

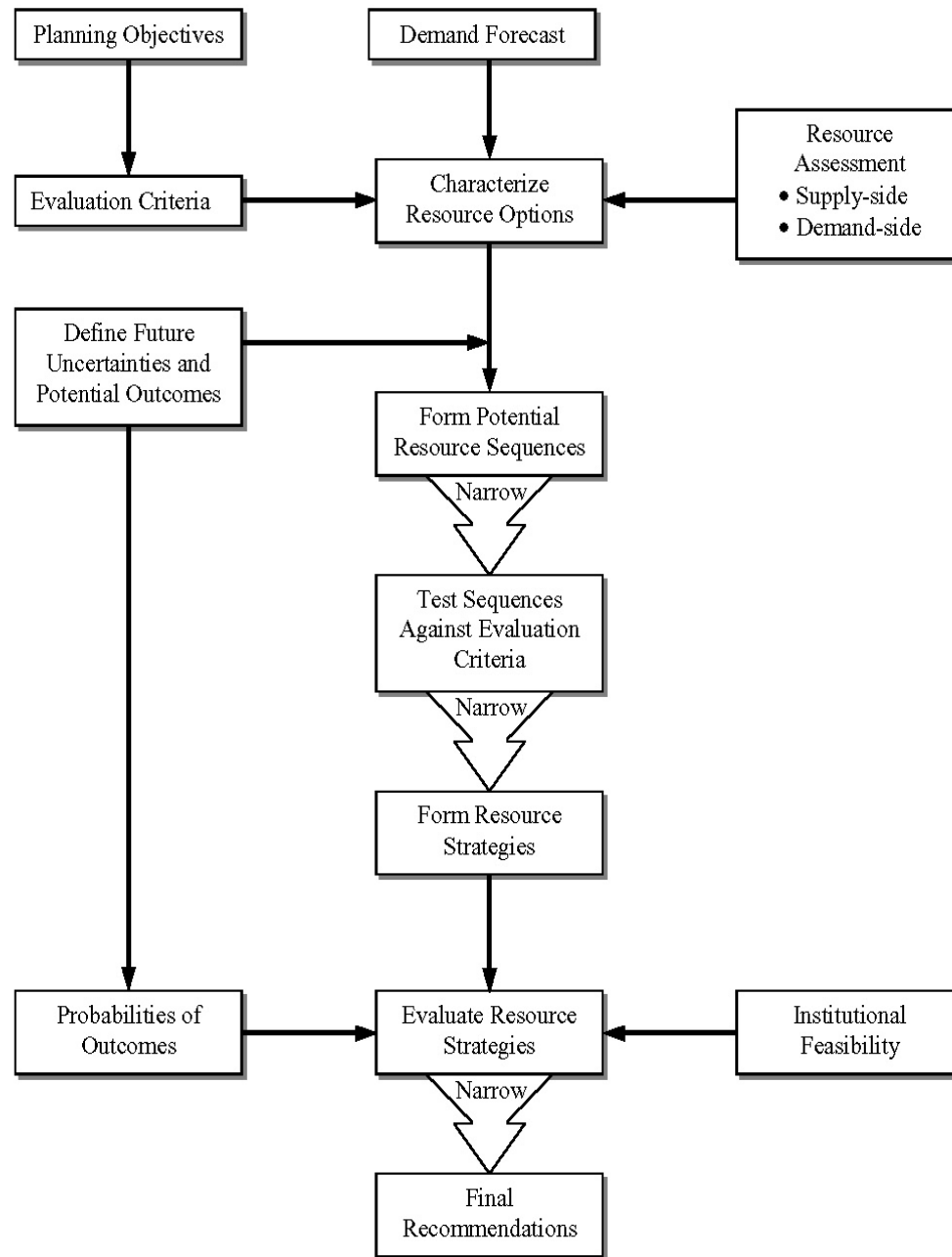
# Maui County Water Use & Development Plan

## Final Candidate Strategies Analysis Update

Water Advisory Committee  
Central District

January 8, 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.

# Central District

## Final Candidate Strategies

- A. Na Wai Eha Surface Water Treatment
- B. Northward Basal Groundwater
- C. Eastward Basal Groundwater
- D. Desalination
- E. Extensive Conservation and Wastewater Recycling

# Options Included in All Strategies

- Committed Options
  - Kupaa Well
  - Iao Tank Site Well
  - Waikapu Tank Well
  - Maui Lani Wells
- Near Term Options
  - Waikapu South Well
  - Shaft 33 Replacement Wells

# Installation of Committed and Near Term Source Additions Is Essential

- These source additions are necessary ASAP.
- Without these sources the Central District system is capacity deficient in near term.
- With these sources installed the Central District system has sufficient capacity until 2012.

# Options Included in All Strategies

- Demand Side Management Portfolio
  - Basic Programs Included in All Strategies
    - Indoor Fixture Retrofit Program
    - Outdoor Landscape Irrigation Efficiency Program
  - More Aggressive Programs Evaluated Separately
- DPW Water Recycling Projects
  - **NOT** Included in All Strategies
  - Evaluated as Separate Strategy

# Independent Components Included in All Strategies

- Supply Side Leak Reduction Measures
- Production Energy Efficiency Measures
- Energy Production Options
- Water Rate Design and Pricing Policies
- Stream Restoration Measures
- Watershed Protection and Restoration
- Well Development Policies and Regulation
- Wellhead Protection Ordinance
- Landscape Ordinance



