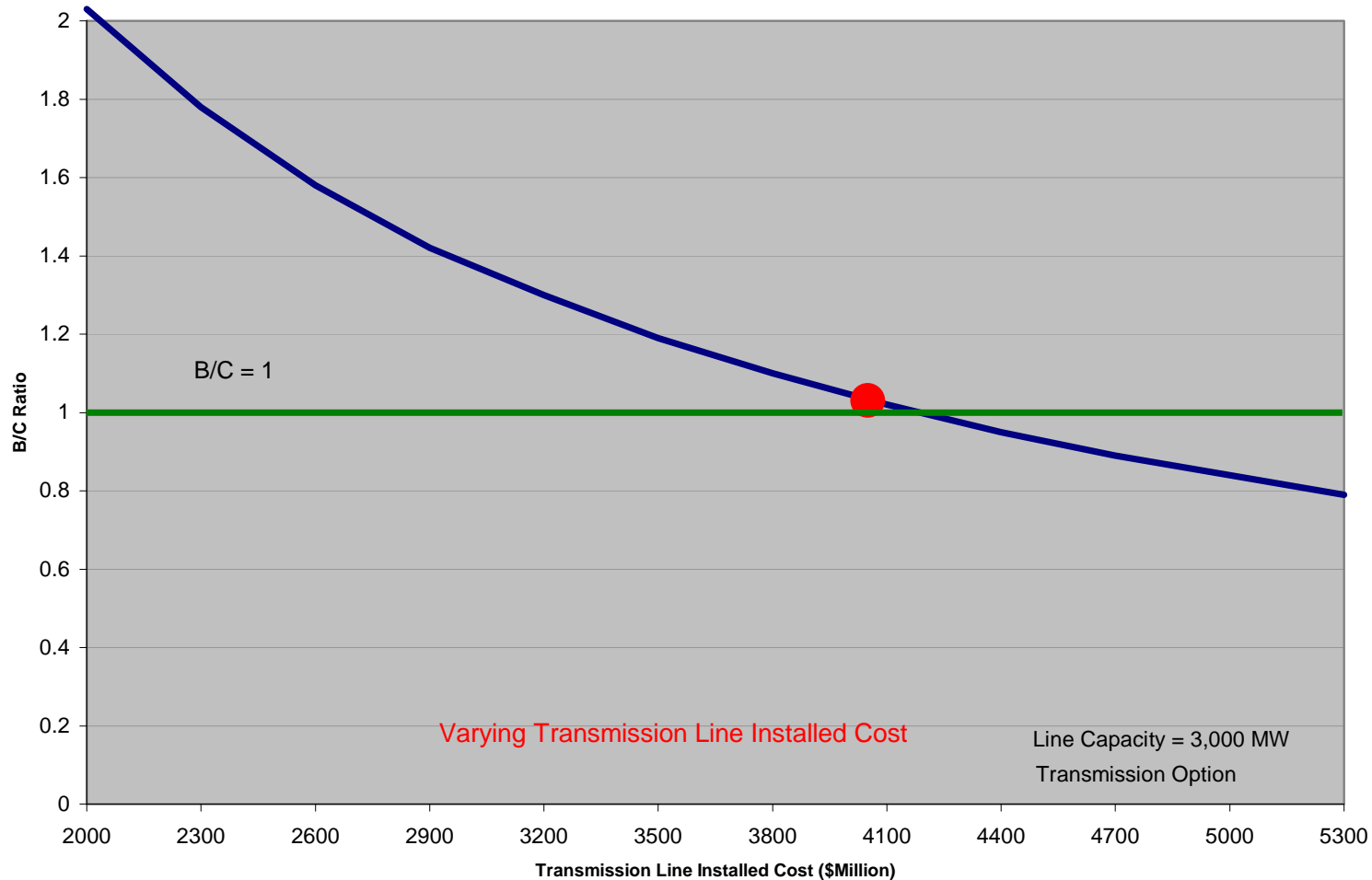
- Transmission line cost changing from \$4.05 Billion to \$2.55 Billion (BCR = 1.61)



Case A4 Sensitivity: *Transmission Cost*

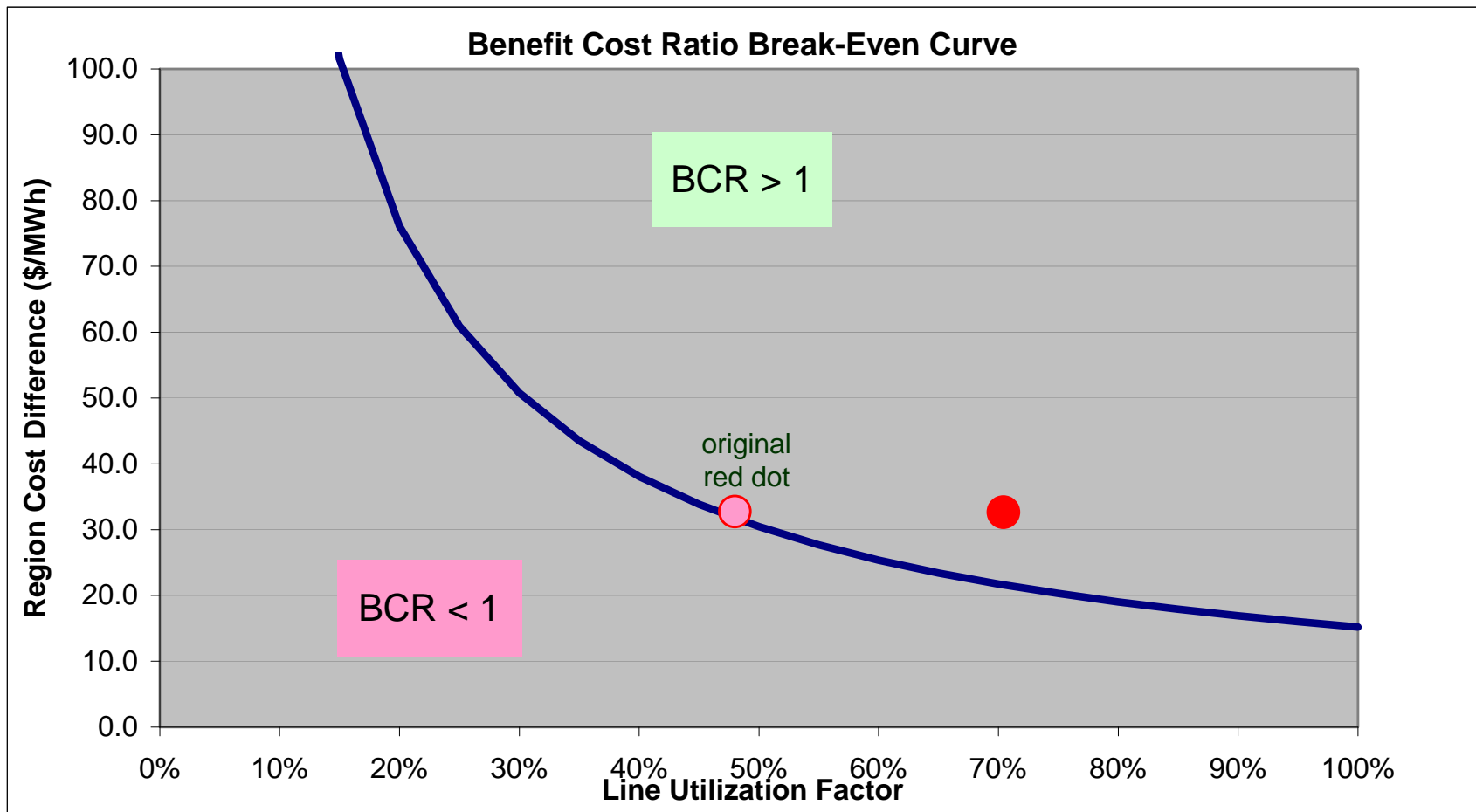
- Effect of Transmission Line Cost on Benefit to Cost Ratio

