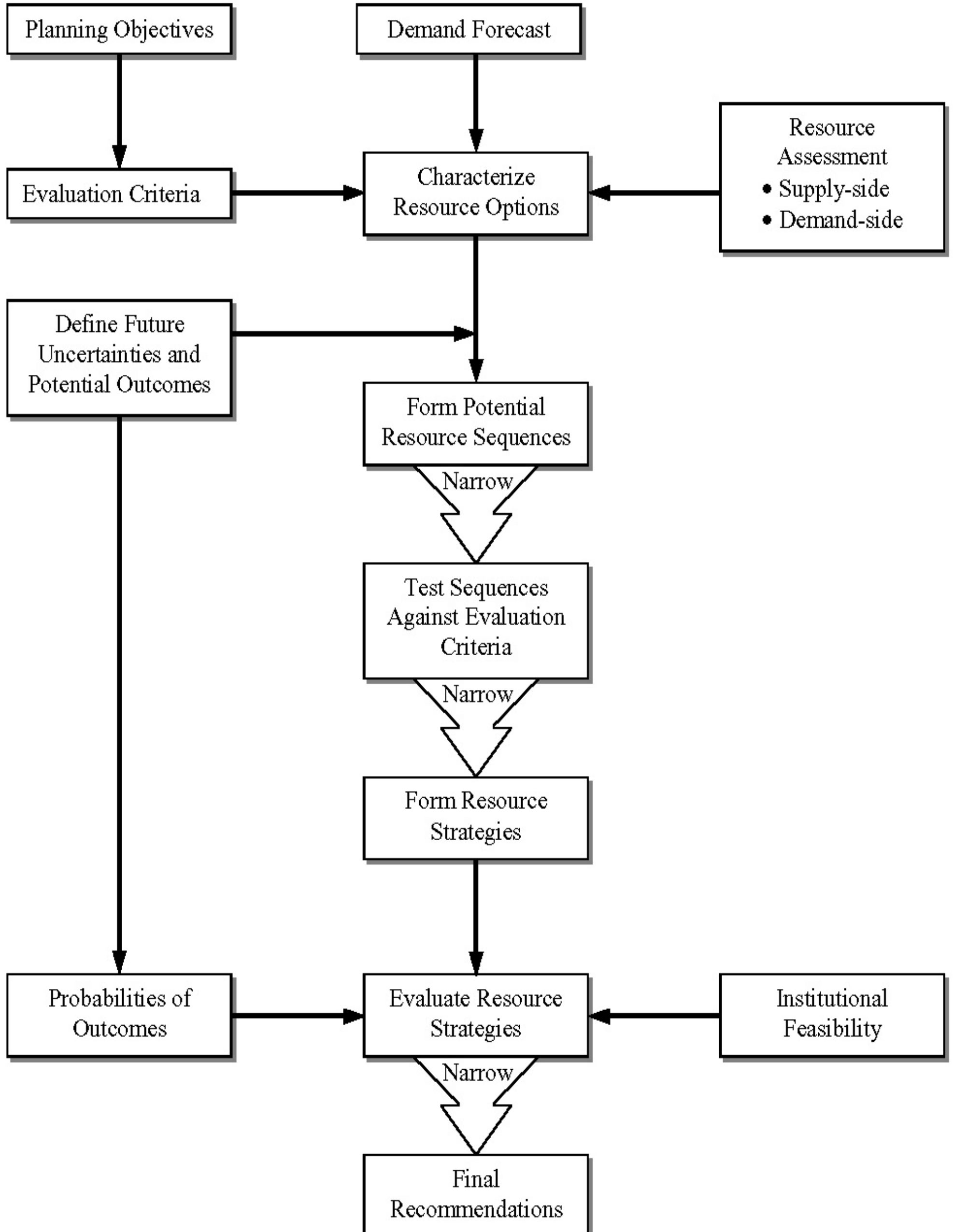
Maui County Water Use & Development Plan

Final Candidate Strategies Analysis Update

Water Advisory Committee Upcountry District

February 13, 2008

ELEMENTS OF AN IRP PROCESS



Current Status of Final Strategies Analysis Presentation

- Analysis is Ongoing. This is a Presentation of Consultant's Work In Progress.
- Work has not been reviewed by DWS, BWS, Council or Public.
- Findings Subject to Change Based on Comments and Further Analysis.
- Review is Welcome.

Upcountry District
Final Candidate Strategies

- A. Expansion of Raw Water Storage
- B. Full Basal Groundwater Backup
- C. Limited Growth with Extensive Conservation Measures
- D. Expanded Kamole Water Treatment Plant Capacity and Volume

Options Included in All Strategies

- Committed / Near Term Options
  - Pookela Well
  - Olinda WTP Upgrade
  - Piiholo Well
  - Kamole WTP Upgrade
- Phase 6 and Phase 10 Booster Upgrades

Options Considered for Each Strategy

- Demand Side Management Portfolio
  - Included in All Strategies
- Standard for Maintaining Drought Period Service Reliability
  - Development of Upcountry District Capacity Expansion Reliability Criteria
  - Alternate Standards Explored to Determine Cost of Reliability Improvements

Independent Components

- Supply Side Leak Reduction Measures
- Production Energy Efficiency Measures
- Energy Production Options
- Stream Restoration Measures
- Watershed Protection and Restoration

Independent Components

- Well Development Policies and Regulation
- Wellhead Protection Ordinance
- Landscape Ordinance
- Drought Period Water Use Restrictions
- Water Rate Design and Pricing Policies
  - Altitude Based Tariff
  - Summer / Winter Rates
  - Drought Period Surcharge

Well - Maluhia

New DWS Well at New Site
1400 GPM
w/Transmission from Kupaa
Derivation:
Capital Costs by HDA from DWS information using recent costs.
Exceptional expected escalation is accounted in substantial contingency allowance.
Operation costs by HDA.

Type	Basal Well
System	Central
Source	Groundwater
Location	North Waihee
Aquifer	Waihee (North)

	Year			Derivation
Earliest Online Date		**2010**		
Capacity (MGD)				
Installed Capacity			**2.016**	1400 GPM
Criteria Capacity			**1.344**	2/3 Installed Capacity
Effective Sustainable Capacity			**1.344**	2/3 Installed Capacity
Capital Costs ($2004)		Total	Per MGD	
Exploration, Land		$250,000	$186,012	
Drilling		$424,500	$315,848	$566 per foot per Kupaa
Transmission		$3,070,625	$2,284,691	9482 feet at $340 per foot based on Kupaa Transmision costs
Development		$1,000,000	$744,048	
			$0	
		$150,000	$111,607	
Contingencies		$2,447,563	$1,821,103	50% Contingency based on DWS Engineering estimates that costs would be much higher than $2002 basis
Total Plant Cost		$7,342,688	$5,463,309	
Expenditure Pattern	Year	Nom	Normalized	
	Serv Date	$2,447,563	33.3%	Contingency
	-1	$1,000,000	13.6%	Development, Storage
	-2	$3,495,125	47.6%	Transmission, Drilling
	-3	$400,000	5.4%	Exploration, Land, Engineering
	-4	$0	0.0%	
	-5	$0	0.0%	
	-6	$0	0.0%	
	-7	$0	0.0%	
	-8	$0	0.0%	
Const. Per. Esc. Rate (Nom.)		3.00%		
AFUDC Interest Rate (Nom.)		6.00%		
AFUDC Factor			1.037	
		Total	Per MGD	
Total Capitalized Cost		**$7,614,358**	$5,665,445	
Fixed Operating Costs ($2004)		Per Year	Per Y/MGD	
Dedicated Operating Labor		$0	$0	
Apportioned Operating Labor		$6,873	$5,114	Fixed labor derived from FY03 Central district costs from R.W.Beck Rate Study district cost analysis, apportioned by project volume. $0.014/kgal*1.344MGD*365.25.
Maintenance Labor		$0	$0	
Fixed Operating Costs		$0	$0	
Electrical Demand		$24,531	$18,252	5 Kwh/Kgal/Kft lift efficiency*derived sys demand cost factor*electrical energy cost*installed capacity
Chemicals/Materials		$0	$0	
Maintenance Expenses		$0	$0	
Amort. of Capitalized Rebuild Costs		$0	$0	
Total Fixed Op. Costs		**$31,403**	$23,365	
Variable Operating Costs ($2004)			Per KGal	
Vertical Lift		750		
Variable O&M			$0.000	
Electrical Energy			$0.973	5 Kwh/Kgal/kft lift efficiency * $.24 per Kwh 2006 energy cost * kft lift / VarOpCost EscRate ^ (2006-2004)
Chemicals/Materials			$0.005	DWS 2001 Average escalated to 2004
Maintenance Expenses			$0.000	
Total Variable Op. Costs			**$0.979**	

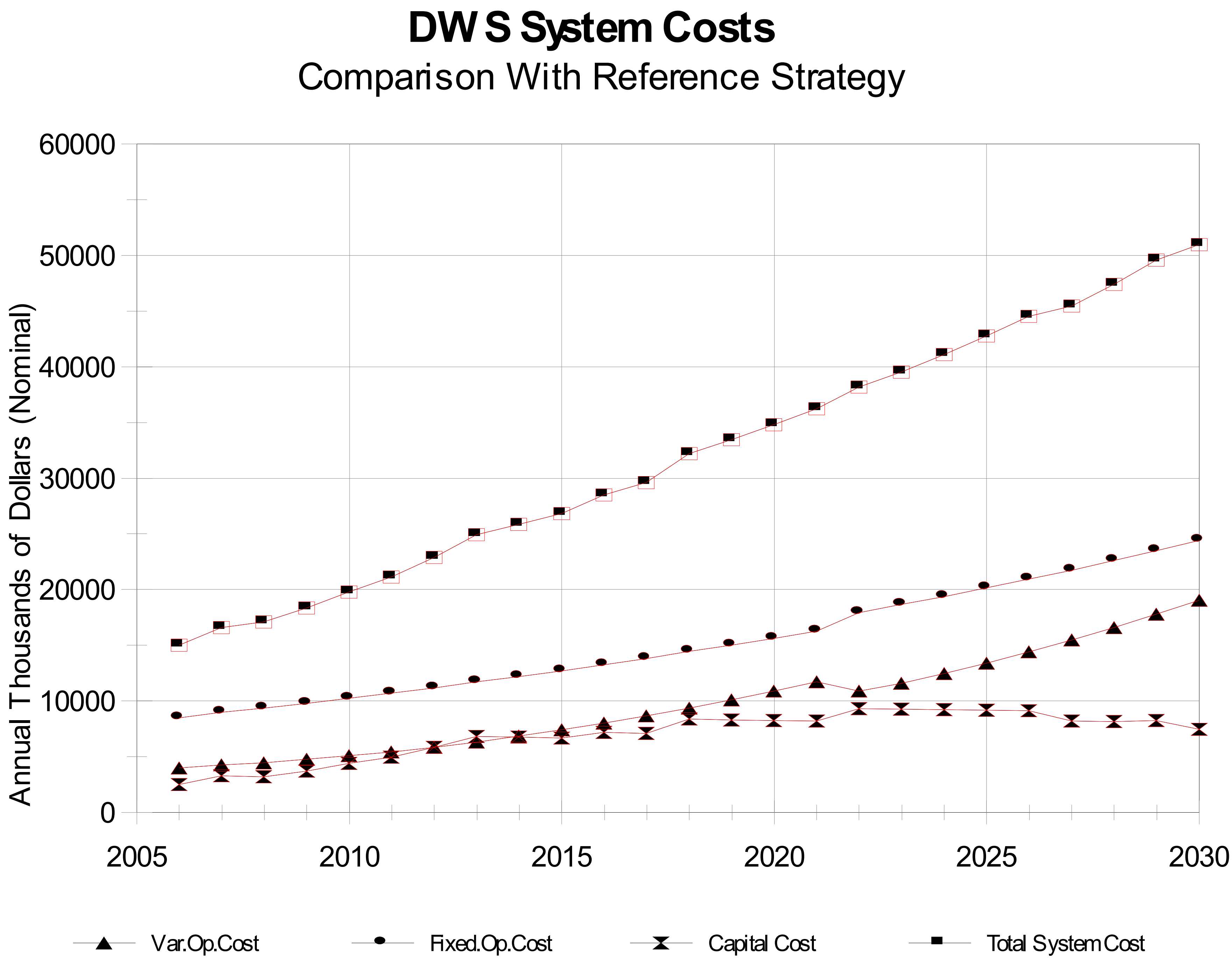
Reference Strategy

Average Years

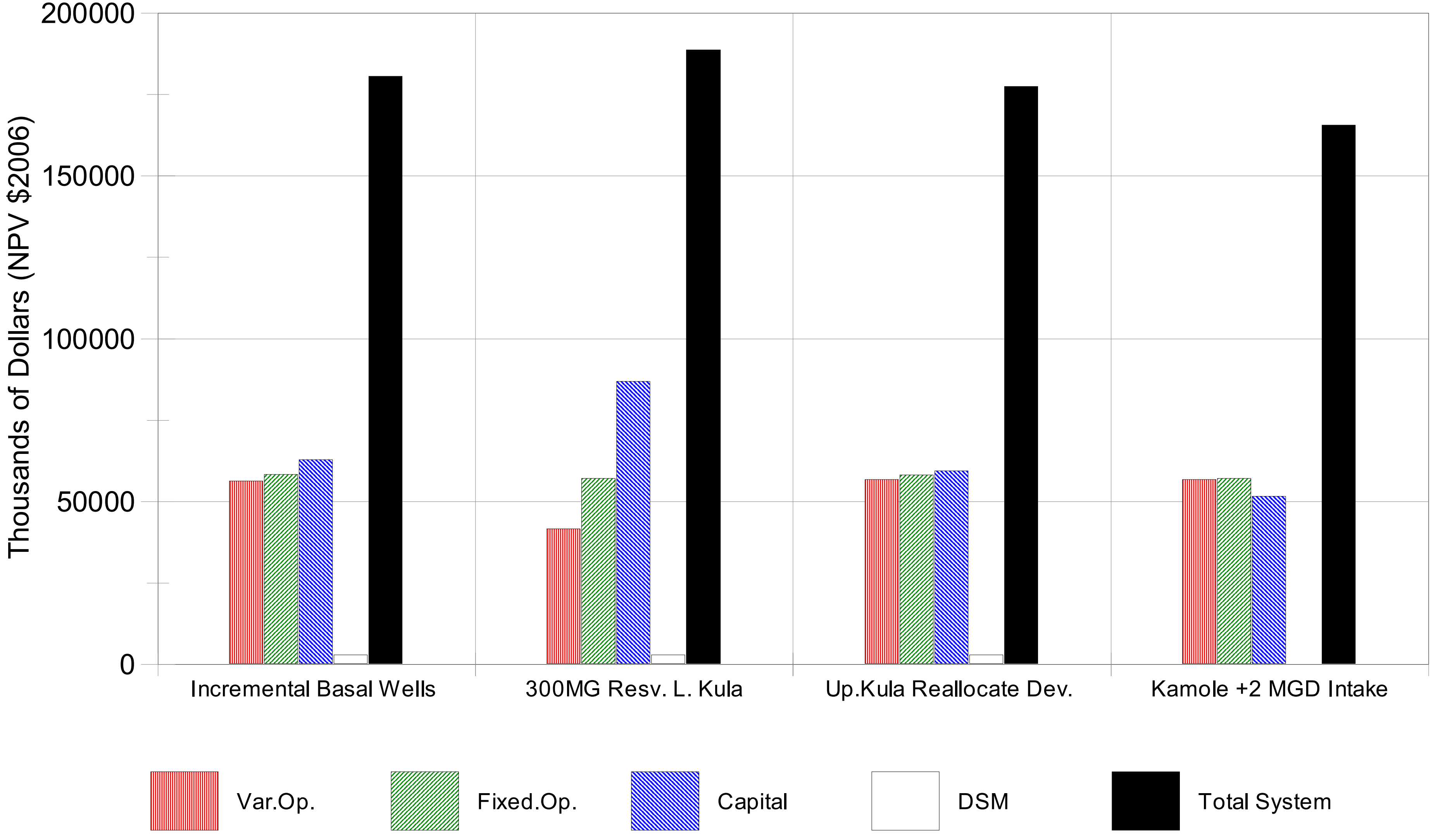
		Demand Subsys	Prod Subsys	Prod Export	Prod Net Req	Drop Import	Drop Export	Pump Import	Resid Unmet
Upper Kula System	2006	487,276	541,417		541,417		0	-103,417	0
	2010	549,447	610,497		610,497		0	0	0
	2020	630,291	700,323		700,323		0	0	0
	2030	747,236	830,263		830,263		0	-82,013	0
	SUM						0	-397,362	0
Lower Kula System	2006	776,591	862,879	103,417	966,297	0	420,703	0	0
	2010	824,090	915,656	0	915,656	0	471,344	0	0
	2020	871,886	968,763	0	968,763	0	418,237	0	0
	2030	941,403	1,046,003	82,013	1,128,016	0	258,984	0	0
	SUM			397,362		0	10,251,187	0	0
Makawao System	2006	794,328	882,586	0	882,586	-420,703	263,980	0	0
	2010	906,793	1,007,548	0	1,007,548	-471,344	343,714	0	0
	2020	1,008,291	1,120,324	0	1,120,324	-418,237	452,001	0	0
	2030	1,164,695	1,294,106	0	1,294,106	-258,984	547,500	0	0
	SUM			0		-10,251,187	10,790,374	0	0
Haiku System	2006	404,131	449,035	0	449,035	-263,980	0	0	0
	2010	475,892	528,769	0	528,769	-343,714	0	0	0
	2020	573,351	637,056	0	637,056	-452,001	0	0	0
	2030	716,612	796,235	0	796,235	-547,500	0	0	0
	SUM			0		-10,790,374	0	0	0
Upcountry Total	2006	2,462,326	2,735,918	103,417	2,839,335	-684,683	684,683	-103,417	0
	2010	2,756,223	3,062,470	0	3,062,470	-815,059	815,059	0	0
	2020	3,083,819	3,426,466	0	3,426,466	-870,238	870,238	0	0
	2030	3,569,946	3,966,607	82,013	4,048,620	-806,484	806,484	-82,013	0
	SUM			397,362		-21,041,561	21,041,561	397,362	0