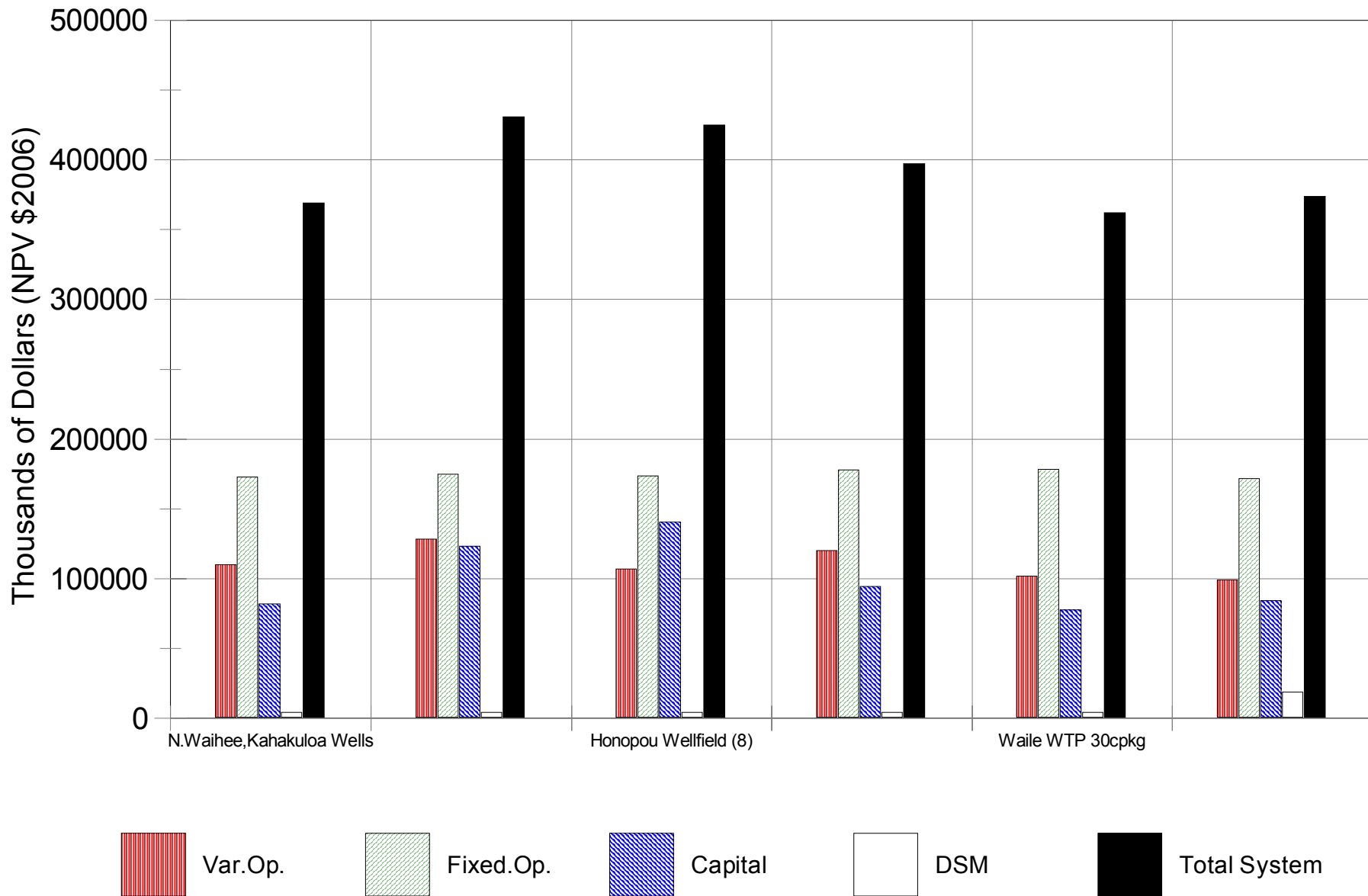
# Exploratory Components

- Investigatory Measures Included in All Strategies
  - Deep Aquifer Wells
  - Perched Water Sources
  - New Production Tunnels
  - Transmission from Existing Production Tunnels
  - Directional “Deviated” Drilling

# Recent Analysis

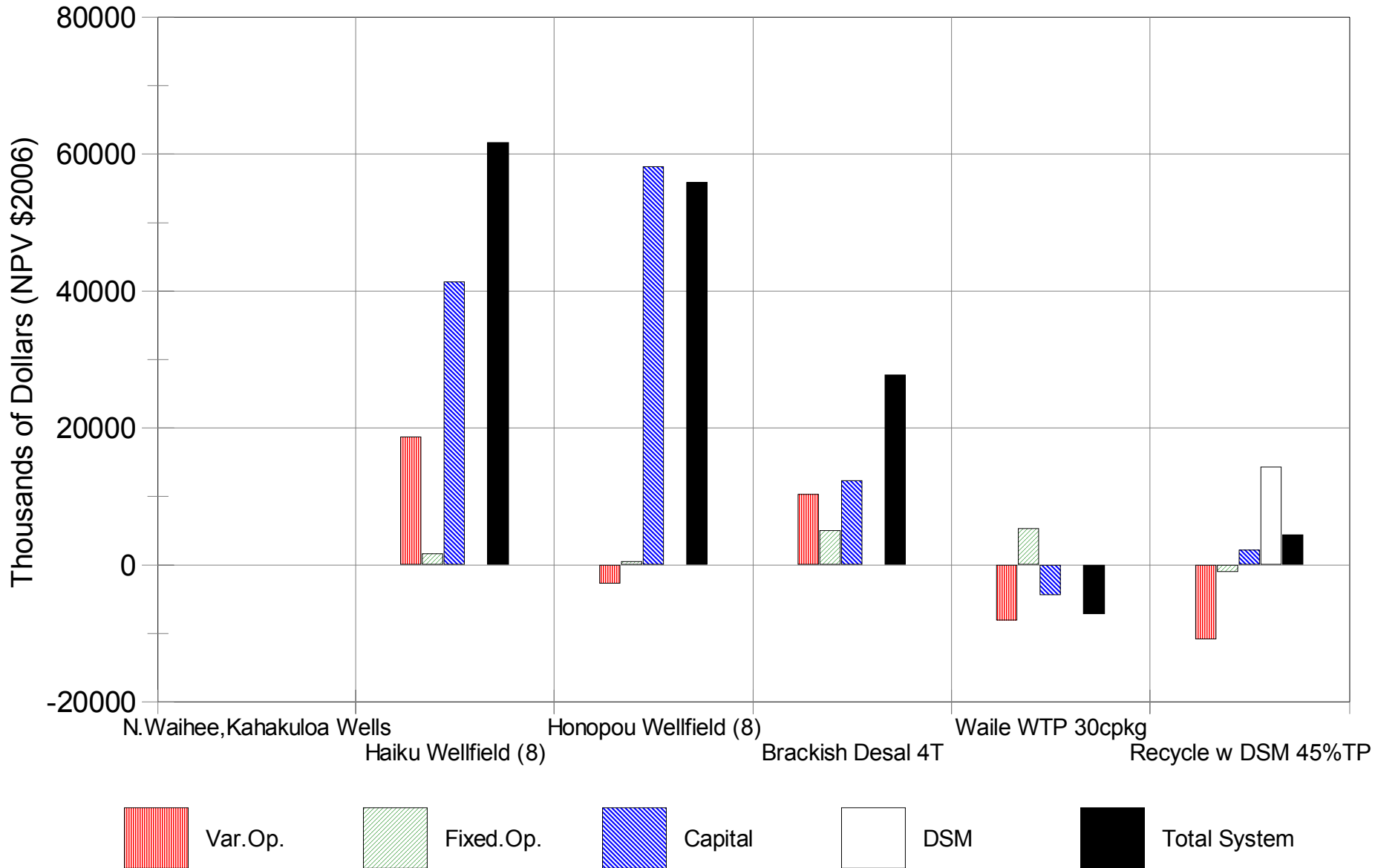
- Characterization of Resource Options Updated
  - Energy Costs
  - Hydrology / Efficacy
  - Capital Costs Updated and Refined
- DSM, Wastewater Recycling, Reservoir Options Analyzed in More Detail
- Integration Model Improved and Updated
- Strategies Reconfigured / Optimized

# Total Planning Period System Costs



# Total Planning Period System Costs

Difference From Reference Strategy



# Demand Side Management Program Analysis

- Analysis of End Uses of Water
  - How much water is used for various end uses?
- Assessment of DSM Technical Potential
  - How much water could be saved with efficient fixtures and practices?
- Assessment of DSM Economic Potential
  - How much water could be saved with different levels of expenditure on measures and program administration?