Case A4: BC Wind vs. CA Renewable Mix - Transmission Line Cost Sensitivity



Case A4 Sensitivity: *BC Wind Capacity*

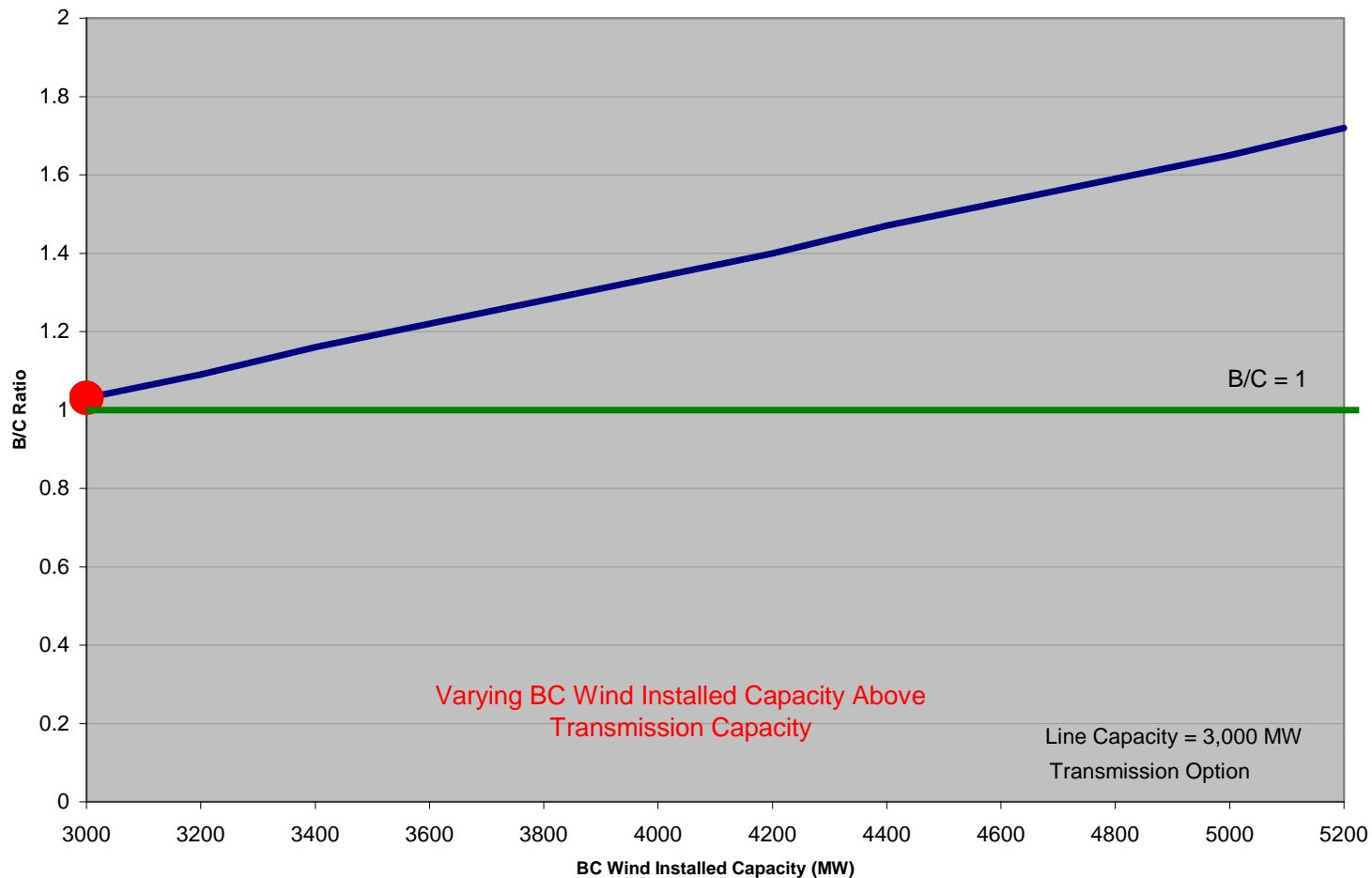
- Overbuilding BC Wind installed capacity to 4400 MW. (BCR = 1.5)