Drought Years

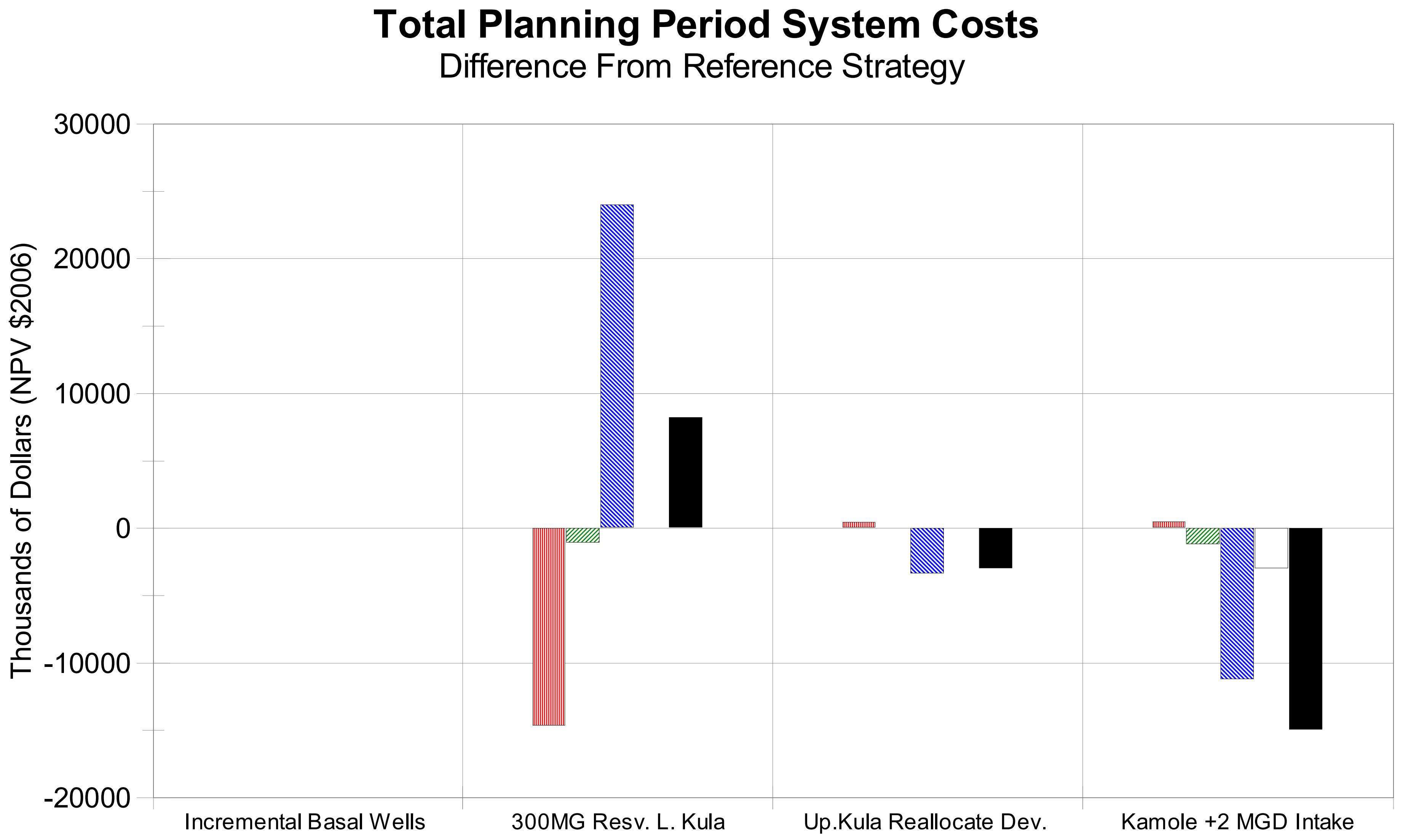
		Demand Subsys	Prod Subsys	Prod Export	Prod Net Req	Drop Import	Drop Export	Pump Import	Resid Unmet
Upper Kula System	2006	528,891	587,657		587,657		0	-222,657	0
	2010	596,372	662,636		662,636		0	-224,636	0
	2020	684,121	760,134		760,134		0	-322,134	0
	2030	811,054	901,171		901,171		0	-463,171	0
	SUM						0	-7,794,400	0
Lower Kula System	2006	842,916	936,573	222,657	1,159,230	0	0	-327,030	0
	2010	894,471	993,857	224,636	1,218,493	0	0	-386,293	0
	2020	946,349	1,051,499	322,134	1,373,633	0	0	-541,433	0
	2030	1,021,803	1,135,337	463,171	1,598,508	0	0	-766,308	0
	SUM			7,794,400		0	0	-13,067,819	0
Makawao System	2006	862,167	957,963	327,030	1,284,993	0	263,980	0	0
	2010	984,238	1,093,597	386,293	1,479,890	0	162,610	0	0
	2020	1,094,404	1,216,004	541,433	1,757,438	0	73,272	0	0
	2030	1,264,165	1,404,628	766,308	2,170,936	0	0	-163,436	0
	SUM			13,067,819		0	1,571,802	0	0
Haiku System	2006	405,378	450,420	0	450,420	-263,980	0	0	0
	2010	477,361	530,401	0	530,401	-162,610	0	0	0
	2020	575,120	639,022	0	639,022	0	0	-73,272	0
	2030	718,823	798,692	0	798,692	0	163,436	0	0
	SUM			0		-1,571,802	0	0	0
Upcountry Total	2006	2,639,352	2,932,613	549,687	3,482,300	-263,980	263,980	-549,687	0
	2010	2,952,442	3,280,491	610,929	3,891,420	-162,610	162,610	-610,929	0
	2020	3,299,994	3,666,660	863,568	4,530,227	0	73,272	-936,839	0
	2030	3,815,845	4,239,828	1,229,478	5,469,307	0	163,436	-1,392,914	0
	SUM			20,862,219		-1,571,802	1,571,802	-20,862,219	0


DW S System Costs
Comparison With Reference Strategy
Annual Thousands of Dollars (Nominal)
60000
50000
40000
30000
20000
10000
0
2005
2010
2015
2020
2025
2030
Var.Op.Cost
Fixed.Op.Cost
Capital Cost
Total System Cost

Total Planning Period System Costs



Comparison of Upcountry Candidate Strategies



Comparison of Upcountry Candidate Strategies

DWS UPCOUNTRY SYSTEM CANDIDATE STRATEGIES	Planning Objectives														
	Availability	Cost	Efficiency	Environment	Equity	Sustainablility	Quality	Reliability	Streams	Resources	Culture	DHHL	Agriculture	Conformity	Viability
	MGD	$ / kgal	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -
	Average	20YR Lev.													
CANDIDATE STRATEGY COMPONENTS															
EXPANDED STREAM WATER DIVERSION	+							+	?			+	+		
IMPROVED COLLECTION SYSTEM EFFICIENCY	+		+					+				+	+	?	
INCREASED SURFACE STORAGE RESERVOIRS	+							+				+	+		
HAIKU SYSTEM BASAL WELL DEVELOPMENT	+							+				+	+	?	
MAKAWAO SYSTEM BASAL WELL DEVELOPMEN	+							+				+	+	?	
DEMAND SIDE MANAGEMENT PROGRAMS	+	+	+	+		+		+				+	+		
AWALAU TREATMENT PLANT	+							+				+	? / -		
INTERCONNECTION WITH CENTRAL SYSTEM	?	-	-					+					?	?	
INDEPENDENT STRATEGY COMPONENTS															
SUPPLY SIDE LEAK REDUCTION	+	+	+												
ENERGY PRODUCTION AND EFFICIENCY MEASU		+	+												
STREAM RESTORATION MEASURES		-		+		+	+		+	+	+		+ / -		
WATERSHED PROTECTION AND RESTORATION	+			+		+	+		+	+	+		+		
WELL DEVELOPMENT POLICIES AND REGULATI				+	+	+	+			+					
WELLHEAD PROTECTION ORDINANCE				+	?	+	+		+	+					
LANDSCAPE ORDINANCE	+	+	+					+	+	+					
DROUGHT WATER USE RESTRICTIONS	-	+											+ / -		
WATER RATE DESIGN AND PRICING POLICIES			+										+		

Demand Side Management Program Analysis

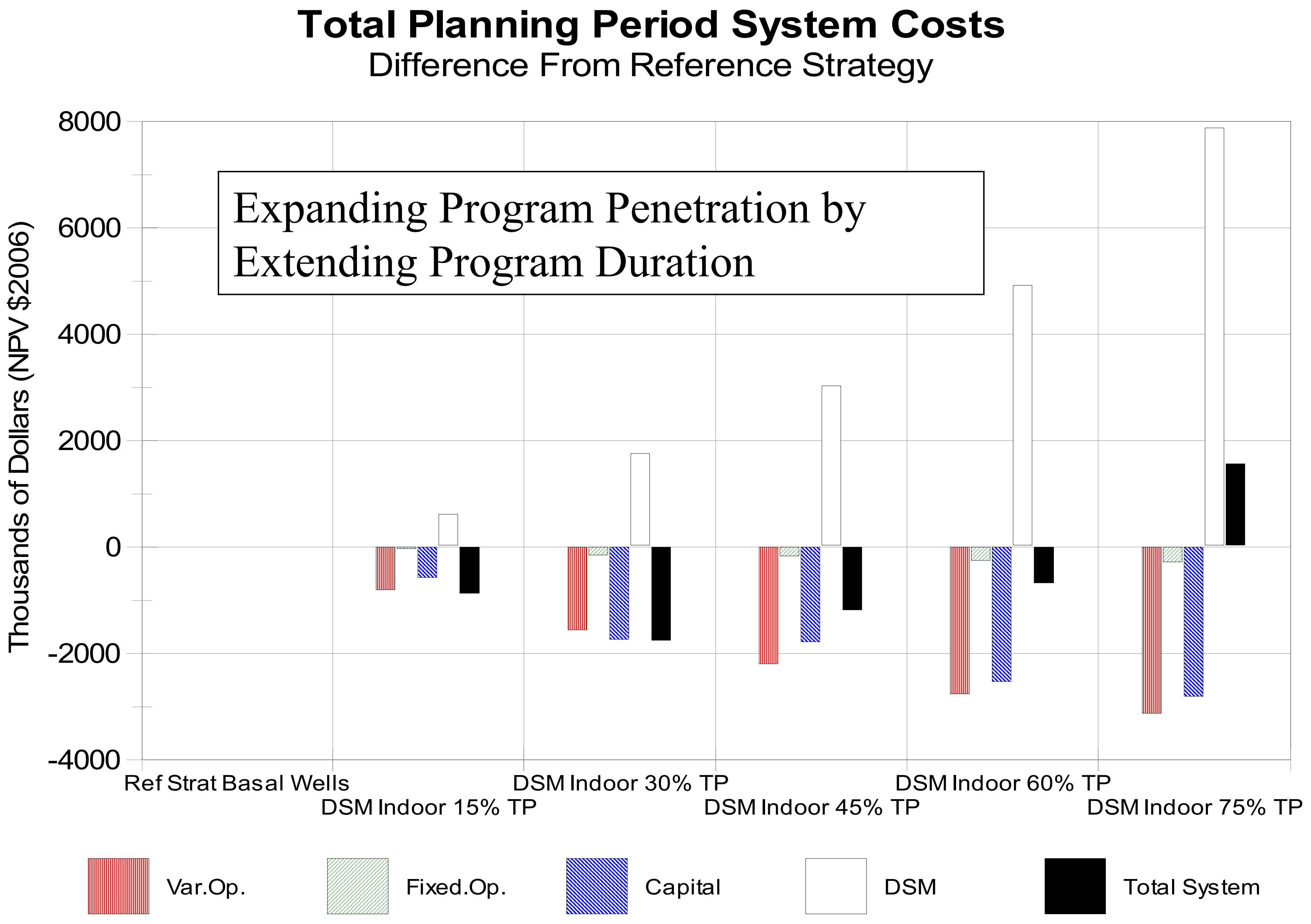
- What programs can the County implement to encourage customers to use energy efficiently?
- How effective will the programs be as a “resource” to meet future water needs?
- Are the programs cost effective?