# Demand Side Management End-Use Analysis

DWS CY2006 Consumption (MGD)			
	Wailuku Kahului CPD	Kihei Makena CPD	Central District
Agriculture	0.1	0.3	0.4
Commercial	1.4	0.9	2.4
Industrial	0.7	0.4	1.0
Domestic Indoor	3.8	3.4	7.2
Outdoor (Non-Ag)	3.3	7.5	10.8
Total	9.3	12.5	21.8

# Demand Side Management End-Use Analysis

CY2006 Domestic Indoor Consumption (MGD)			
	Wailuku Kahului CPD	Kihei Makena CPD	Central District
Toilets	0.9	0.8	1.8
Showers	0.8	0.7	1.4
Baths	0.3	0.3	0.6
Faucets	1.0	0.9	1.9
Dishwashers	0.1	0.1	0.1
Clothes Washers	0.7	0.7	1.5
Total	3.9	3.5	7.2

# Demand Side Management Technical Potential

DSM Technical Potential (MGD)			
	Wailuku Kahului CPD	Kihei Makena CPD	Central District
Toilets	0.6	0.5	1.0
Showers	0.4	0.2	0.6
Baths	0.0	0.0	0.0
Faucets	0.3	0.2	0.6
Dishwashers	0.0	0.0	0.1
Clothes Washers	0.3	0.3	0.6
Total Indoor	1.6	1.2	2.9
Outdoor Irrigation	1.1	2.6	3.8
Total	2.7	3.9	6.7



# Demand Side Management Economic Potential

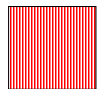
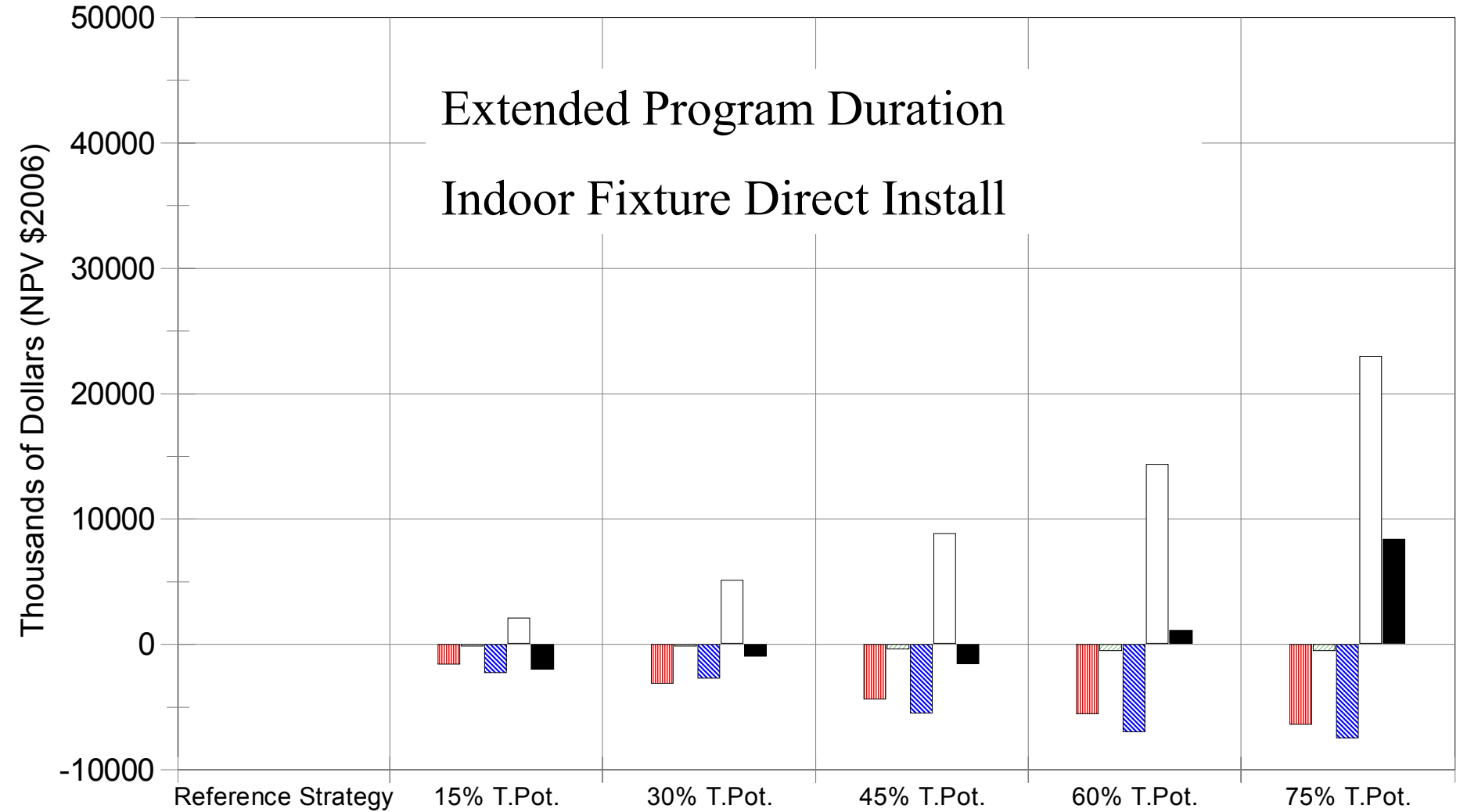
- Several Possible DSM Programs Characterized
  - Targeting Indoor and Outdoor End Uses
  - Implemented Various Conserving Measures
  - Using Alternate Delivery Mechanisms
- Costs of Attaining Progressive Levels of Technical Potential Estimated
- Cost Effectiveness Evaluated in Integration Model

# Total Planning Period System Costs

Difference From Reference Strategy

Extended Program Duration

Indoor Fixture Direct Install



Var.Op.



Fixed.Op.