Case A4 Sensitivity: *BC Wind Capacity*

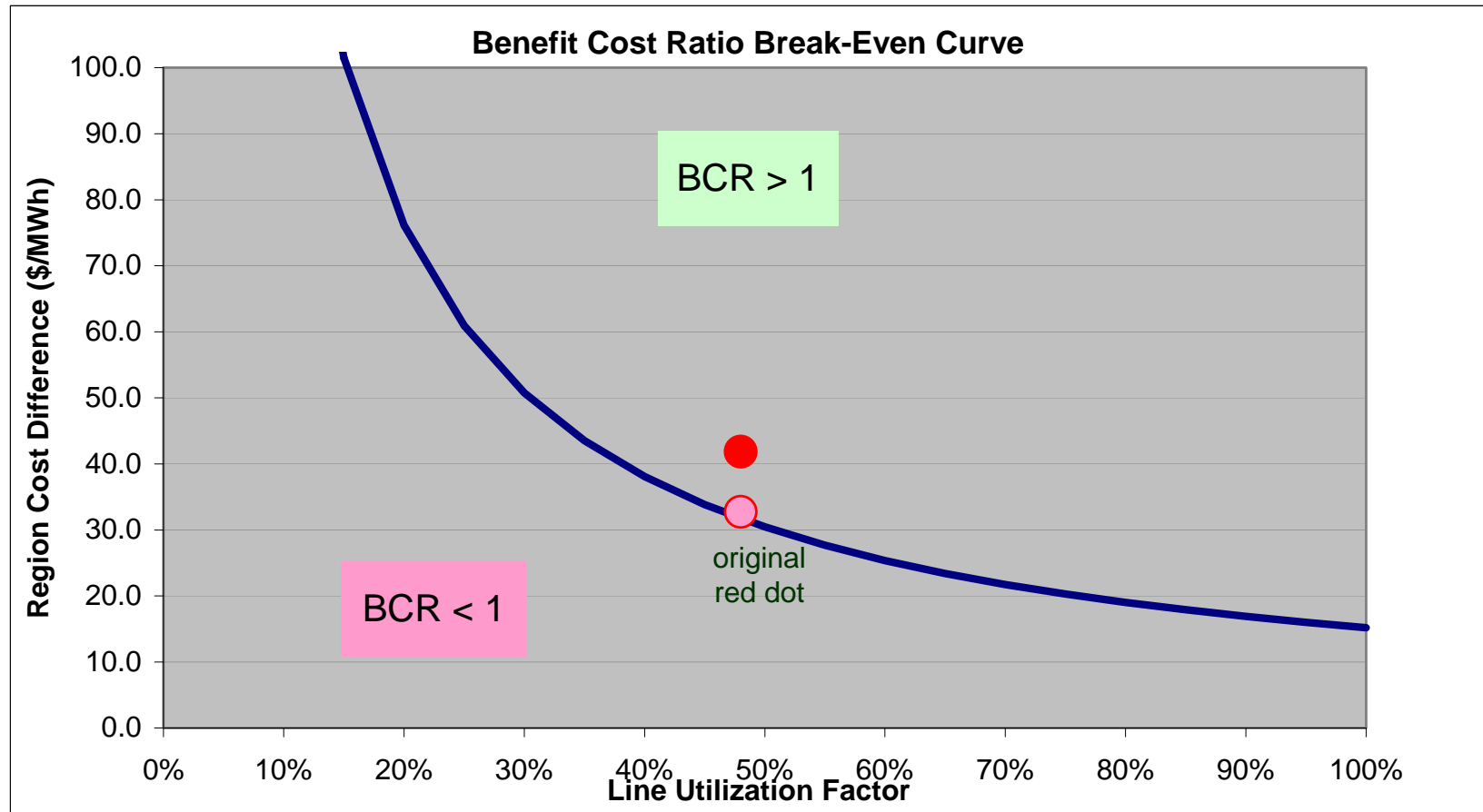
- Effect of building BC Wind Capacity above the new Transmission Line