Demand Side Management Program Analysis

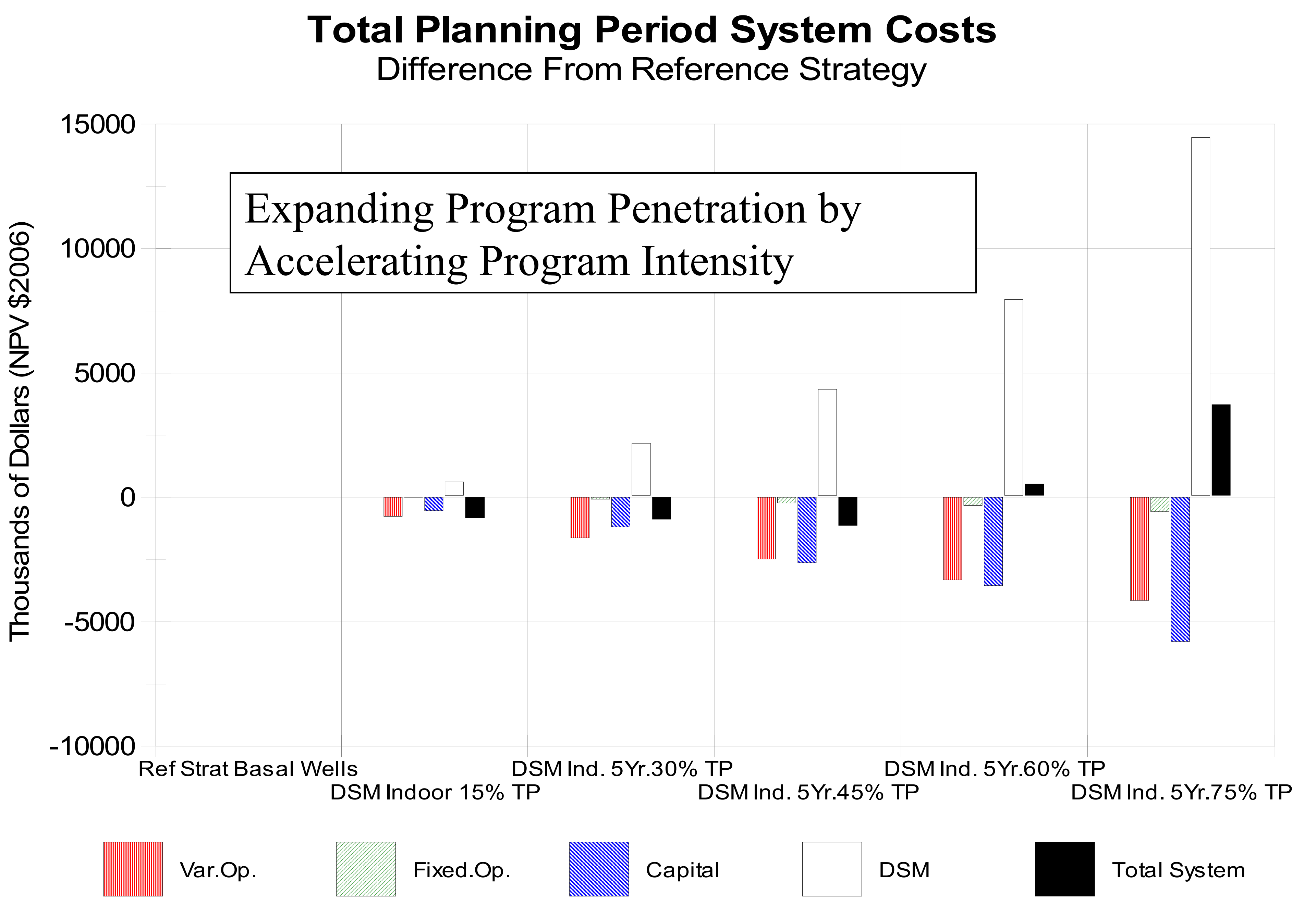
- One Indoor DSM Program Currently Characterized for Upcountry District
- One Indoor and one Outdoor Program Characterized for the Central District
- Programs are Analyzed Using an Integrated Capacity Expansion and Production Cost Model
- Characterization is Prospective for Analysis

Demand Side Management Program Analysis

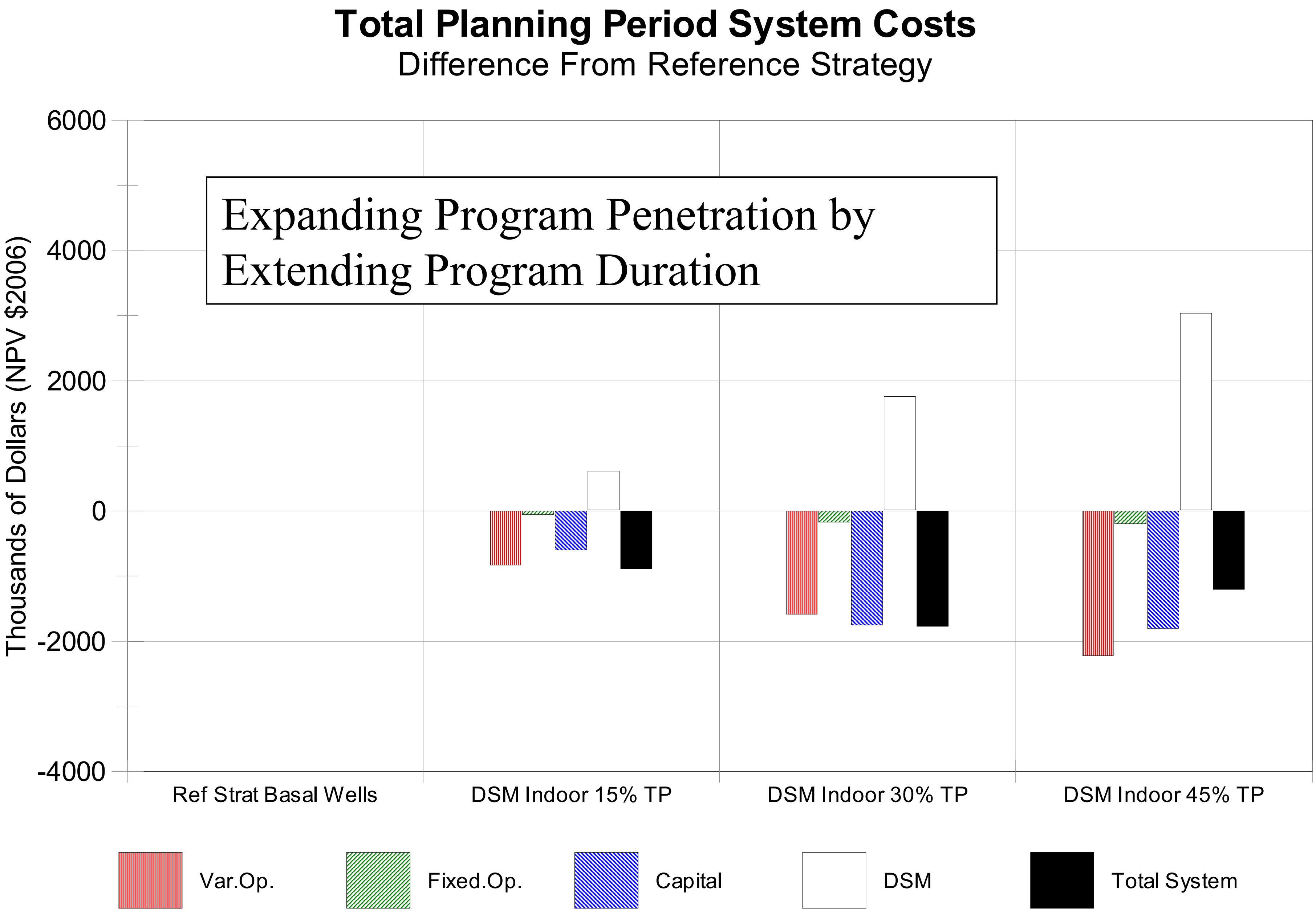
- Indoor DSM Program for the Upcountry District
  - Direct Installation Program for Residences
  - Installation of Low-Flow Toilets, Showerheads and Faucet Restrictors
  - Five Year Program Costs $162,000/Year and Reduces Consumption by 25,970 GPD/Year
  - Alternative Program Durations and Intensities Characterized and Analyzed

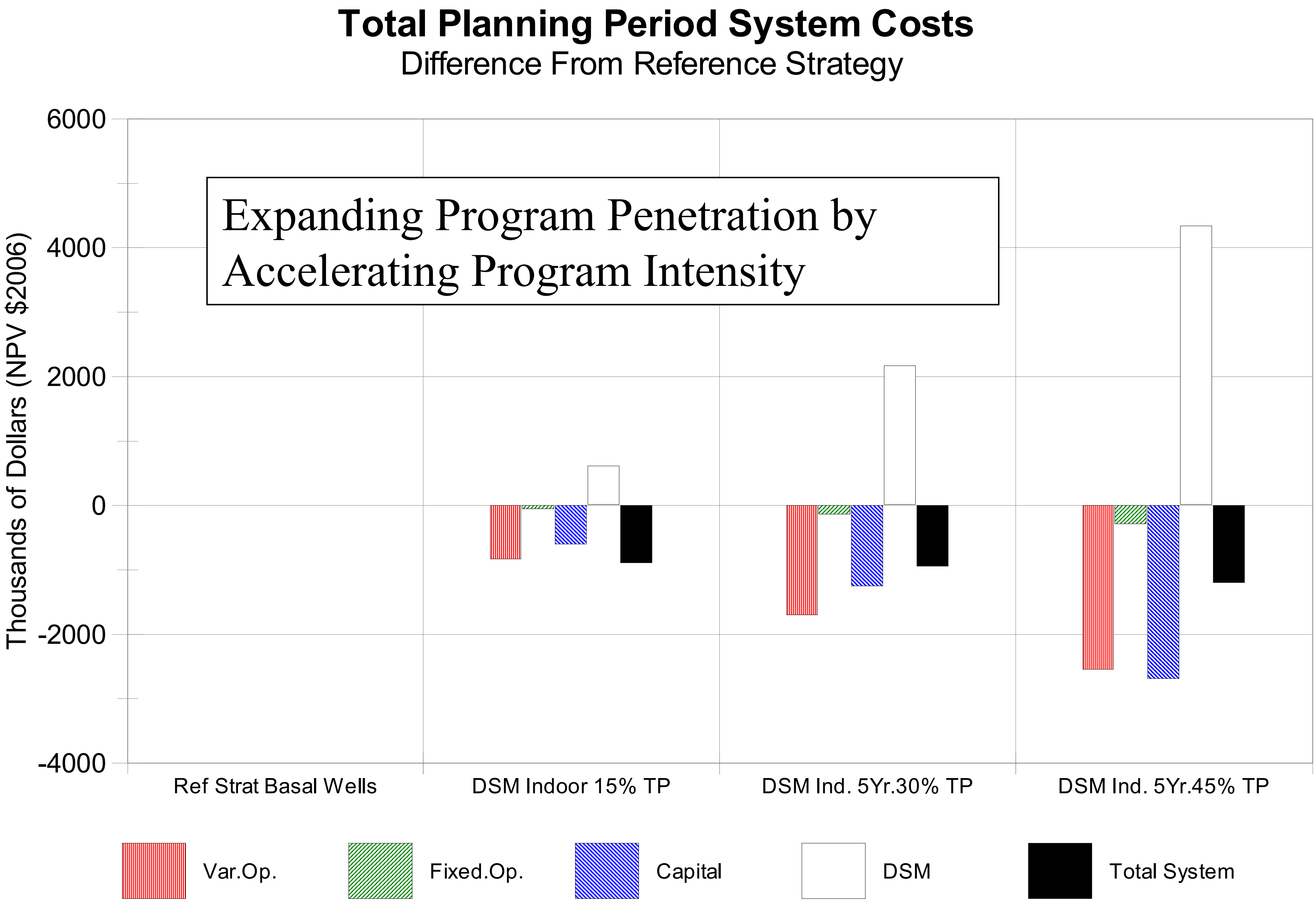


Total Planning Period System Costs
Difference From Reference Strategy
Expanding Program Penetration by
Extending Program Duration
Thousands of Dollars (NPV $2006)
8000
6000
4000
2000
0
-2000
-4000
Ref Strat Basal Wells
DSM Indoor 15% TP
DSM Indoor 30% TP
DSM Indoor 45% TP
DSM Indoor 60% TP
DSM Indoor 75% TP
Var.Op.
Fixed.Op.
Capital
DSM
Total System



Total Planning Period System Costs
Difference From Reference Strategy
Expanding Program Penetration by
Accelerating Program Intensity
15000
10000
5000
0
-5000
-10000
Thousands of Dollars (NPV $2006)
Ref Strat Basal Wells
DSM Indoor 15% TP
DSM Ind. 5Yr.30% TP
DSM Ind. 5Yr.45% TP
DSM Ind. 5Yr.60% TP
DSM Ind. 5Yr.75% TP
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Difference From Reference Strategy
Expanding Program Penetration by
Extending Program Duration
Thousands of Dollars (NPV $2006)
6000
4000
2000
0
-2000
-4000
Ref Strat Basal Wells
DSM Indoor 15% TP
DSM Indoor 30% TP
DSM Indoor 45% TP
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Difference From Reference Strategy
Expanding Program Penetration by Accelerating Program Intensity
Thousands of Dollars (NPV $2006)
6000
4000
2000
0
-2000
-4000
Ref Strat Basal Wells
DSM Indoor 15% TP
DSM Ind. 5Yr.30% TP
DSM Ind. 5Yr.45% TP
Var.Op.
Fixed.Op.
Capital
DSM
Total System

Demand Side Management Program Analysis

- Conclusions:
  - DSM programs can be an effective and cost-effective resource to meet future Upcountry District water needs.
  - Prospective characterization and analysis of programs am designs is necessary

Demand Side Management Program Analysis

- Conclusions:
  - DSM programs can be an effective and cost-effective resource to meet future Upcountry District water needs.
  - Review of program characterization and refinement of program designs is necessary

Demand Side Management Program Analysis

- DSM Program Design Consultant is Being Retained
  - Review of Existing Characterization of DSM Programs in Central and Upcountry Analysis
  - Recommend Additional Program Designs
    - Commercial Users
    - Agricultural Users
    - Outdoor Program for Upcountry

A. Expansion of Raw Water Storage

Addition of substantial additional raw water storage for the Upper Kula, Lower Kula and/or Makawao systems.