Capital



DSM



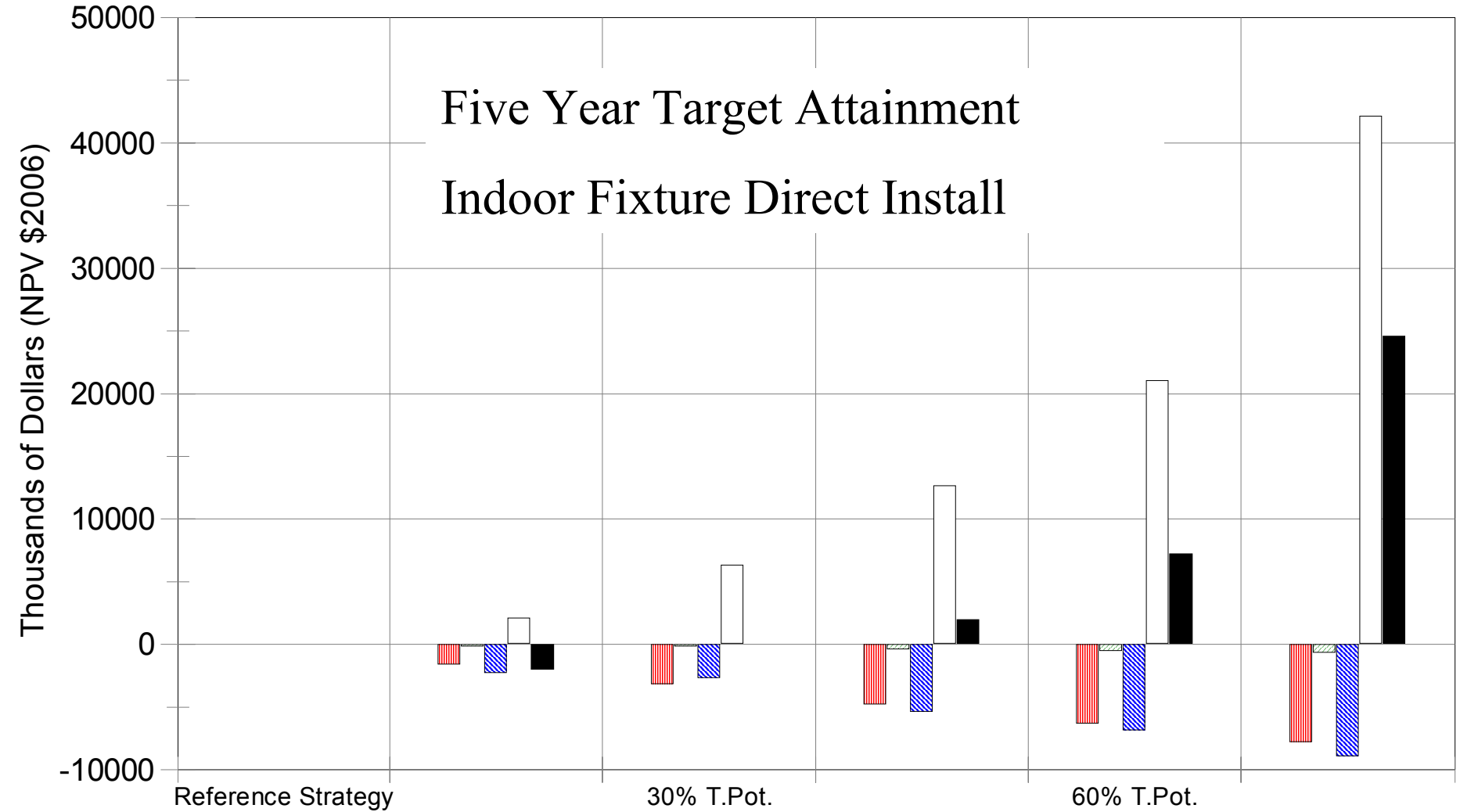
Total System

# Total Planning Period System Costs

Difference From Reference Strategy

Five Year Target Attainment

Indoor Fixture Direct Install



Var.Op.



Fixed.Op.