Case A4: BC Wind vs. CA Renewable Mix - BC Wind Installed Capacity Sensitivity



Case A4 Sensitivity: *BC Wind Installation Cost*

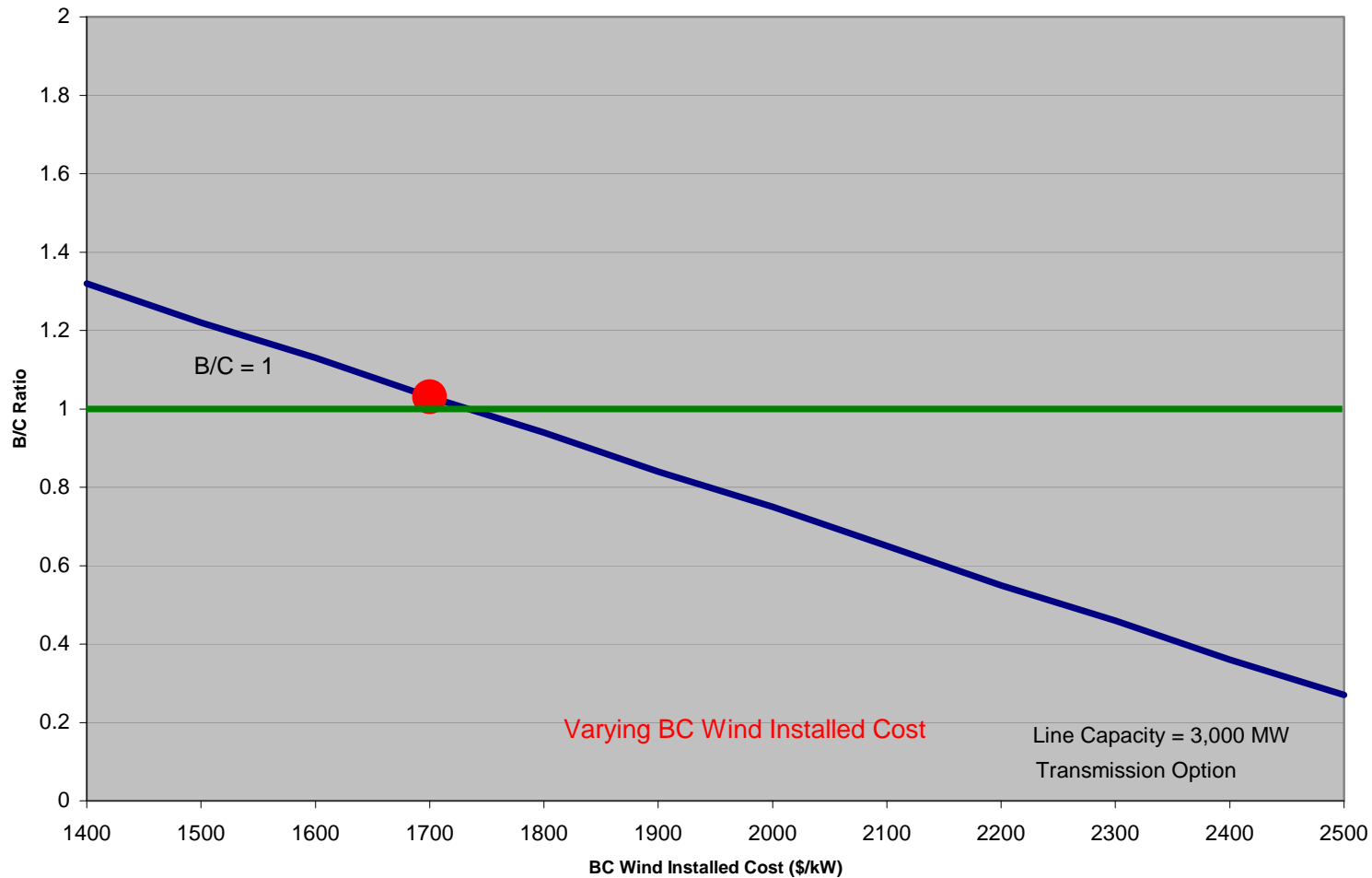
- If BC Wind installed cost is \$1400/kW. (BCR = 1.3)



Case A4 Sensitivity: *BC Wind Installation Cost*

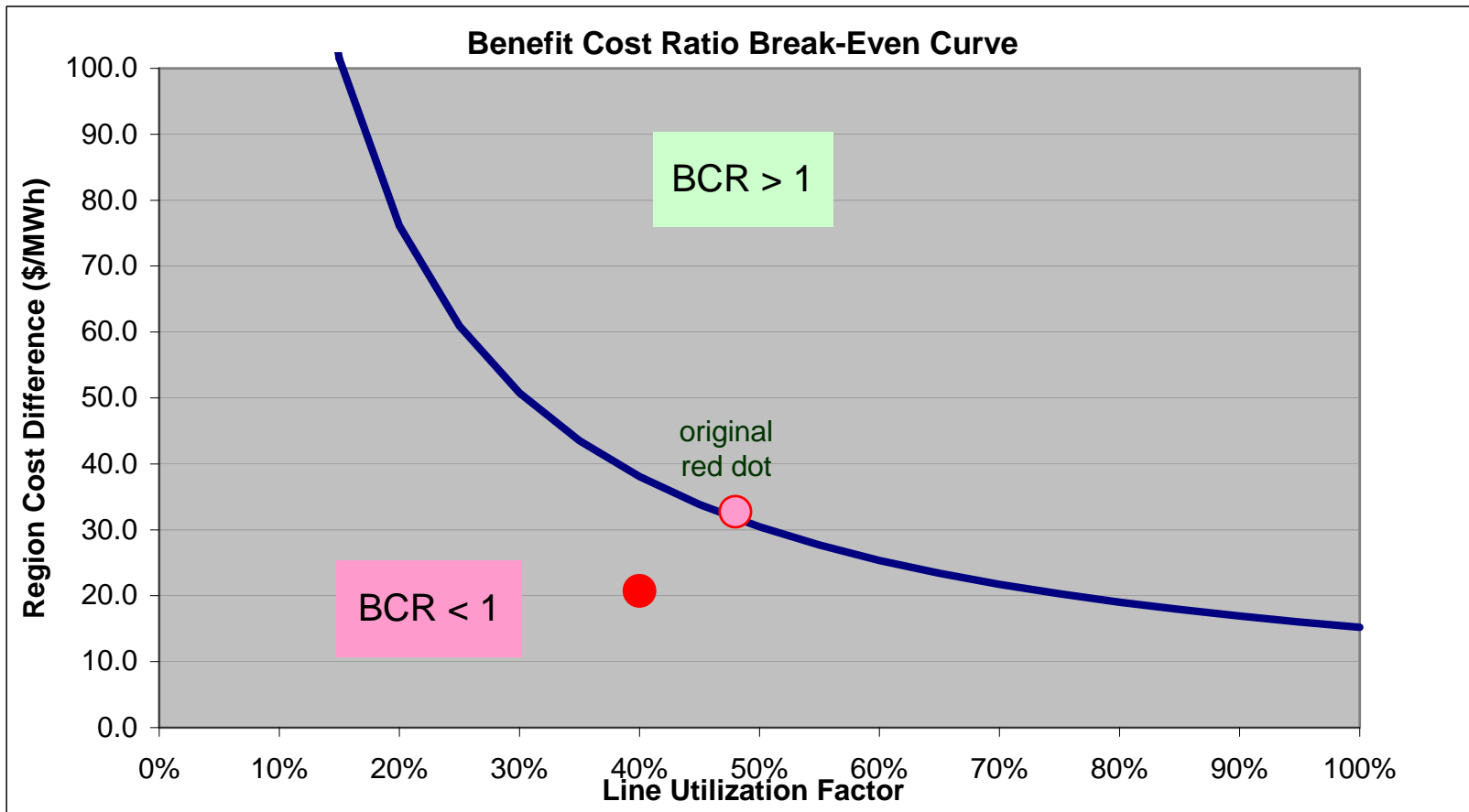
■ Effect of BC Wind Cost on Benefit to Cost Ratio