A. Expansion of Raw Water Storage Variations / Analysis Issues

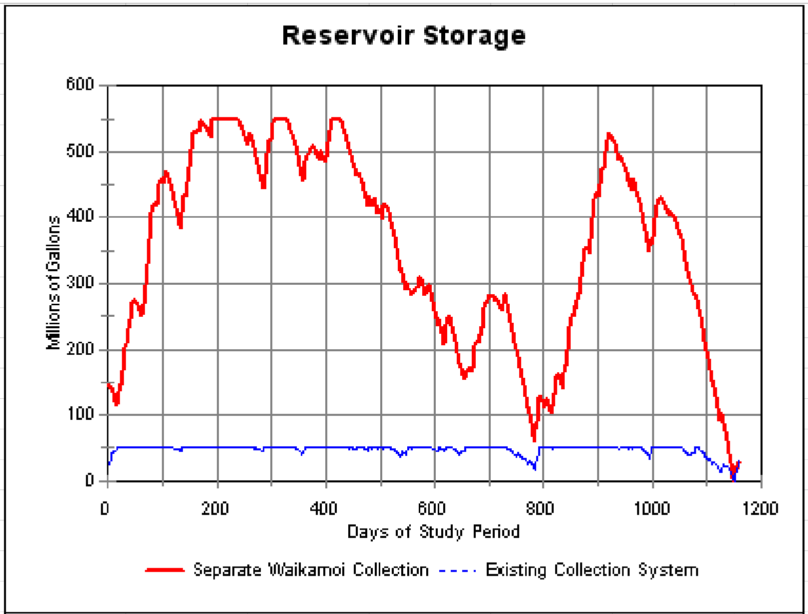
- Reservoir Size – Target System Reliability
- Water System
  - Upper Kula, Lower Kula or Makawao Systems
- Reservoir Operation Objectives
  - Maximize Drought Reliability
  - Optimize Operation Economics
- Financing Alternatives

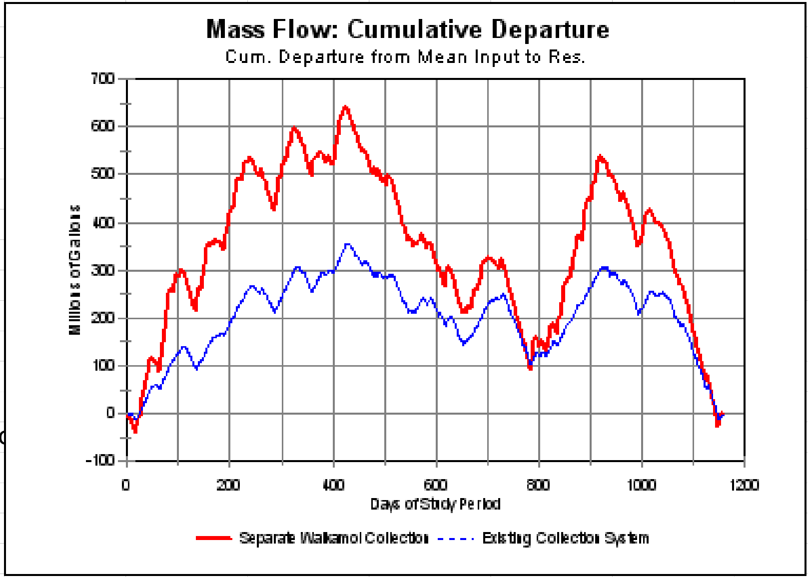
Reservoir Mass Flow Analysis

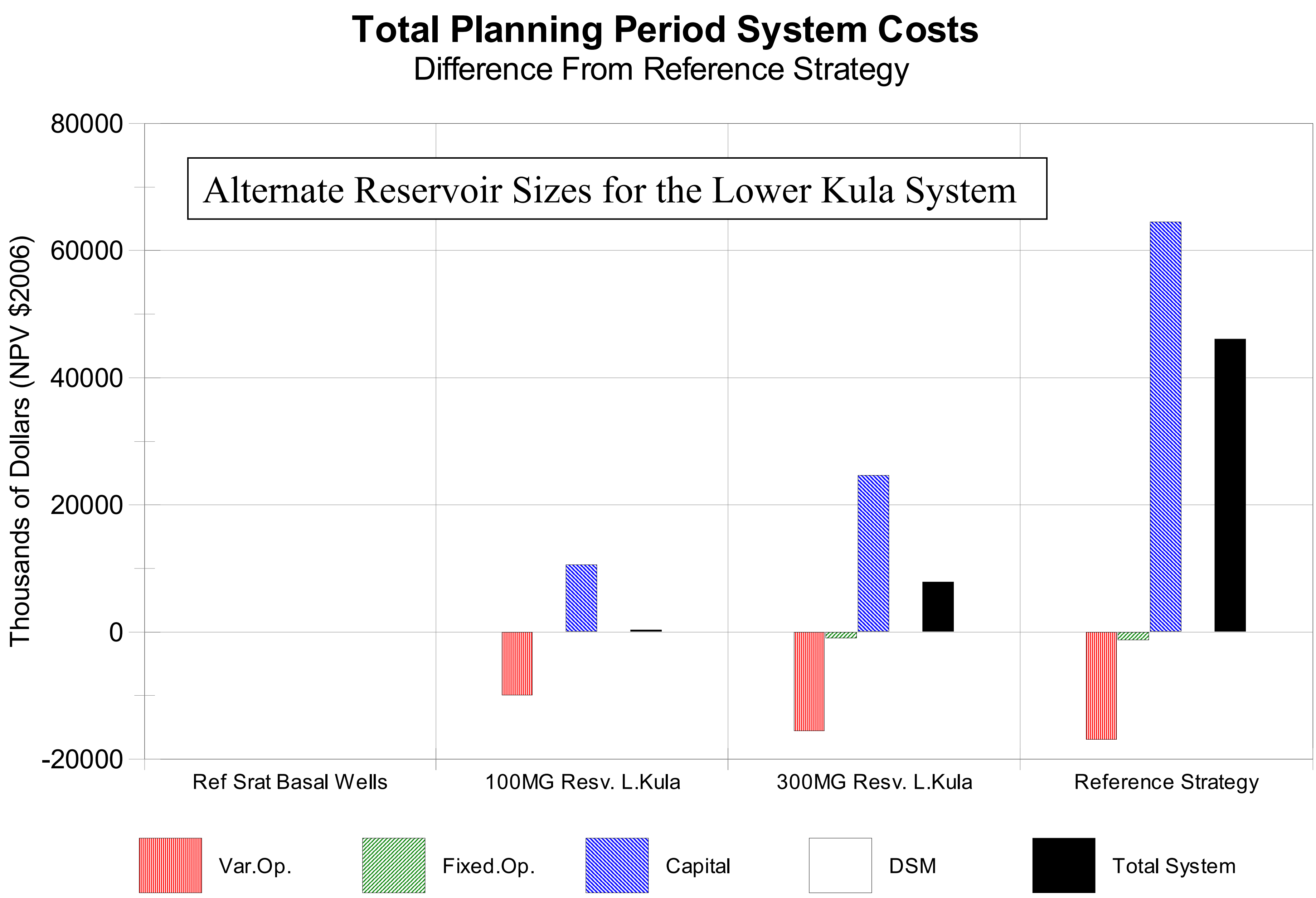
	Separate Waikamoi Collection	Original Config.	
Input Data			
Reservoir Capacity	550	50	MG
Average Demand (Res. Output)	6.439	2.930	MGD
Max Stream Diversion			
Honomanu	2.000	2.000	MGD
Haipuaena	2.000	2.000	MGD
Puohokamoa E	2.000	2.000	MGD
Puohokamoa M	2.000	2.000	MGD
Puohokamoa W	2.000	2.000	MGD
Waikamoi	6.000	2.000	MGD
Waikamoi E	6.000	2.000	MGD
Max Collection Capacity	4.700	7.500	MGD
Reservoir Starting Volume	150	25	MG
Output Data			
Average Streamflow	20.975	20.975	MGD
Average Input to Reservoir	6.600	5.117	MGD
Reservoir Full Days	76	805	# Days
Reservoir Empty Days	0	0	# Days
Reservoir Spill Days	76	805	# Days

This analysis assumes no contribution from the Kailua stream(s)
Calculations are based on the Mink and Yuen spreadsheet columns A thru AM
Calculations consider constraints on total contribution to collection system
This calculation accounts for limit of 4.7 MGD on E.Puoho... to Waikamoi Collection line.

Separate collection for Waikamoi streams appears to provide about 450,000 GPD additi
With no empty reservoir days
With all stream diversion limits at 2.0 MGD






Total Planning Period System Costs
Difference From Reference Strategy
Alternate Reservoir Sizes for the Lower Kula System
Thousands of Dollars (NPV $2006)
80000
60000
40000
20000
0
-20000
Ref Srat Basal Wells
100MG Resv. L.Kula
300MG Resv. L.Kula
Reference Strategy
Var.Op.
Fixed.Op.
Capital
DSM
Total System

Resource Additions

Reference Strategy		**100 MG Resv. L.Kula**	
Ph 10 Boost Add.	2009	Ph 10 Boost Add.	2009
Phase 6 Boost Add.	2009	Phase 6 Boost Add.	2009
Ph 10 Boost Add#2	2011	Well 1300 ft Kokomo	2011
Well 1600' (Mak)	2011	100 MG Reservoir	2011
Well 1600' (Mak)	2011	Phase 6 #2 Boost Add.	2014
Phase 6 #2 Boost Add.	2014	Well 1600' (Mak)	2017
Well 1300 ft Kokomo	2017	Well 1600' (Mak)	2024
Well 1600' (Mak)	2022	Ph 10 Boost Add#2	2026
Well Supp. (Mak)	2027	Additional Well	2029
Ph 10 3rd Upgrade	2029		