Capital



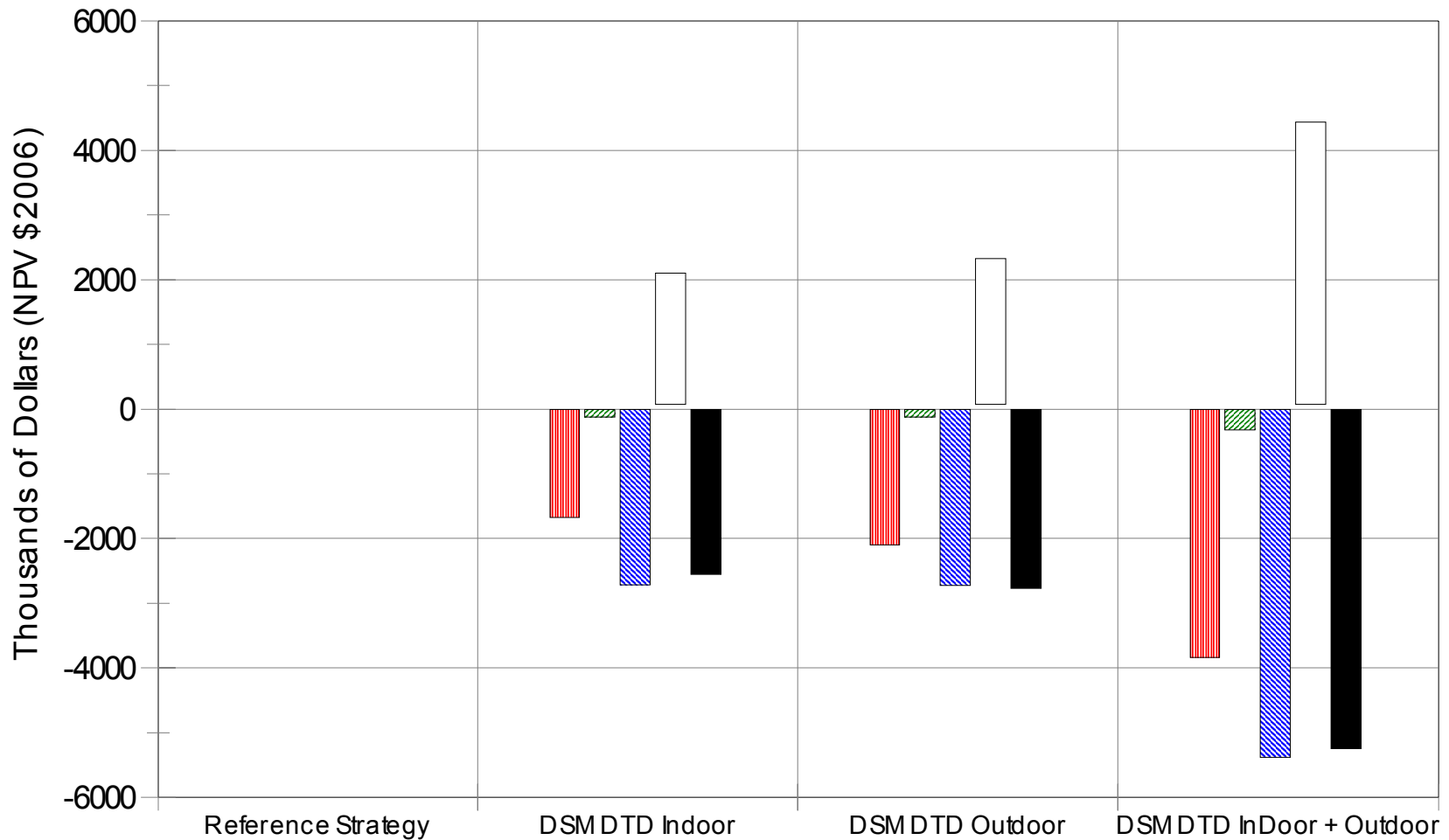
DSM



Total System

# Total Planning Period System Costs

Difference From Reference Strategy



Var.Op.



Fixed.Op.