Case A4: BC Wind vs. CA Renewable Mix - BC Wind Installed Cost Sensitivity



Case A4 Sensitivity: *BC Wind Capacity Factor*

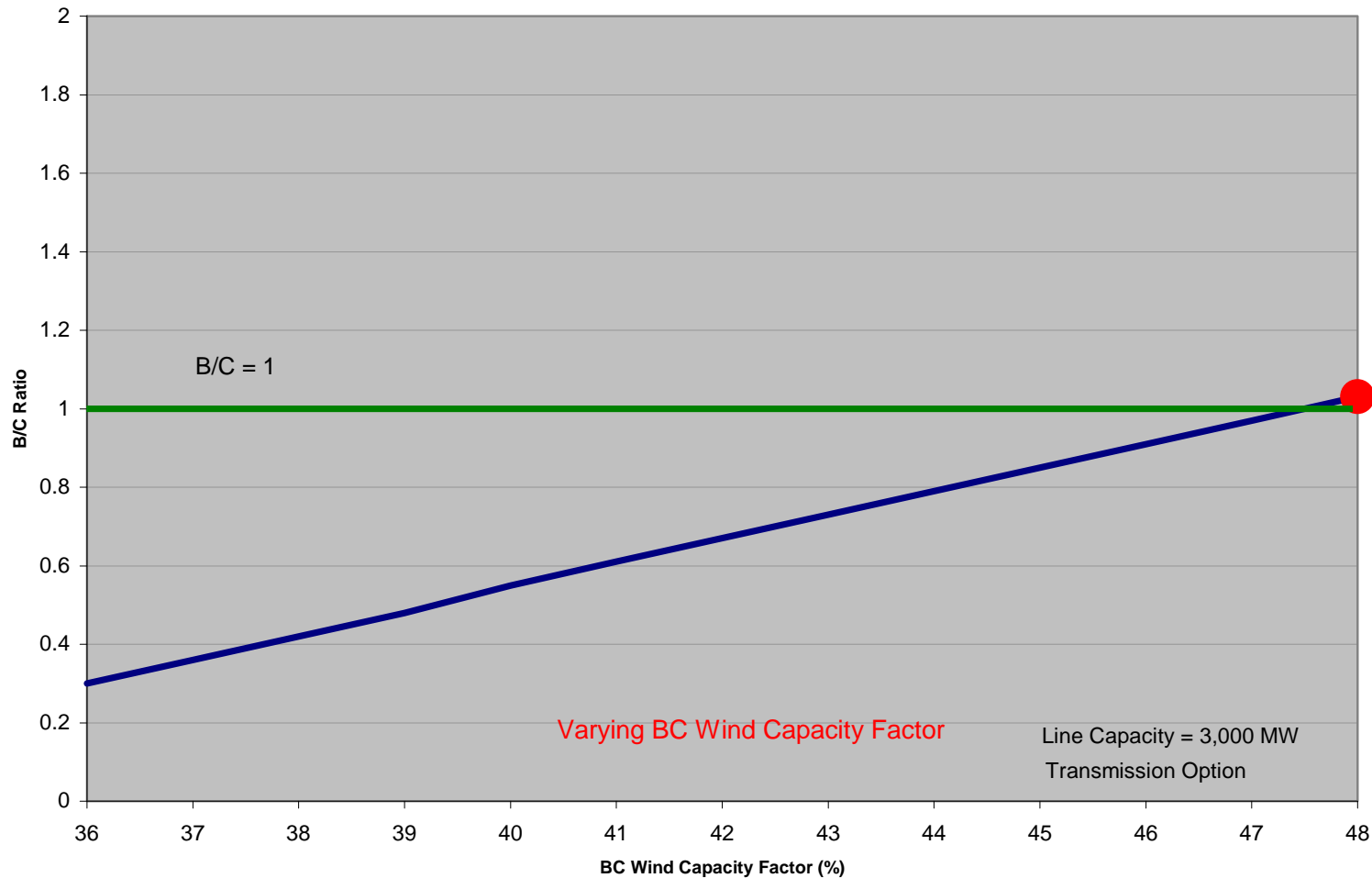
- If BC Wind capacity factor is at 40%. (BCR = 0.6)