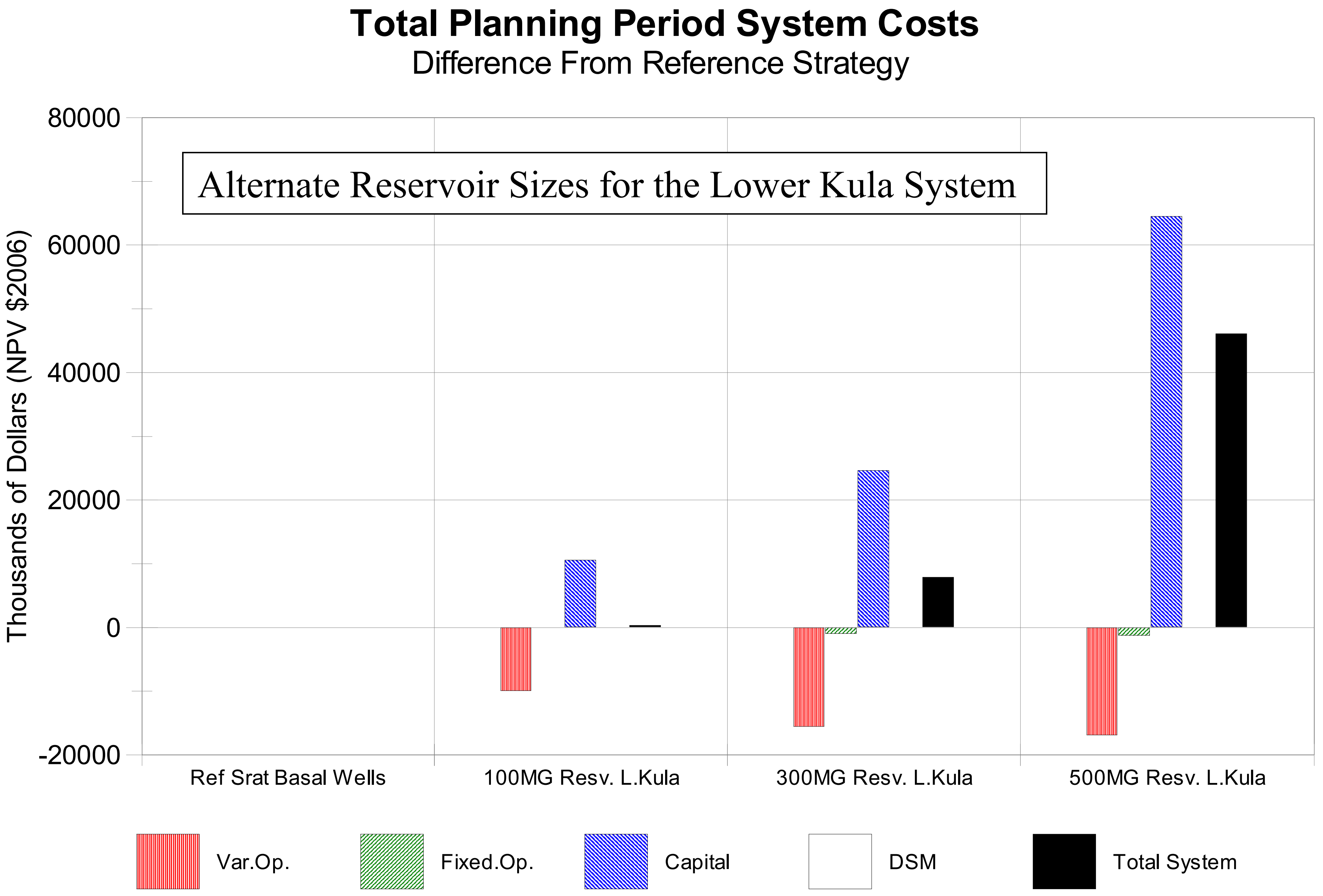
Resource Additions

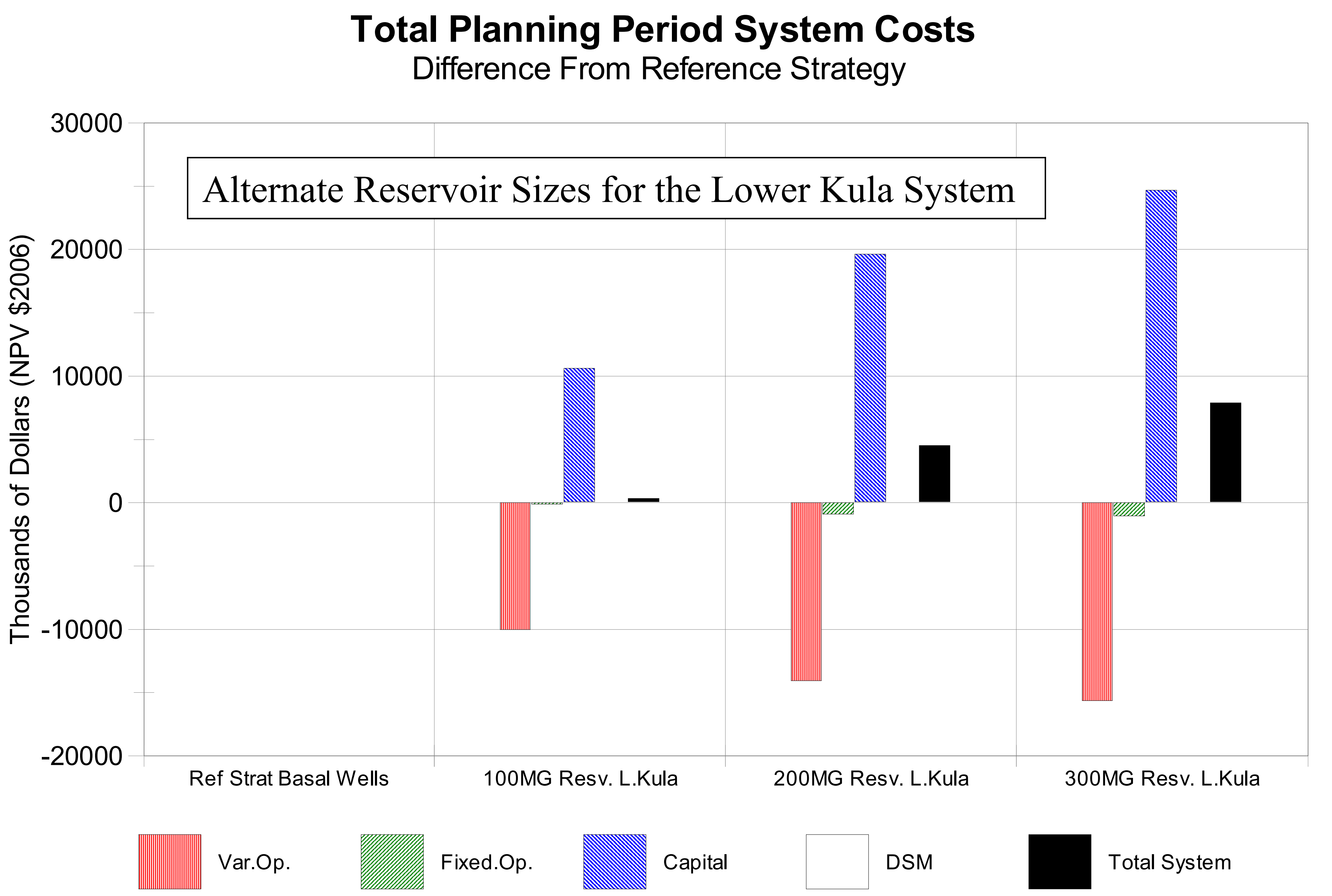
300 MG Resv. L.Kula

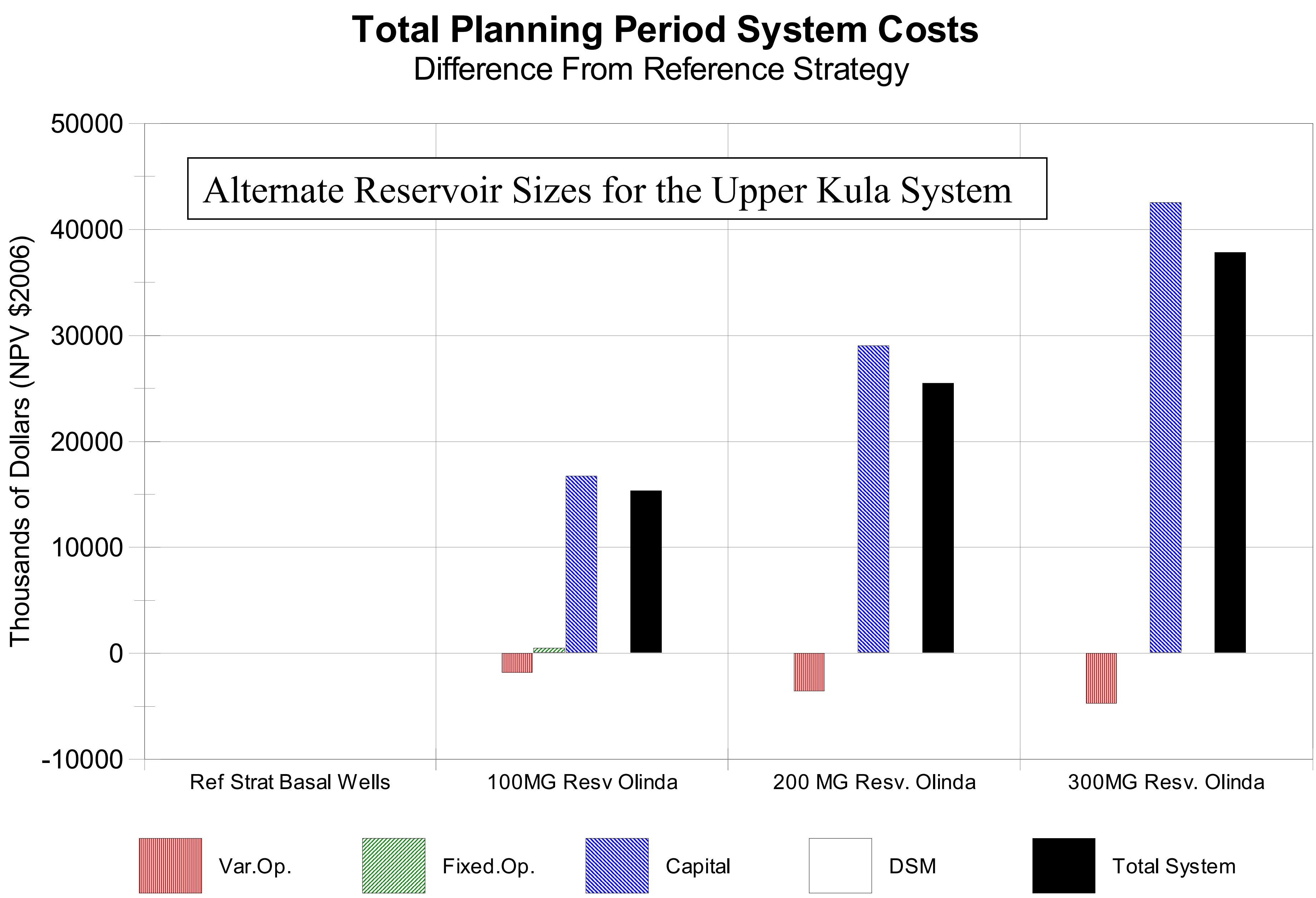
Ph 10 Boost Add.	2009
Phase 6 Boost Add.	2009
300 MG Reservoir	2011
Phase 6 #2 Boost Add.	2014
Well 1300 ft Kokomo	2022
Well 1600' (Mak)	2027

500 MG Resv. L.Kula

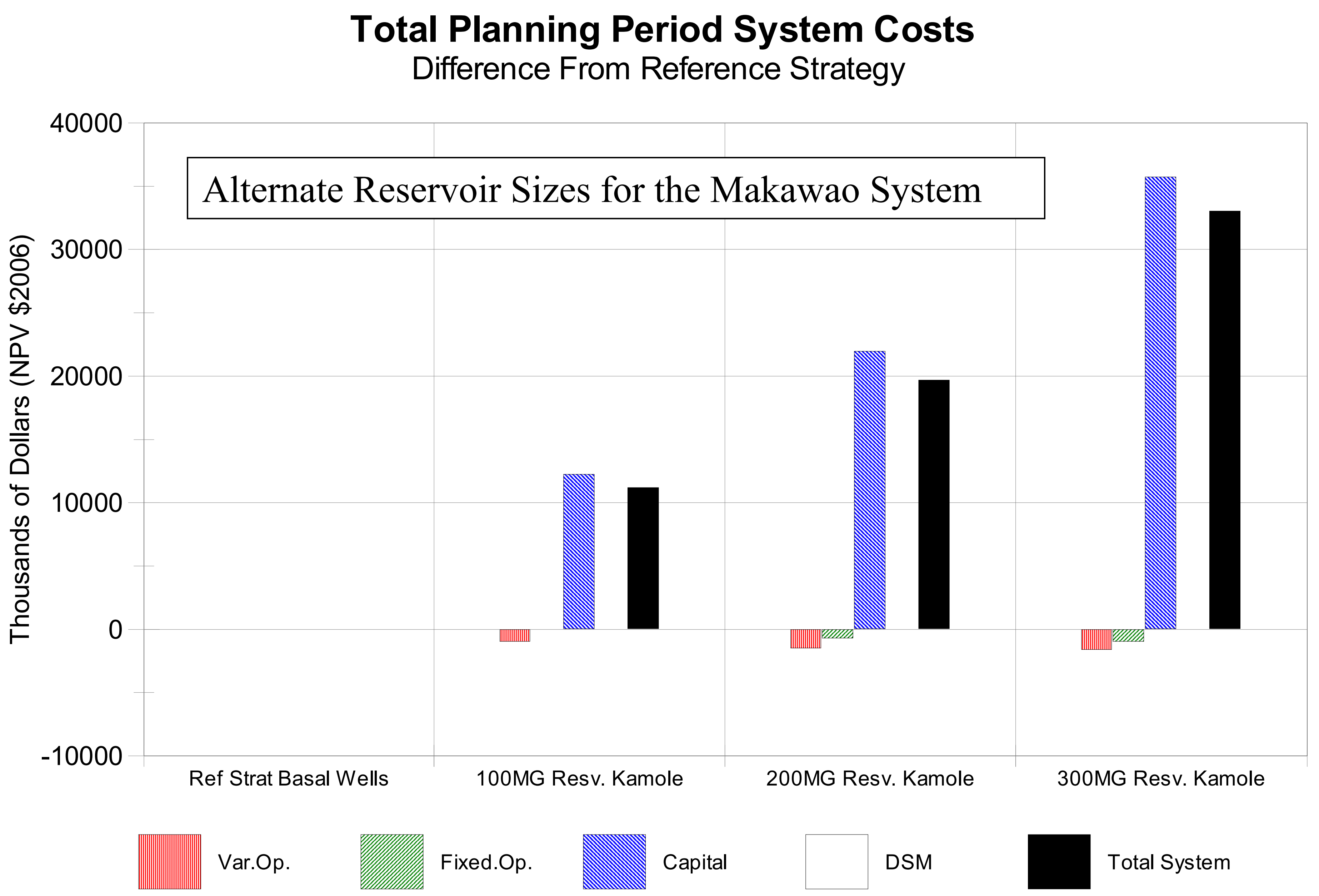
Ph 10 Boost Add.	2009
Phase 6 Boost Add.	2009
500 MG Reservoir	2011
Phase 6 #2 Boost Add.	2014
Supplemental Mak	2028


Total Planning Period System Costs
Difference From Reference Strategy
Alternate Reservoir Sizes for the Lower Kula System
Thousands of Dollars (NPV $2006)
80000
60000
40000
20000
0
-20000
Ref Srat Basal Wells
100MG Resv. L.Kula
300MG Resv. L.Kula
500MG Resv. L.Kula
Var.Op.
Fixed.Op.
Capital
DSM
Total System

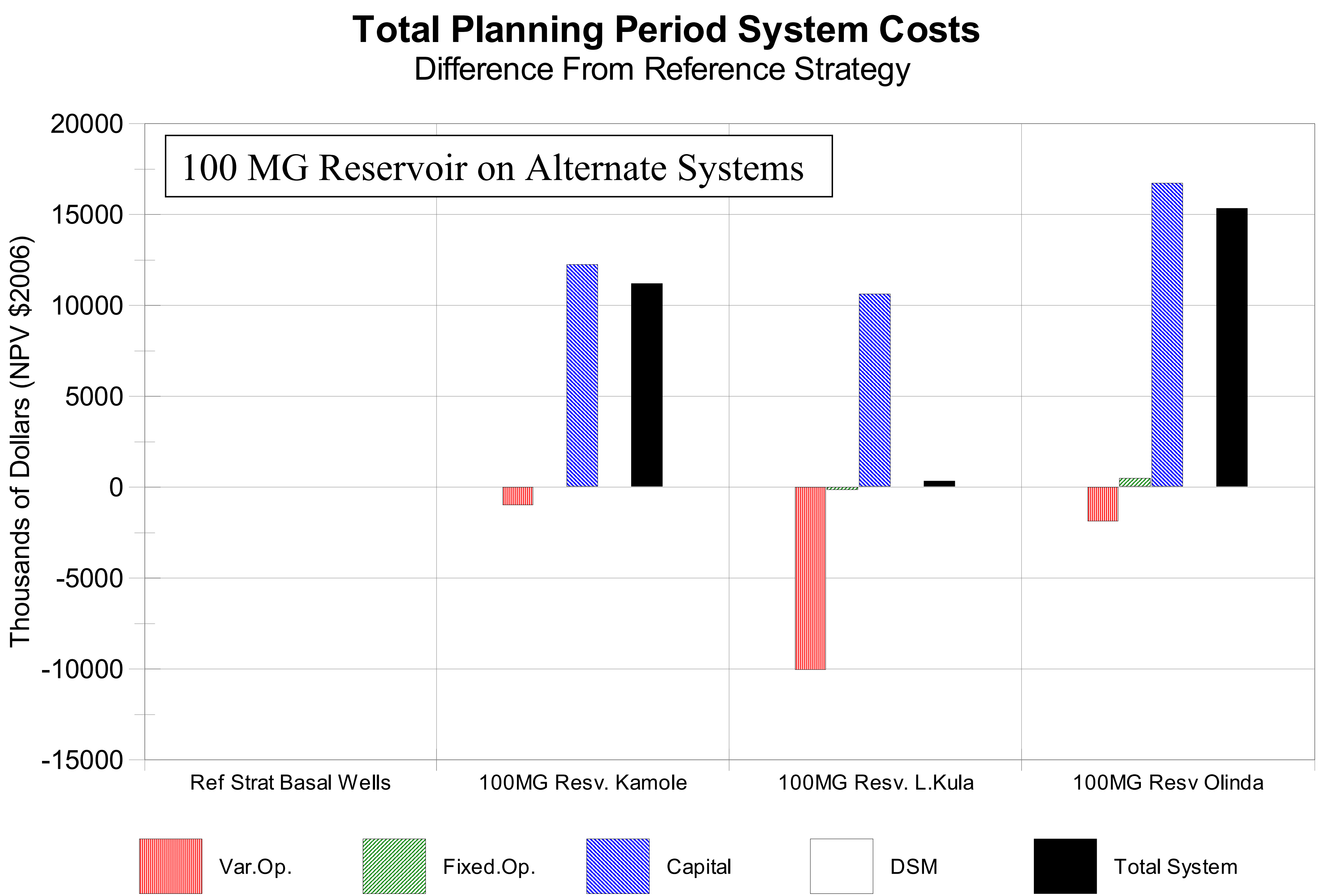

Total Planning Period System Costs
Difference From Reference Strategy
Alternate Reservoir Sizes for the Lower Kula System
Thousands of Dollars (NPV $2006)
30000
20000
10000
0
-10000
-20000
Ref Strat Basal Wells
100MG Resv. L.Kula
200MG Resv. L.Kula
300MG Resv. L.Kula
Var.Op.
Fixed.Op.
Capital
DSM
Total System