Capital



DSM

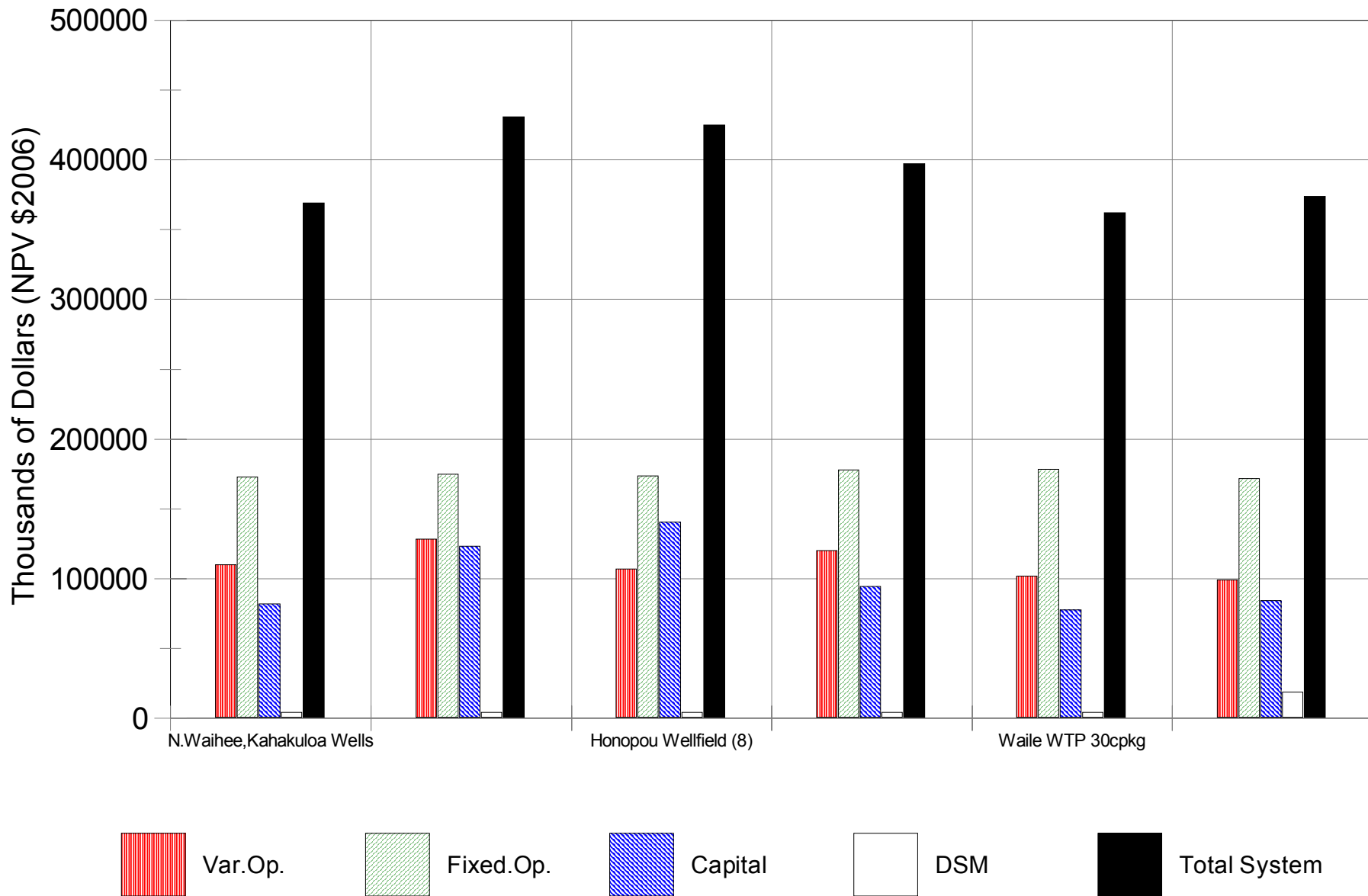


Total System

## Reference Strategy with Alt. Demand Management Components

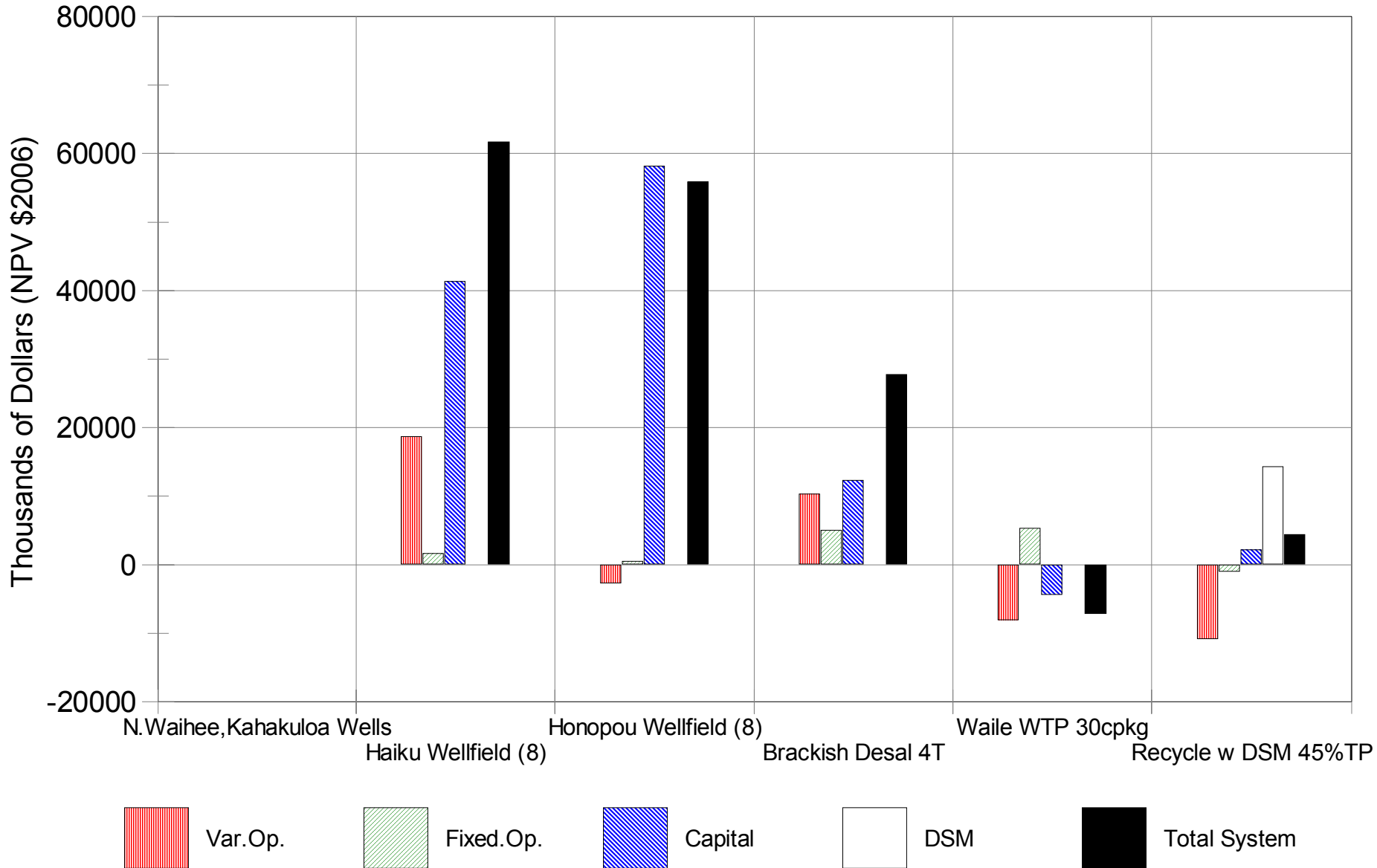
Direct Installation DSM Programs: Indoor Plumbing Fixture Retrofit, Outdoor Irrigation Controls

# Total Planning Period System Costs



# Total Planning Period System Costs

Difference From Reference Strategy



# A. Na Wai Eha Surface Water Treatment

One or more water treatment plants using water from the Na Wai Eha Rivers

# A. Na Wai Eha Surface Water Options

- Base Flow Options:
  - Waiale Water Treatment Plant
  - Waihee Water Treatment Plant
- Storage Reservoir Options:
  - Design for Maximum Reliable Capacity
  - Design for Reducing Groundwater Withdrawals



# A. Na Wai Eha Surface Water Options

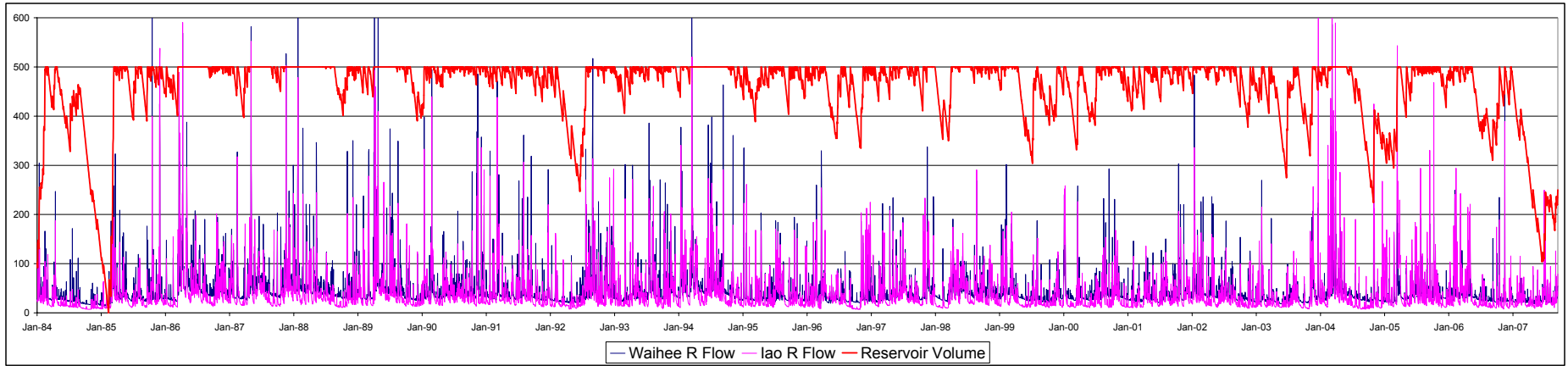
- Base Flow Options:
  - Waiale Water Treatment Plant
  - Waihee Water Treatment Plant
- Storage Reservoir Options:
  - Design for Maximum Reliable Capacity
  - Design for Reducing Groundwater Withdrawals

# A. Na Wai Eha Surface Water Project Variations

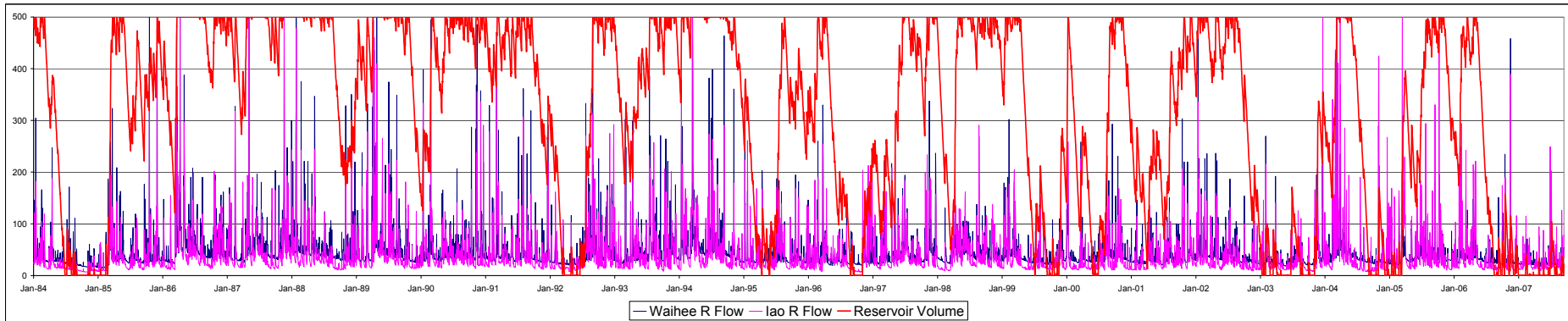
- Treatment Plant Location
- Treatment Plant Type
- Water Source Agreement
  - Water Price
  - Conditions and Contingencies
- Raw Water Storage Reservoir
  - Size and Location
  - System Operation Objectives