Case A4 Sensitivity: *BC Wind Capacity Factor*

- Effect of BC Wind Capacity Factor on Benefit to Cost Ratio

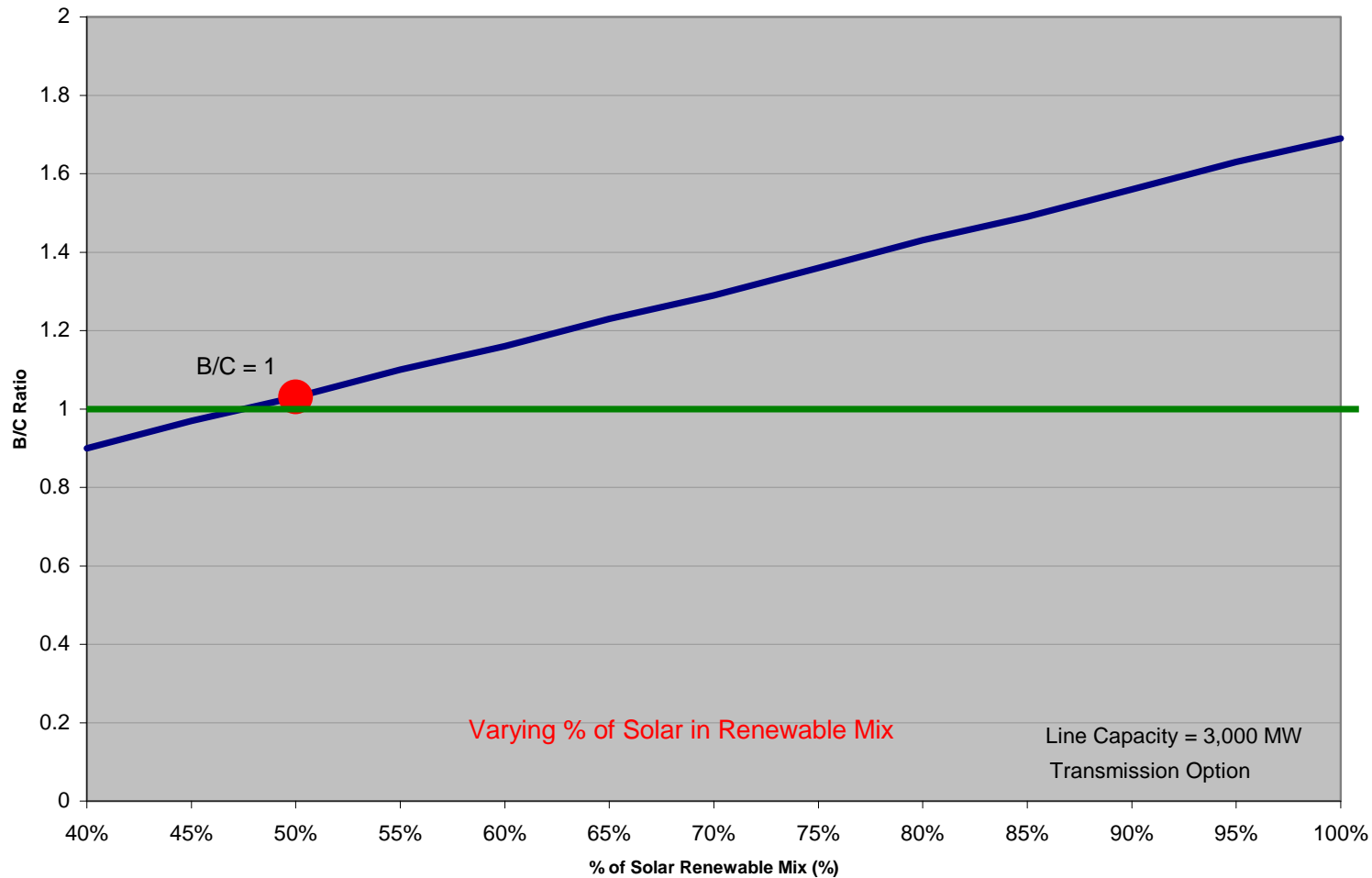
Case A4: BC Wind vs. CA Renewable Mix - BC Wind Capacity Factor Sensitivity



Case A4 Sensitivity: *CA Renewable Mix*

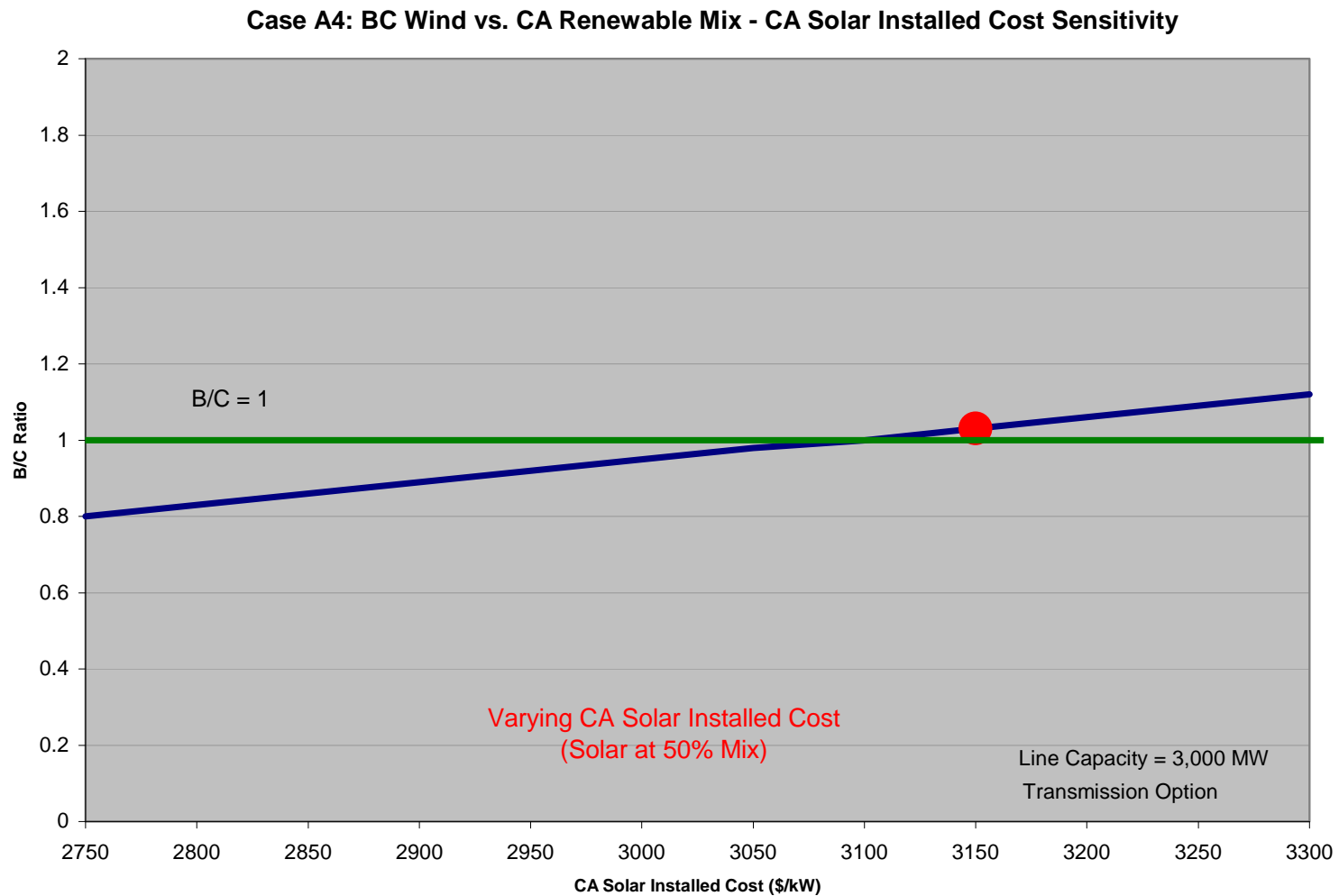
■ Effect of CA Renewable Mix on Benefit to Cost Ratio