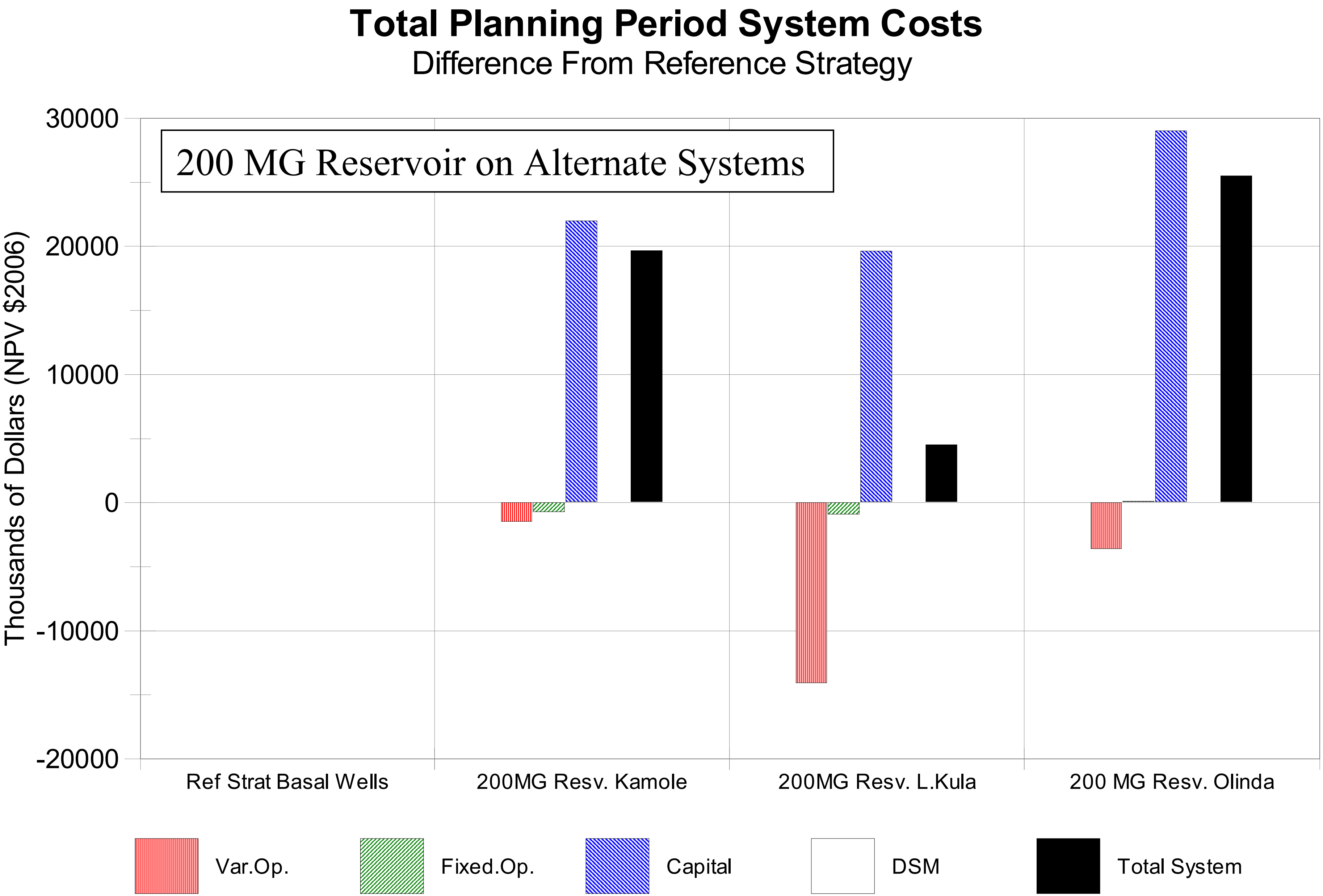


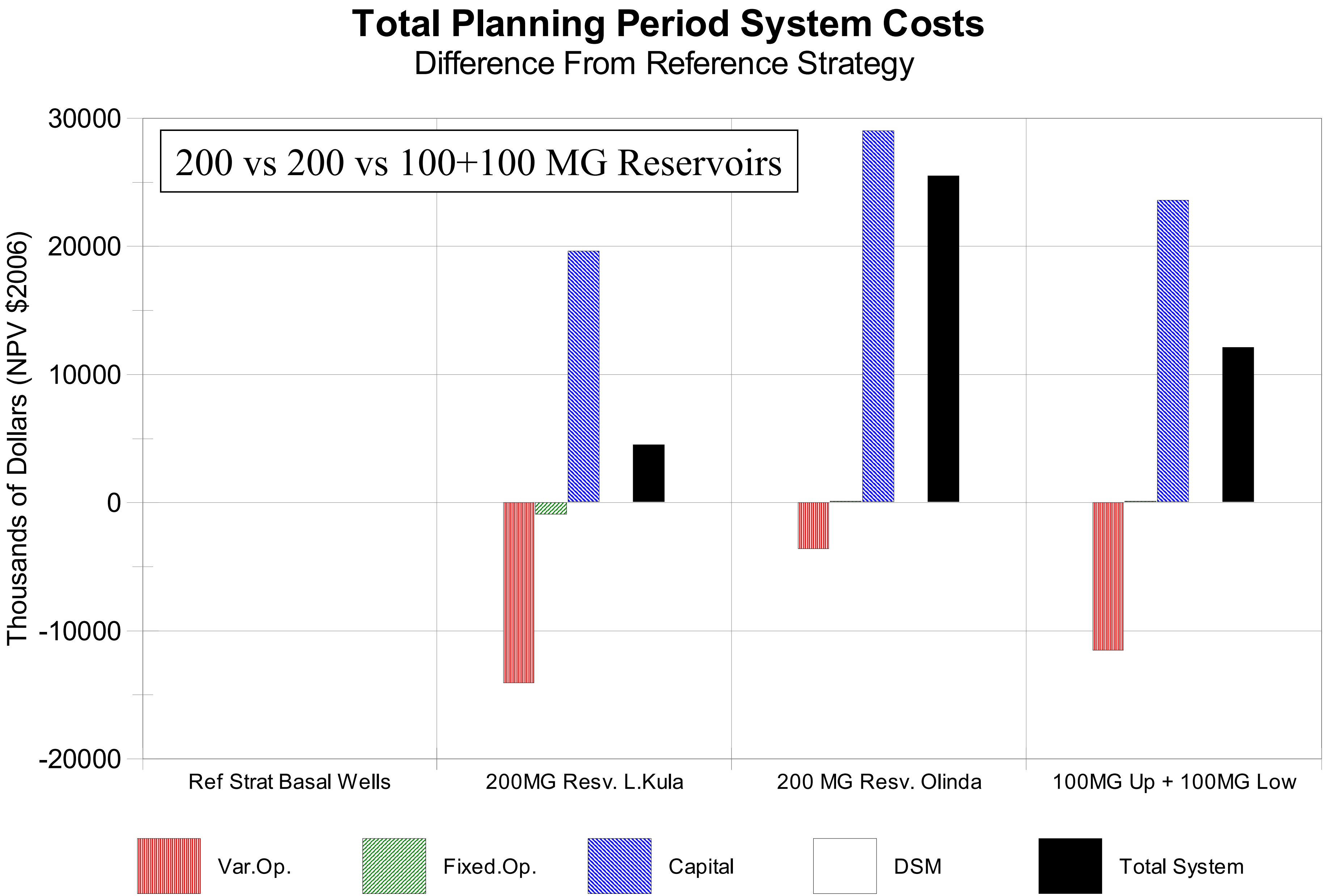
Total Planning Period System Costs
Difference From Reference Strategy
Alternate Reservoir Sizes for the Upper Kula System
Thousands of Dollars (NPV $2006)
50000
40000
30000
20000
10000
0
-10000
Ref Strat Basal Wells
100MG Resv Olinda
200 MG Resv. Olinda
300MG Resv. Olinda
Var.Op.
Fixed.Op.
Capital
DSM
Total System



Total Planning Period System Costs
Difference From Reference Strategy
Alternate Reservoir Sizes for the Makawao System
Thousands of Dollars (NPV $2006)
40000
30000
20000
10000
0
-10000
Ref Strat Basal Wells
100MG Resv. Kamole
200MG Resv. Kamole
300MG Resv. Kamole
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Difference From Reference Strategy
100 MG Reservoir on Alternate Systems
Thousands of Dollars (NPV $2006)
20000
15000
10000
5000
0
-5000
-10000
-15000
Ref Strat Basal Wells
100MG Resv. Kamole
100MG Resv. L.Kula
100MG Resv Olinda
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Difference From Reference Strategy
200 MG Reservoir on Alternate Systems
Thousands of Dollars (NPV $2006)
30000
20000
10000
0
-10000
-20000
Ref Strat Basal Wells
200MG Resv. Kamole
200MG Resv. L.Kula
200 MG Resv. Olinda
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Difference From Reference Strategy
200 vs 200 vs 100+100 MG Reservoirs
Thousands of Dollars (NPV $2006)
30000
20000
10000
0
-10000
-20000
Ref Strat Basal Wells
200MG Resv. L.Kula
200 MG Resv. Olinda
100MG Up + 100MG Low
Var.Op.
Fixed.Op.
Capital
DSM
Total System

A. Expansion of Raw Water Storage Variations / Analysis Issues

- Reservoir Size – Target System Reliability
- Water System
  - Upper Kula, Lower Kula or Makawao Systems
- Reservoir Operation Objectives
  - Maximize Drought Reliability
  - Optimize Operation Economics
- Financing Alternatives

A. Expansion of Raw Water Storage Policy Issues

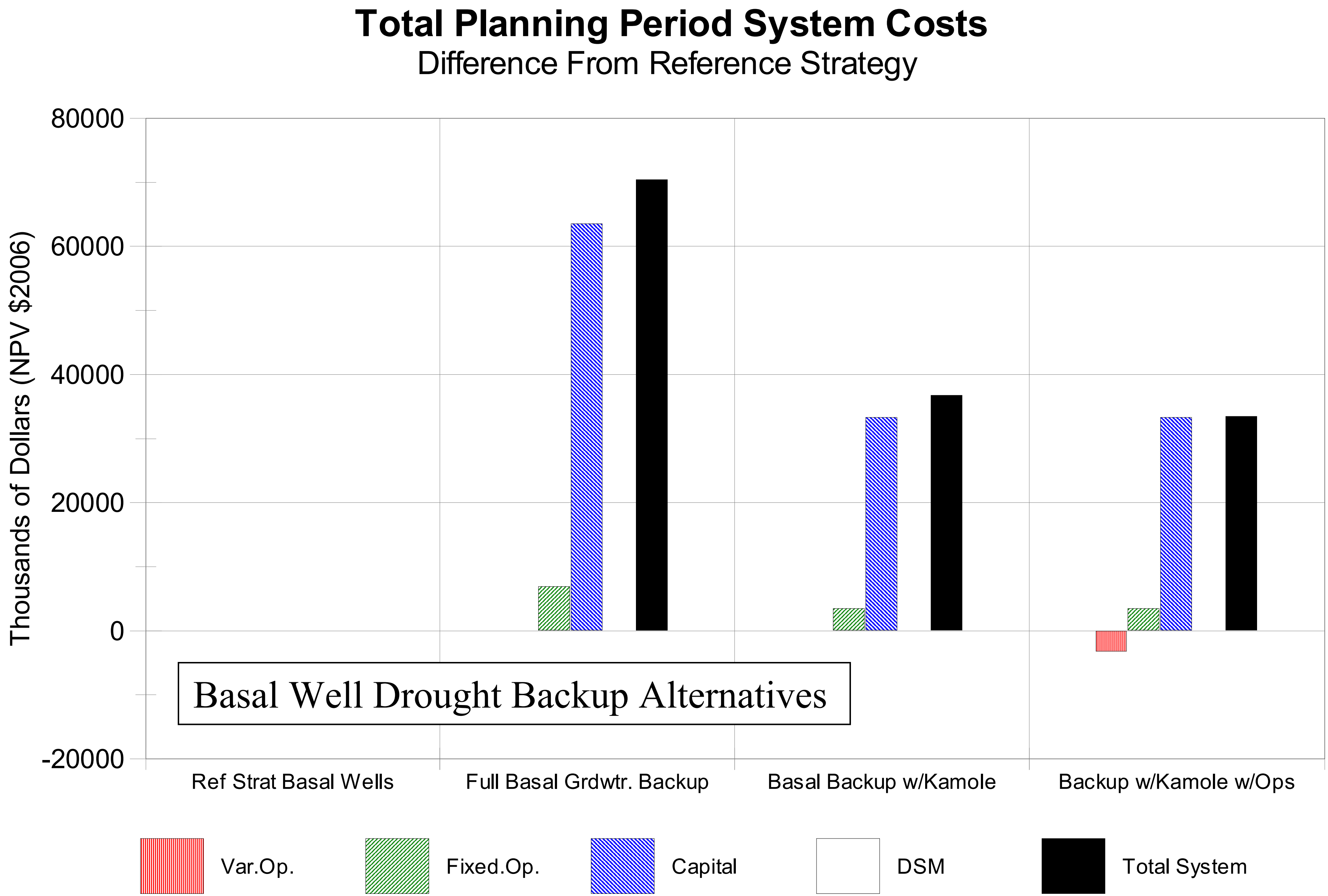
- Cost vs Reliability vs Sustainability
  - Budgeting for Project Capital Costs
  - Reservoir Management Objectives
- Agricultural vs Municipal Service Objectives
  - Protocols for Allocation in Drought Periods
  - Financing Alternatives
- Additional Use of Stream Water

B. Full Basal Groundwater Well Backup

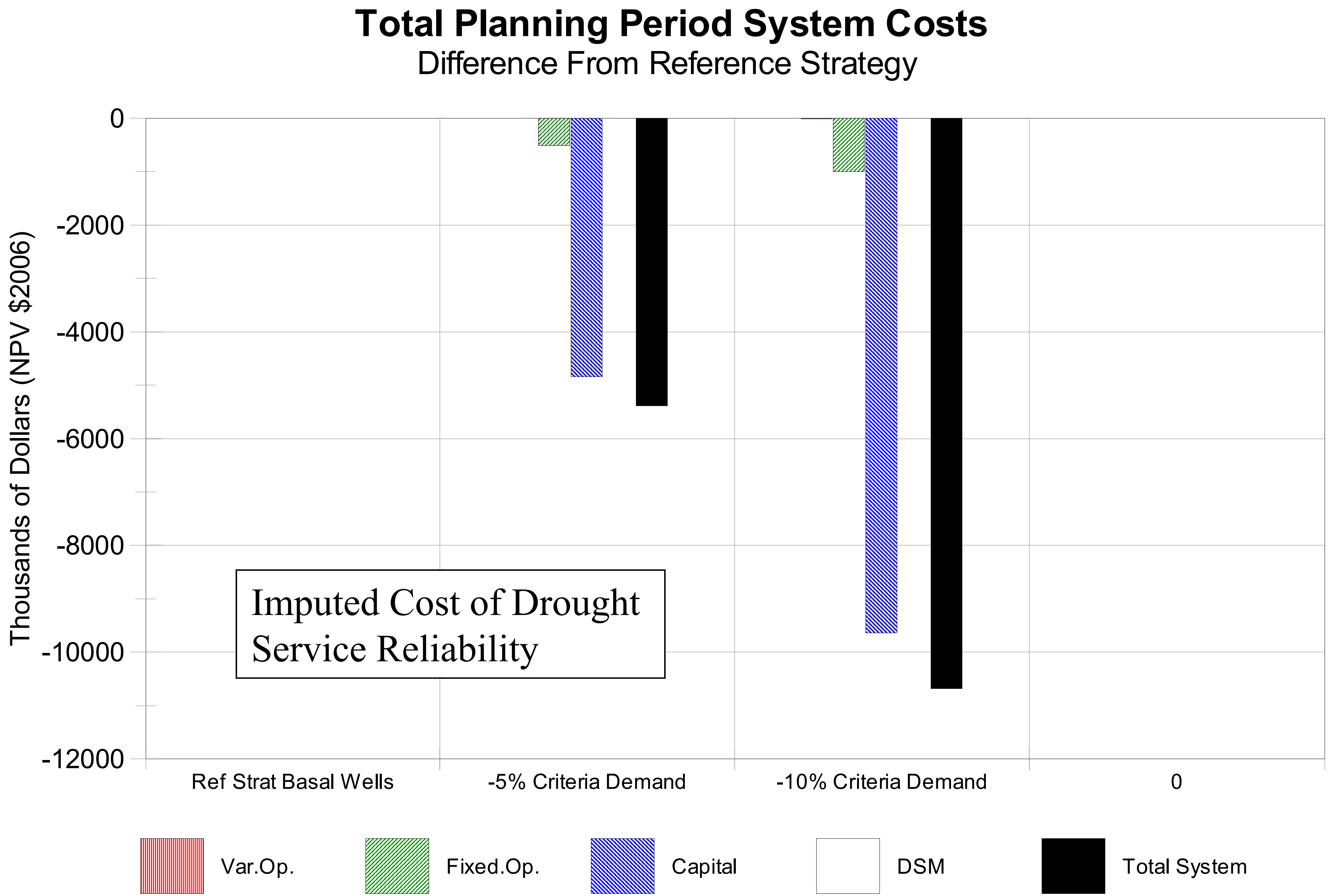
Development of sufficient new basal wells to provide reliable water capacity in “worst case” drought conditions