# A. Na Wai Eha Surface Water Financing Variations

- Project Ownership
- Project Capitalization
  - County Financing
  - Project Developer Financing
  - State or Federal Contribution
- Development Source Credits
- Developer Entitlements



IAO RIVER					WAIHEE RIVER					RESERVOIR																
Stream Discharge	Instream Baseflow	Offstream Baseflow	Capacity Limit	Capacity Limit	Diversion Above	Transmission Losses	Addition to Reservoir	Stream Discharge	Instream Baseflow	Offstream Baseflow	Capacity Limit	Capacity Limit	Diversion Above	Transmission Losses	Addition to Reservoir	Total Capacity	Total Addition	Evaporative Losses	Seepage Losses	Reservoir Capacity	Yield	Initial Reservoir Volume	Reservoir Full Days	Reservoir Empty Days	Total Days	
MGD = MG	MGD (nondiverted)	MGD	MGD	MGD	Base Use	Percent	MG	MGD = MG	MGD (nondiverted)	MGD	MGD	MGD	Base Use	Percent	MG	MGD	MGD	Inches/day	Inches/day	MG	MGD	MG	MGD	MGD	MGD	
INPUT VALUES ==>																										
Min =>	7.1							Min =>	0.0	Min =>	14.2					Min =>	0.0									
Max =>	1099.2							Max =>	7.1	Max =>	750.0					Max =>	53.0									
Mean =>	41.1							Mean =>	3.6	Mean =>	47.4					Mean =>	10.0									
Median =>	25.2	10.000	10.000	20.000	18.000	5.00%		Median =>	3.8	Median =>	33.6					Median =>	6.4	0.250	0.000	500.000	3.230	100.000				



IAO RIVER					WAIHEE RIVER					RESERVOIR																
Stream Discharge	Instream Baseflow	Offstream Baseflow	Capacity Limit	Capacity Limit	Diversion Above	Transmission Losses	Addition to Reservoir	Stream Discharge	Instream Baseflow	Offstream Baseflow	Capacity Limit	Capacity Limit	Diversion Above	Transmission Losses	Addition to Reservoir	Total Capacity	Total Addition	Evaporative Losses	Seepage Losses	Reservoir Capacity	Yield	Initial Reservoir Volume	Reservoir Full Days	Reservoir Empty Days	Total Days	
MGD = MG	MGD (nondiverted)	MGD	MGD	MGD	Base Use	Percent	MG	MGD = MG	MGD (nondiverted)	MGD	MGD	MGD	Base Use	Percent	MG	MGD	MGD	Inches/day	Inches/day	MG	MGD	MG	MGD	MGD	MGD	
INPUT VALUES ==>																										
Min =>	7.1							Min =>	0.0	Min =>	14.2					Min =>	0.0									
Max =>	1099.2							Max =>	7.1	Max =>	750.0					Max =>	53.0									
Mean =>	41.1							Mean =>	3.6	Mean =>	47.4					Mean =>	10.0									
Median =>	25.2	10.000	10.000	20.000	18.000	5.00%		Median =>	3.8	Median =>	33.6					Median =>	6.4	0.250	0.000	500.000	7.000	500.000				

# Existing Diversions and Transmission Capacity

## Reservoir and System Benefits

With max res. withdraw ==> Res.Empty %=10%

With no withdrawal limit

Res. Size MG	Res. Max Withdraw	Res. Net Yield	System Benefit	System Benefit	Res.Empty % Days
0			32.2	32.2	0.0%
30	2.1	1.3	33.5	37.6	38.5%
60	3.4	2.1	34.2	38.3	33.2%
100	4.9	2.9	35.1	38.8	29.3%
200	7.4	4.1	36.3	39.6	24.3%
300	9.0	4.9	37.0	40.0	22.1%
400	10.0	5.3	37.5	40.2	20.7%
500	10.9	5.7	37.8	40.5	19.6%
1000	15.0	7.1	39.3	41.2	15.6%

# Iao Stream Diversion Capacity Doubled

## Reservoir and System Benefits

With max res. withdraw ==> Res.Empty %=10%

With no withdrawal limit

Res. Size MG	Res. Max Withdraw	Res. Net Yield	System Benefit	System Benefit	Res.Empty % Days
0			32.2	32.2	
30	2.4	1.5	33.7	37.8	36.2%
60	4.0	2.4	34.6	38.7	30.1%
100	5.9	3.4	35.6	39.4	25.6%
200	9.2	4.9	37.1	40.3	19.9%
300	11.7	6.0	38.1	40.9	17.2%
400	13.8	6.7	38.9	41.2	15.5%
500	15.3	7.2	39.4	41.4	14.3%
1000	24.0	9.0	41.2	42.2	10.4%

Raw Water Storage Reservoir Cost Estimate  
Central Maui Location  
HDPE Liner w/3" Concrete Cover  
\$ 2007