Case A4: BC Wind vs. CA Renewable Mix - % Solar Mix Sensitivity



Case A4 Sensitivity: *CA Solar Installed Cost*

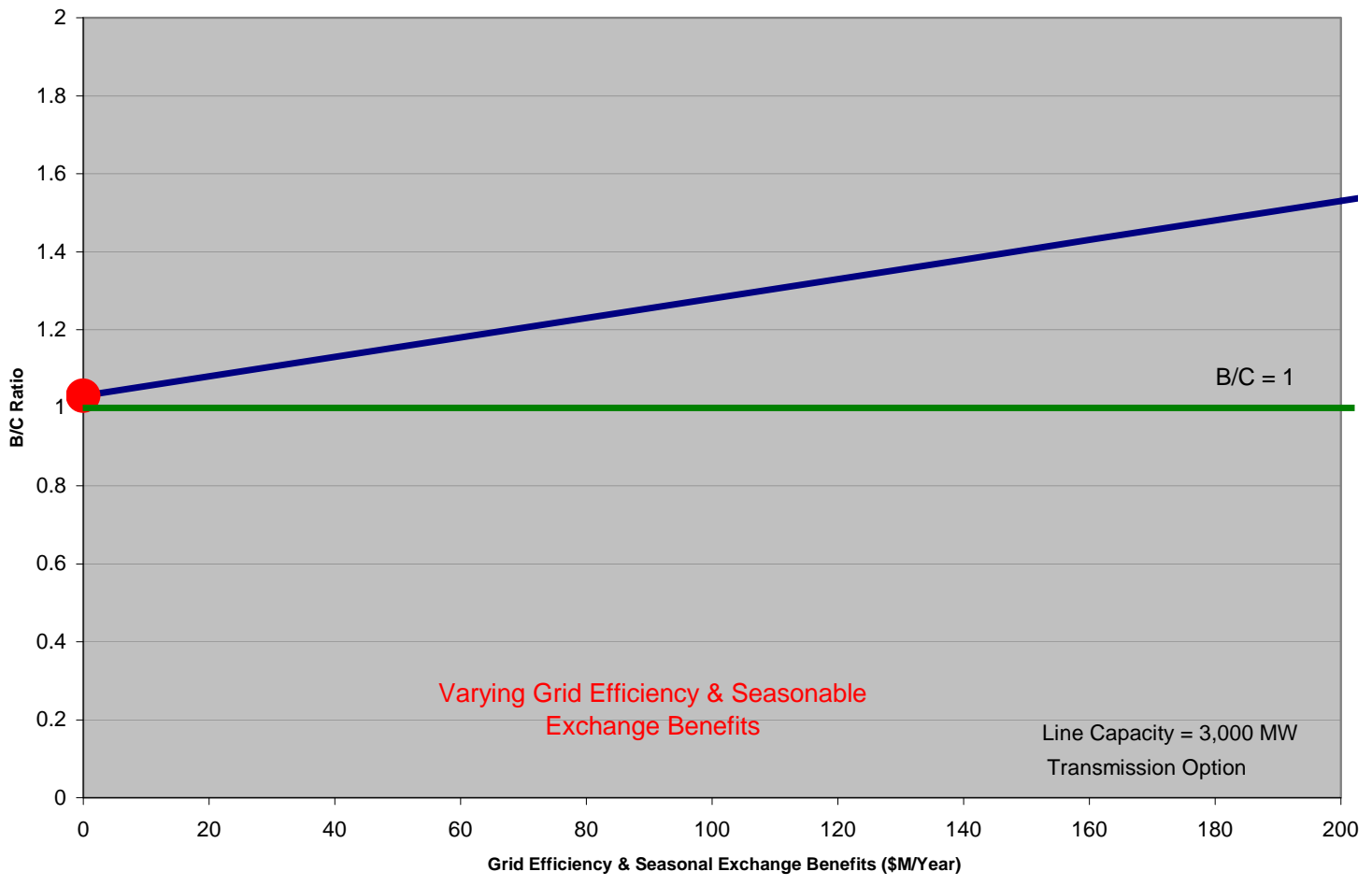
- Effect of CA Solar Installed Cost on Benefit to Cost Ratio