B. Full Basal Well Backup Variations / Analysis Issues

- Well Locations (Elevations)
- Well Costs
- Hydrology – Expected Yield
- Additional Reservoir Alternatives
- Integration with Upcountry Systems
  - Baseline Surface Source Reliability
  - Reservoir Management Protocols



Total Planning Period System Costs
Difference From Reference Strategy
Thousands of Dollars (NPV $2006)
80000
60000
40000
20000
0
-20000
Basal Well Drought Backup Alternatives
Ref Strat Basal Wells
Full Basal Grdwtr. Backup
Basal Backup w/Kamole
Backup w/Kamole w/Ops
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Difference From Reference Strategy
0
-2000
-4000
-6000
-8000
-10000
-12000
Thousands of Dollars (NPV $2006)
Imputed Cost of Drought Service Reliability
Ref Strat Basal Wells
-5% Criteria Demand
-10% Criteria Demand
0
Var.Op.
Fixed.Op.
Capital
DSM
Total System

B. Full Basal Well Backup Policy Issues

- Cost vs Reliability vs Sustainability
- EMPLAN Consent Decree Compliance
- Non-DWS Well Development Issues
  - Well Siting – Wellhead Protection
  - Well Siting – Integration with DWS Systems
  - Capitalization, Source Credits, Entitlements

D. Expanded Kamole WTP Capacity and Volume

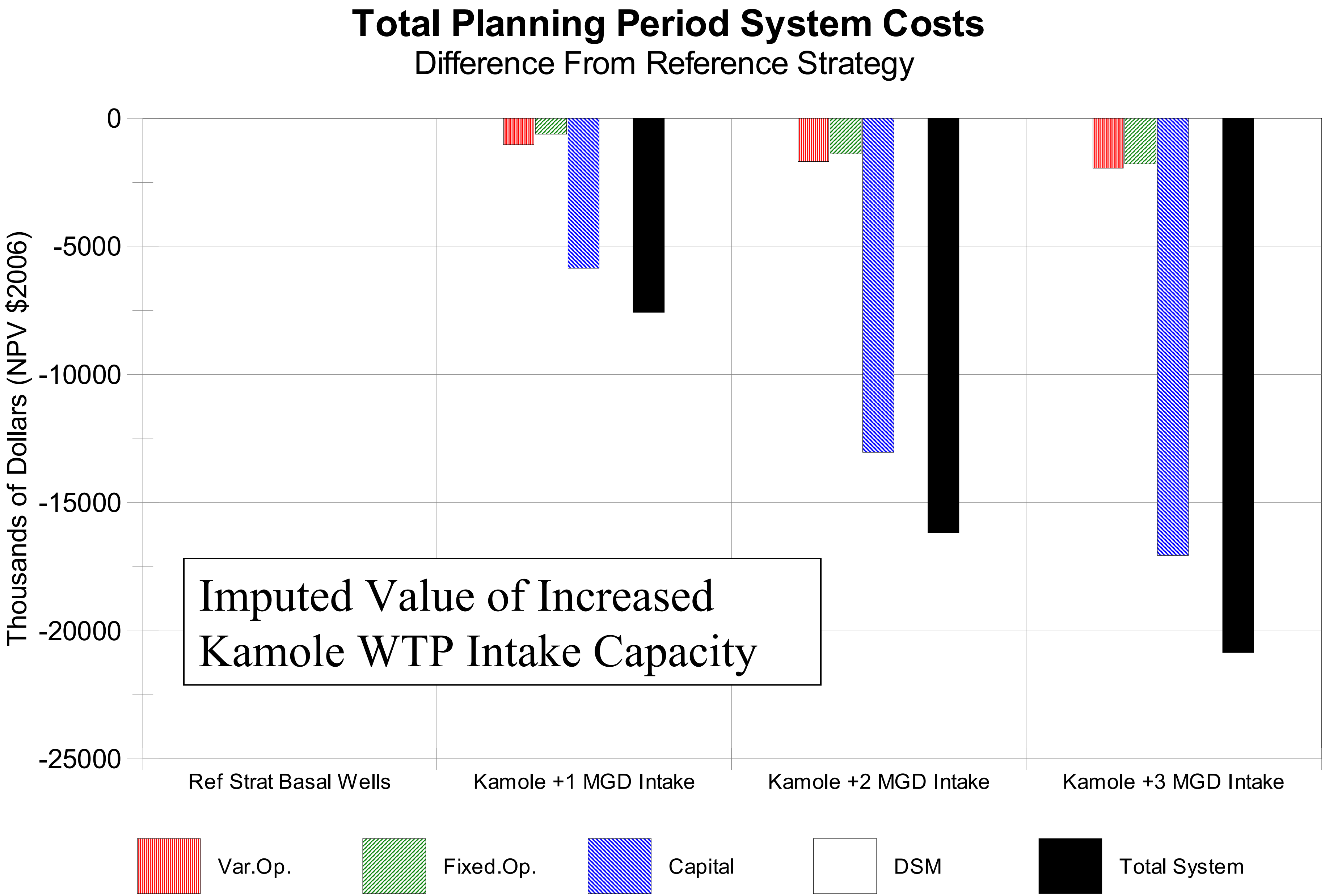
Improvements to storage, pretreatment and/or filter capacity to maximize Kamole WTP drought period capacity

D. Kamole WTP Improvements Analysis Issues

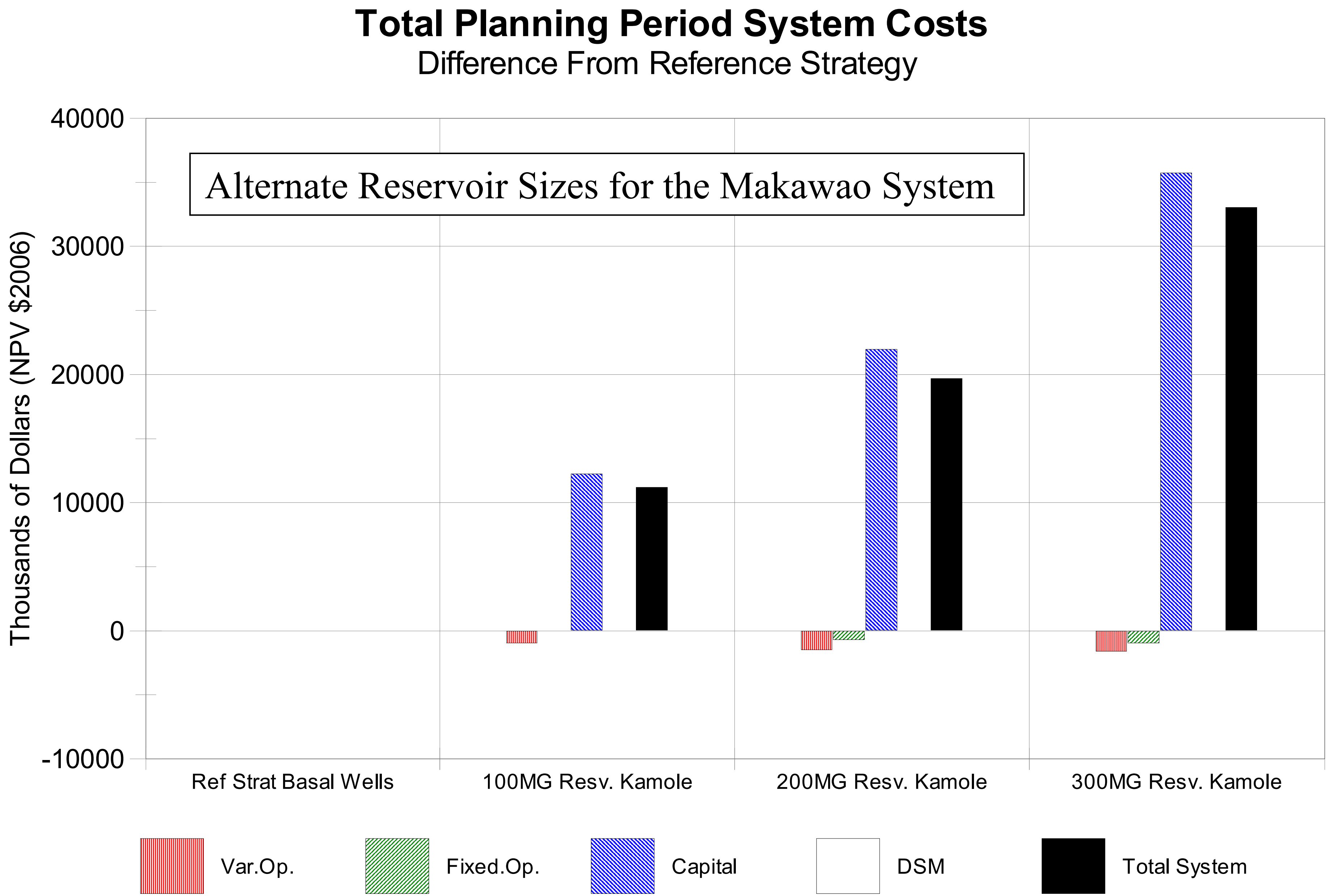
- Determination and Analysis of Options
  - Scope of Possible Options
  - Project Costs
  - Resulting Drought Period Reliable Capacity
- Integration with Upcountry Systems
  - Additional Reservoir Alternatives
  - Reservoir Management Protocols

D. Kamole WTP Improvements Analysis

- Reservoir Options Examined
  - Wailoa Ditch Flow Analysis
  - Mass Flow Analysis of Resv. Reliable Yields
  - Cost/Benefit Analysis in Integration Model
- Kamole WTP Filter Upgrade is Already Planned
- Intake Capacity Improvements Evaluated



Total Planning Period System Costs
Difference From Reference Strategy
Thousands of Dollars (NPV $2006)
0
-5000
-10000
-15000
-20000
-25000
Imputed Value of Increased Kamole WTP Intake Capacity
Ref Strat Basal Wells
Kamole +1 MGD Intake
Kamole +2 MGD Intake
Kamole +3 MGD Intake
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Difference From Reference Strategy
Alternate Reservoir Sizes for the Makawao System
Thousands of Dollars (NPV $2006)
40000
30000
20000
10000
0
-10000
Ref Strat Basal Wells
100MG Resv. Kamole
200MG Resv. Kamole
300MG Resv. Kamole
Var.Op.
Fixed.Op.
Capital
DSM
Total System

D. Kamole WTP Improvements Analysis Conclusions

- There is substantial value to improving Kamole WTP drought period reliability.
  - Primary value is in displacing need for expensive but seldom used backup wells.
- Specific means to increase drought period reliability depend upon collaborative and negotiated details.

D. Kamole WTP Improvements Policy Issues

- Cost vs Drought Condition Reliability
- Additional Use of Stream Water
- Agricultural vs Municipal Use of Drought Period Surface Water

C. Limited Growth with Extensive Conservation Measures

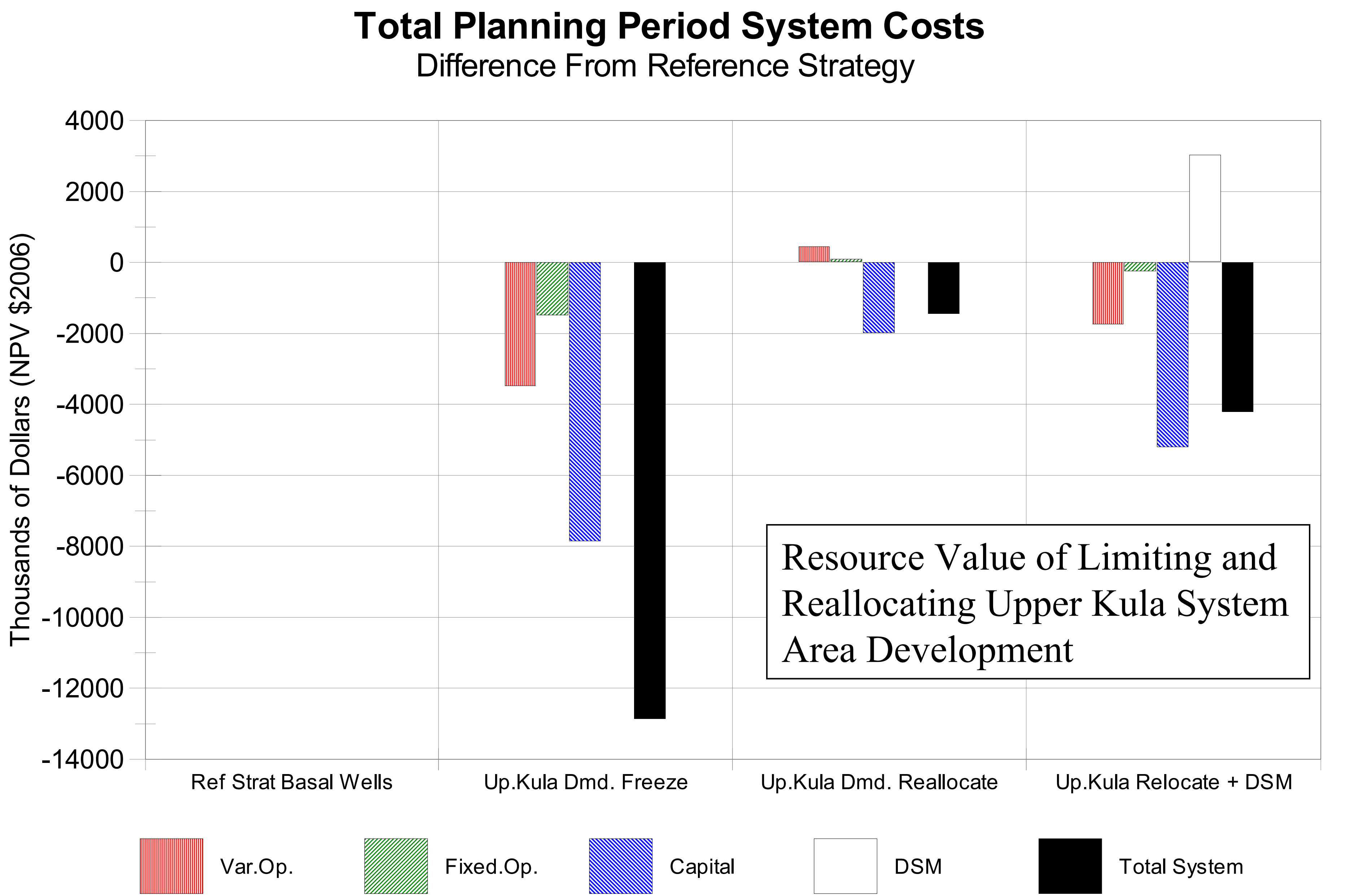
Restrictions on growth on Upper Kula system and targeted conservation to keep water demands within surface water system capacity

C. Limited Growth and Conservation Variations / Policy Issues

- Nature and Extent of Growth Restrictions
  - Restrict Number of New Services?
  - Restrict Subdivisions?
  - Restrict Increases in Water Consumption?
  - Restrict Agricultural and Municipal Uses?
- Implementation or Restrictions
  - Interface with Land Use Plans and Regulation
- DHHL Exemption from Restrictions

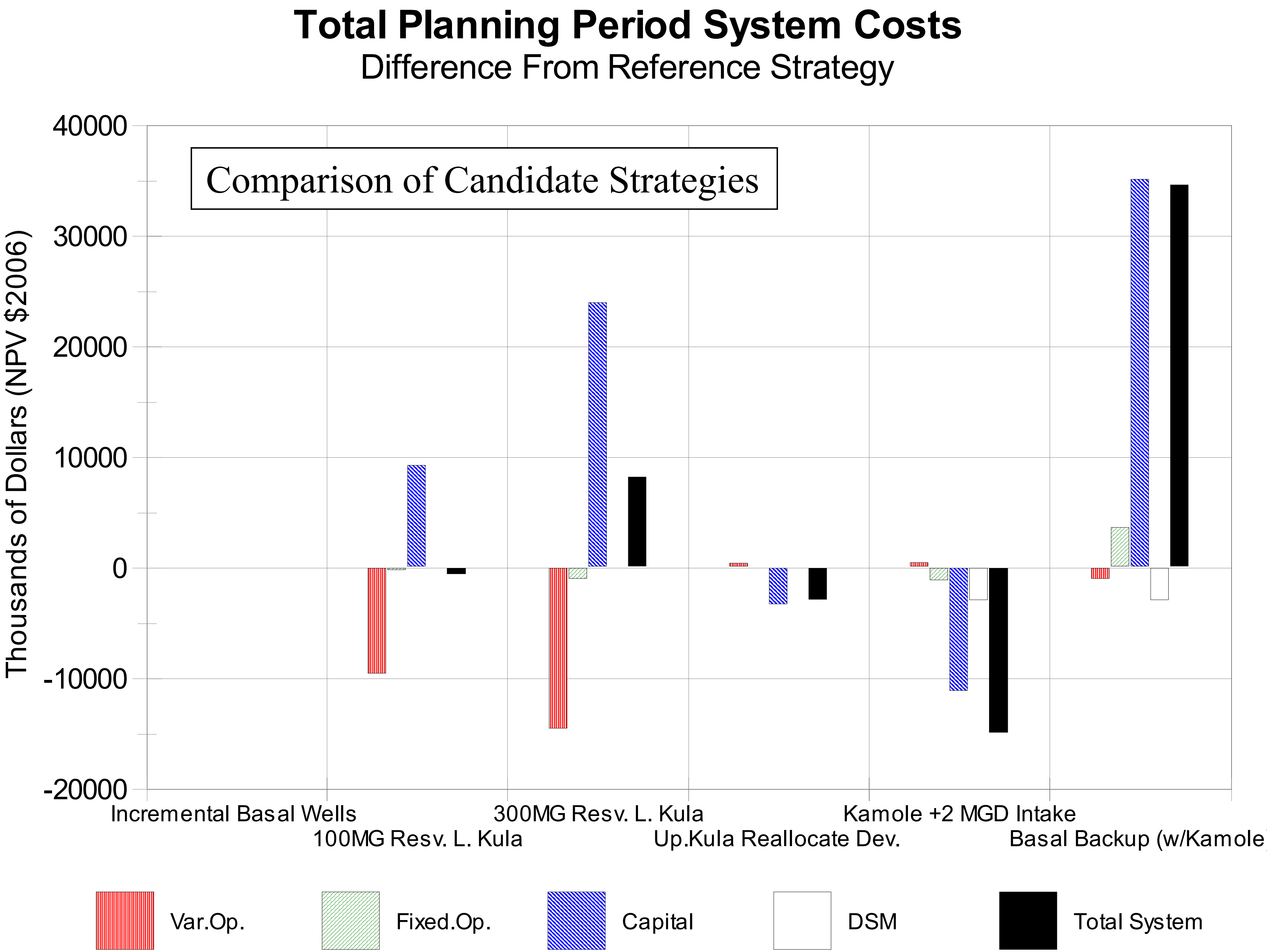
C. Limited Growth and Conservation Variations / Policy Issues

- Conservation Implementation Thresholds
  - Cost-effective Efficiency Measures
  - Subsidized Efficiency Measures
  - Use Restrictions
- Conservation Implementation Measures
  - Incentives
  - Mandates

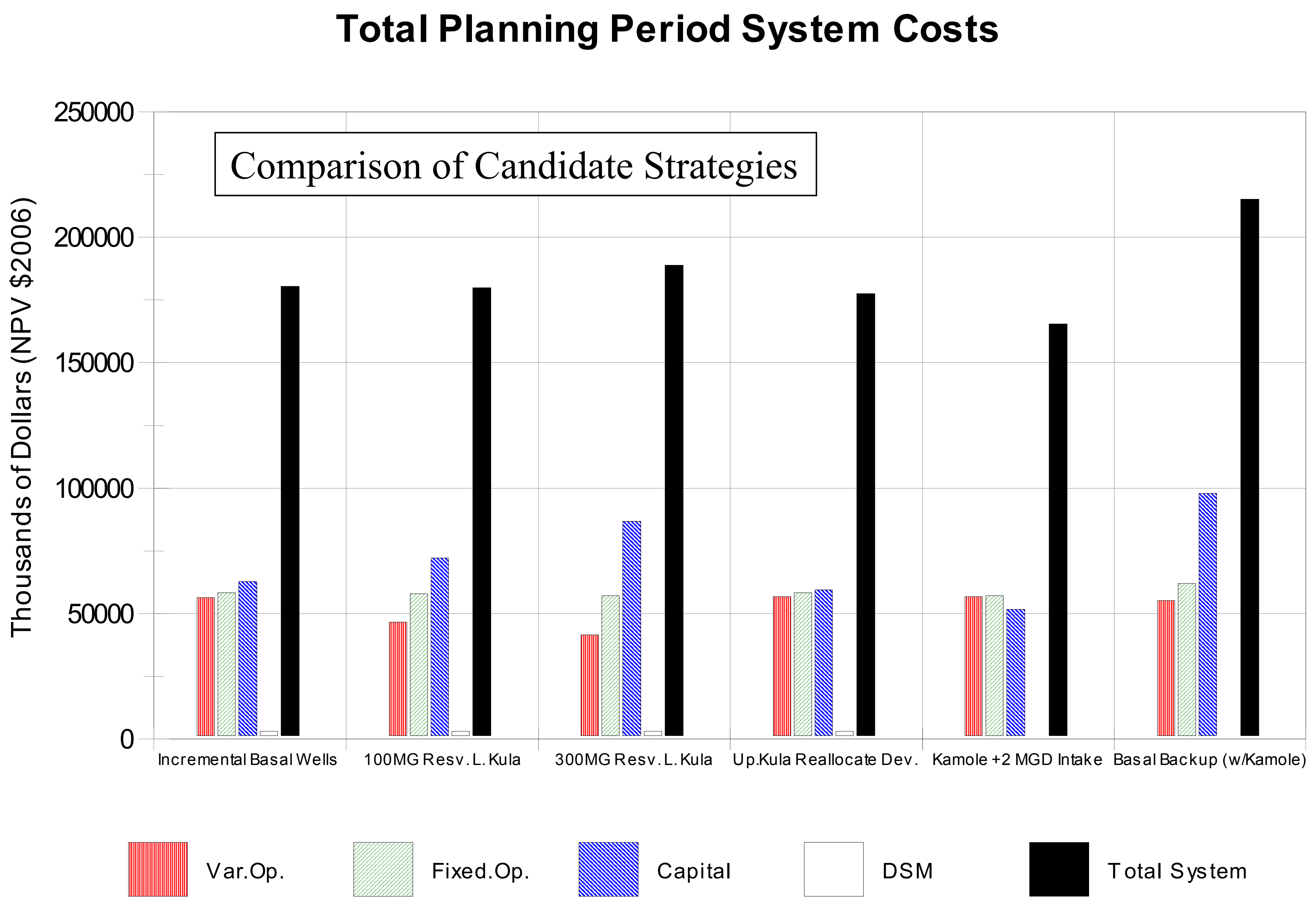

Total Planning Period System Costs
Difference From Reference Strategy
Thousands of Dollars (NPV $2006)
4000
2000
0
-2000
-4000
-6000
-8000
-10000
-12000
-14000
Resource Value of Limiting and Reallocating Upper Kula System Area Development
Ref Strat Basal Wells
Up.Kula Dmd. Freeze
Up.Kula Dmd. Reallocate
Up.Kula Relocate + DSM
Var.Op.
Fixed.Op.
Capital
DSM
Total System

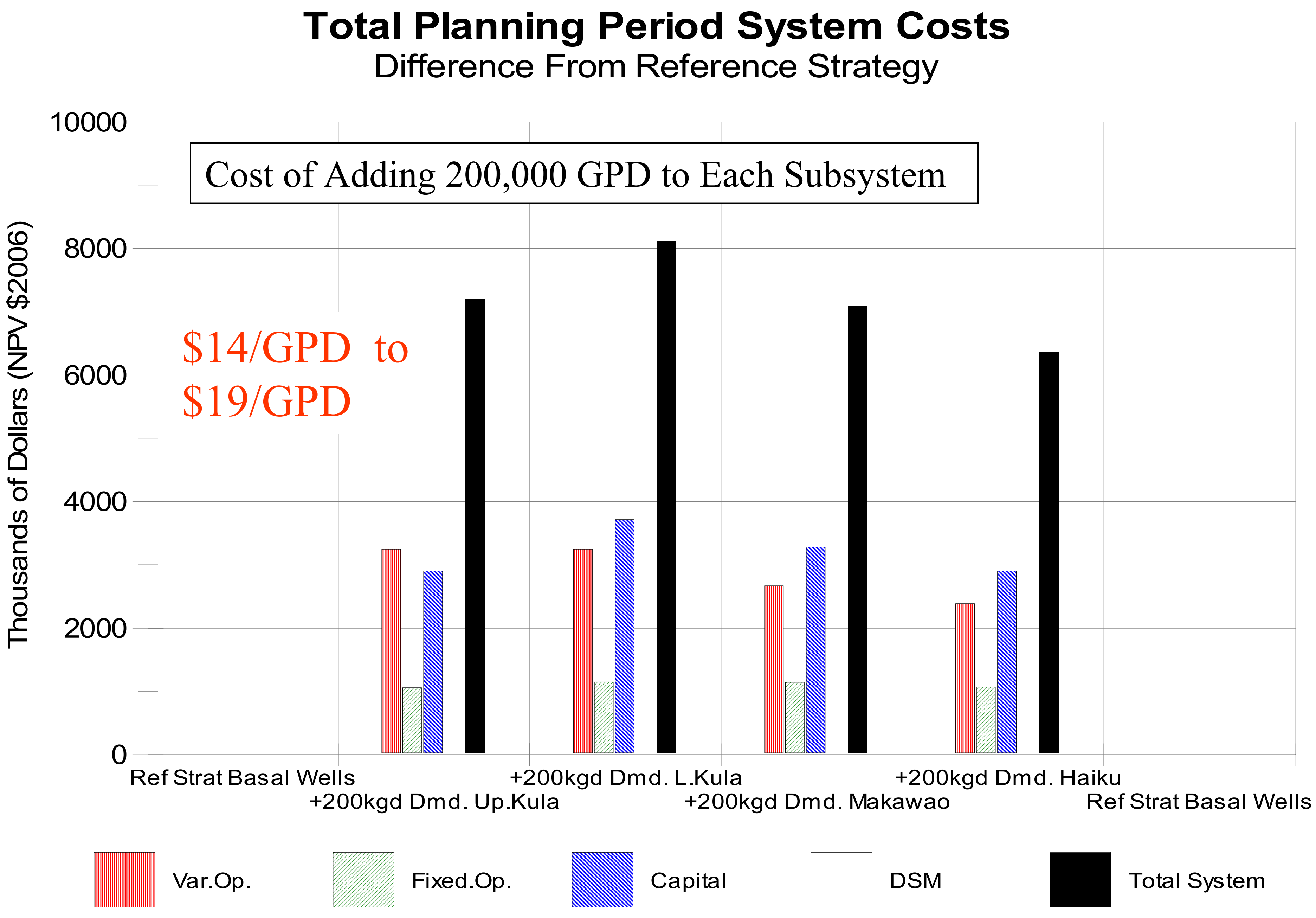
Upcountry District
Final Candidate Strategies

- A. Expansion of Raw Water Storage
- B. Full Basal Groundwater Backup
- C. Limited Growth with Extensive Conservation Measures
- D. Expanded Kamole Water Treatment Plant Capacity and Volume



Total Planning Period System Costs
Difference From Reference Strategy
Comparison of Candidate Strategies
Thousands of Dollars (NPV $2006)
40000
30000
20000
10000
0
-10000
-20000
Incremental Basal Wells
100MG Resv. L. Kula
300MG Resv. L. Kula
Up.Kula Reallocate Dev.
Kamole +2 MGD Intake
Basal Backup (w/Kamole)
Var.Op.
Fixed.Op.
Capital
DSM
Total System


Total Planning Period System Costs
Comparison of Candidate Strategies
Thousands of Dollars (NPV $2006)
250000
200000
150000
100000
50000
0
Incremental Basal Wells
100MG Resv. L. Kula
300MG Resv. L. Kula
Up.Kula Reallocate Dev.
Kamole +2 MGD Intake
Basal Backup (w/Kamole)
Var.Op.
Fixed.Op.
Capital
DSM
Total System



Total Planning Period System Costs
Difference From Reference Strategy
Cost of Adding 200,000 GPD to Each Subsystem
$14/GPD to
$19/GPD
Thousands of Dollars (NPV $2006)
10000
8000
6000
4000
2000
0
Ref Strat Basal Wells
+200kgd Dmd. Up.Kula
+200kgd Dmd. L.Kula
+200kgd Dmd. Makawao
+200kgd Dmd. Haiku
Ref Strat Basal Wells
Var.Op.
Fixed.Op.
Capital
DSM
Total System

Upcountry District
Final Candidate Strategies

- A. Expansion of Raw Water Storage
- B. Full Basal Groundwater Backup
- C. Limited Growth with Extensive Conservation Measures
- D. Expanded Kamole Water Treatment Plant Capacity and Volume
- E. ???

UPCOUNTRY CANDIDATE STRATEGIES	Planning Objectives														
	Availability	Cost	Efficiency	Environment	Equity	Sustainability	Quality	Reliability	Streams	Resources	Culture	DHHL	Agriculture	Conformity	Viability
	MGD Average	$ / kgal 20YR Lev.	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -
CANDIDATE STRATEGIES															
INCREASED RAW WATER STORAGE RESERVOI															
ADD WELL AND BOOSTER PUMPS INCREMENTA															
BASAL WELLS FOR FULL SYSTEM BACKUP															
LIMIT AND REALLOCATE UPPER KULA GROWTH															
IMPROVE KAMOLE WTP DROUGHT RELIABILITY															
COMPONENTS IN ALL STRATEGIES															
COMMITTED RESOURCE OPTIONS															
BOOSTER PUMP UPGRADES															
DEMAND SIDE MANAGEMENT PROGRAMS															
INDEPENDENT STRATEGY COMPONENTS															
SUPPLY SIDE LEAK REDUCTION															
ENERGY PRODUCTION AND EFFICIENCY MEASU															
STREAM RESTORATION MEASURES													+ / -		
WATERSHED PROTECTION AND RESTORATION															
WELL DEVELOPMENT POLICIES AND REGULATI															
WELLHEAD PROTECTION ORDINANCE															
LANDSCAPE ORDINANCE															
DROUGHT WATER USE RESTRICTIONS													+ / -		
WATER RATE DESIGN AND PRICING POLICIES															
WTP WATER QUALITY IMPROVEMENTS															

Comments Are Encouraged:

ellen.kraftsow@co.maui.hi.us

Ellen Kraftsow
Department of Water Supply
59 Kanoa Street
Wailuku, HI 96793