Case A4 Sensitivity: *Grid Efficiency/Exchange*

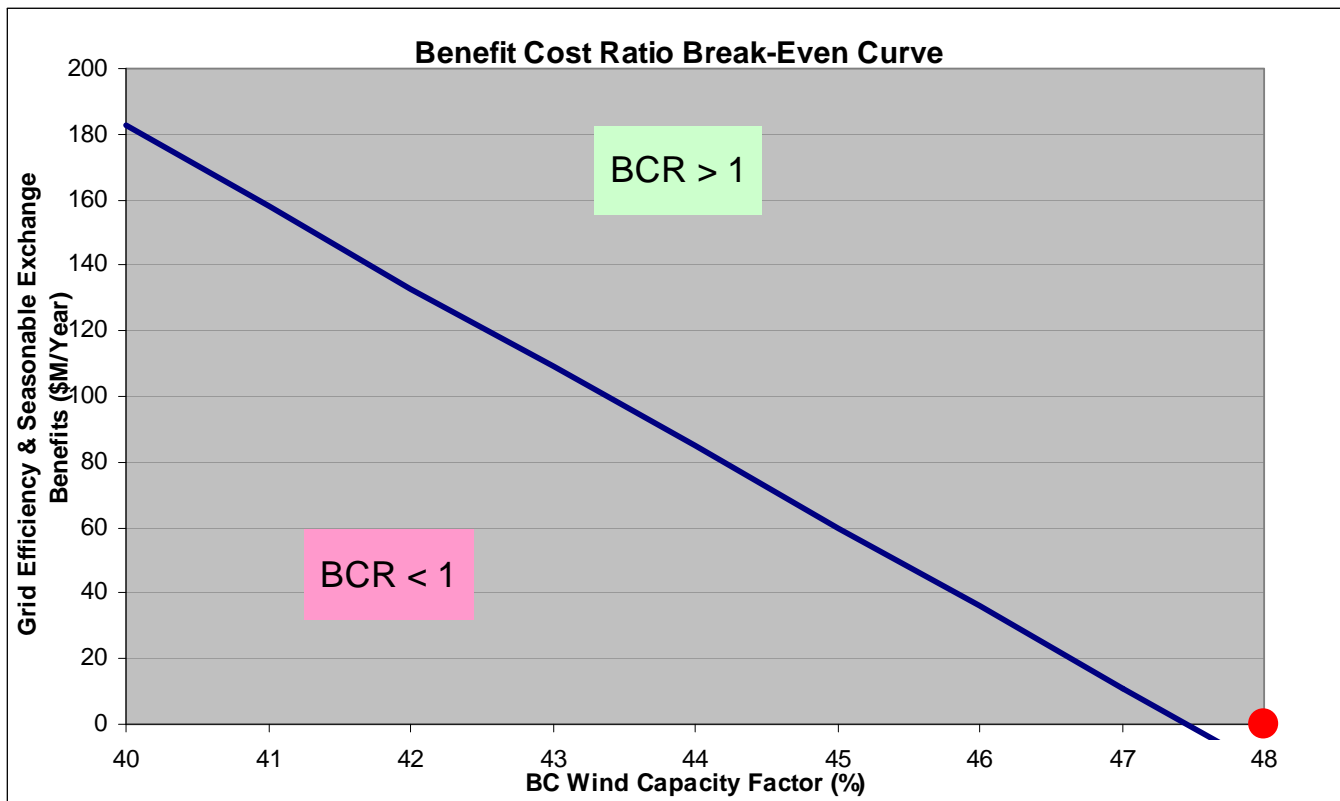
- Effect of Grid Efficiency and Seasonable Exchange Benefits

Case A4: BC Wind vs. CA Renewable Mix - Grid Efficiency & Seasonable Exchange



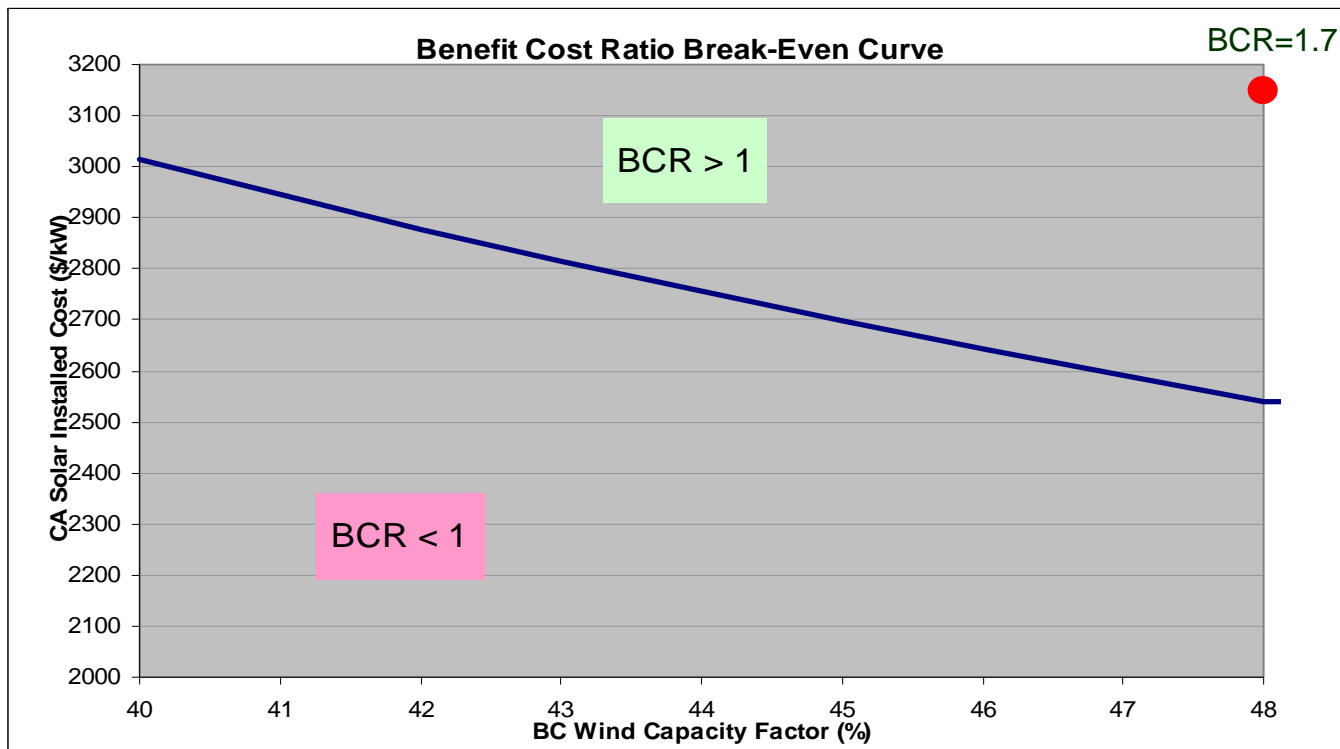
Case A4 Sensitivity: Two Variables

- BC Wind Capacity Factor vs. Grid Efficiency & Seasonal Exchange



Case A4 Sensitivity: Two Variables

- BC Wind Capacity Factor vs. CA Solar Installed Cost (100% Solar Mix)





Next Steps

- Validate, coordinate and cross-check reference case starting point assumptions with:
 - The Economic Analysis Committee members,
 - The Loads & Resources Committee, and
 - The Technical Analysis Committee.
- Draft and complete economic screening analysis report.



Opportunity!

- Still time for interested parties to join the Economic Committee.
- Contact Manho Yeung of PG&E at:
MXY6@PGE.Com