100 MG

\$10,873,300

200 MG

\$21,746,600

500 MG

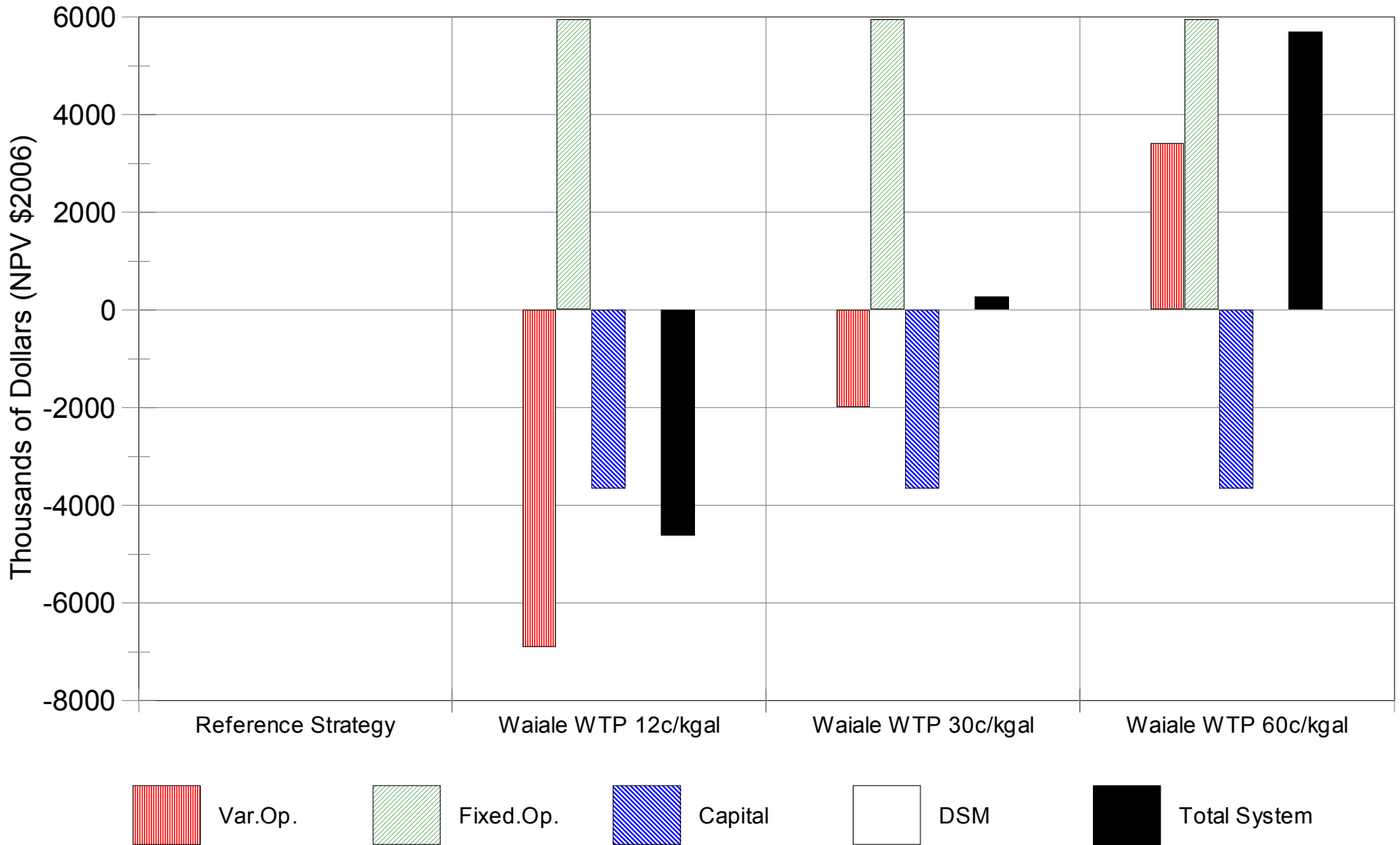
\$54,366,500

1000 MG

\$108,733,000

# Total Planning Period System Costs

Difference From Reference Strategy



**Waiale WTP with alternate assumptions for raw water purchase price**



# A. Na Wai Eha Surface Water Policy Issues

- Water Allocation Issues
  - Instream, Kuleana, Riparian, Agricultural, Municipal, Purveyors, Project Developers
- Capitalization, Credits, Entitlements
  - County Saves 13% by Splitting WTP Project Financing 50/50
- Reservoir Land Use Issues

## B. Northward Basal Groundwater Development

New basal wells,  
transmission and storage  
northward in Waihee and  
Kahakuloa aquifers

# B. Northward Basal Groundwater Analysis Issues

- Economics Generally
  - Capital and Operation Costs
- Project Design
  - Number, Size and Location of Wells
- Project Extent
  - Waihee Only or Include Kahakuloa Aquifer
- Hydrology – Expected Yield

## B. Northward Basal Groundwater Policy / Feasibility Issues

- Transport of Water from Kahakuloa Aquifer for Central District Use
- Acceptance of Project by Kahakuloa Area Residents
- Verification of Aquifer Sustainable Yield and Well Production

# C. Eastward Basal Groundwater Development

New Basal Wells in the  
Haiku and/or Honopou  
Aquifers w/ Transmission to  
the Central District System

## C. Eastward Basal Groundwater Variations / Analysis Issues

- Haiku vs. Honopou Aquifer Wells
- Optimization of Well Size, Number of Wells, Altitude
- Refinement of Transmission Cost Estimates

## C. Eastward Basal Groundwater Policy / Feasibility Issues

- Compliance With Consent Decree
- Transport of Water From East Aquifers to Central System
- Acceptance of Project by East aquifer area residents
- Potential Impacts on Existing Wells, Springs and Uses
- Capital Costs and Time Framing

# D. Brackish Water Desalination

Desalination Plant Using  
Central Brackish  
Groundwater



# D. Brackish Water Desalination Variations / Analysis Issues

- Economics Generally
  - Capital and Operation Costs
  - Sensitivity to Future Electricity Prices
    - MECO vs. DWS Generation
- Optimize Plant Configuration
  - Number of Independent Trains

# D. Brackish Water Desalination Policy Issues

- Energy Use
  - Need for New Generation Plants
  - Greenhouse Gas Emission Reduction Objectives
  - Cost Volatility
- Disposal of Brackish Water

# E. Large Scale Water Recycling and Conservation

Meeting New Water Needs  
by Maximizing Recycled  
Water Use and Conservation  
Measured

# E. Recycled Water and Conservation Variations / Analysis Issues

- Maximizing Recycled Water Use
  - Size and Location of Displaceable Potable Use
  - Transmission and Distribution Network
  - Capital and Operation Costs
  - Displaced Potable Consumption Benefits
  - Central R-2 to R-1 Upgrade Economics

# E. Recycled Water and Conservation Variations / Analysis Issues

- Maximizing Recycled Water Use
  - Size and Location of Displaceable Potable Use
  - Transmission and Distribution Network
  - Capital and Operation Costs
  - Displaced Potable Consumption Benefits
  - Central R-2 to R-1 Upgrade Economics
- ➔ Wailea Extension \$50M for 3 MGD
- ➔ Wailea Extension \$20M for 1.5 MGD

# E. Recycled Water and Conservation Policy Issues

- Maximizing Recycled Water Use
  - Agricultural Use vs. Displacement of Potable Use
  - Cost Effectiveness vs. Sustainability
  - Allocation of Costs
    - DWS – Potable Water Users
    - DPW – Wastewater Users

# E. Recycled Water and Conservation Analysis

- Conservation / Demand-Side Management
  - Quantification of End-Uses
  - Quantification of Technical Potential
  - Cost and Efficacy of Efficiency Measures
  - Cost and Penetration of DSM Programs
  - Strategy Costs and Impacts

# E. Recycled Water and Conservation Variations / Policy Issues

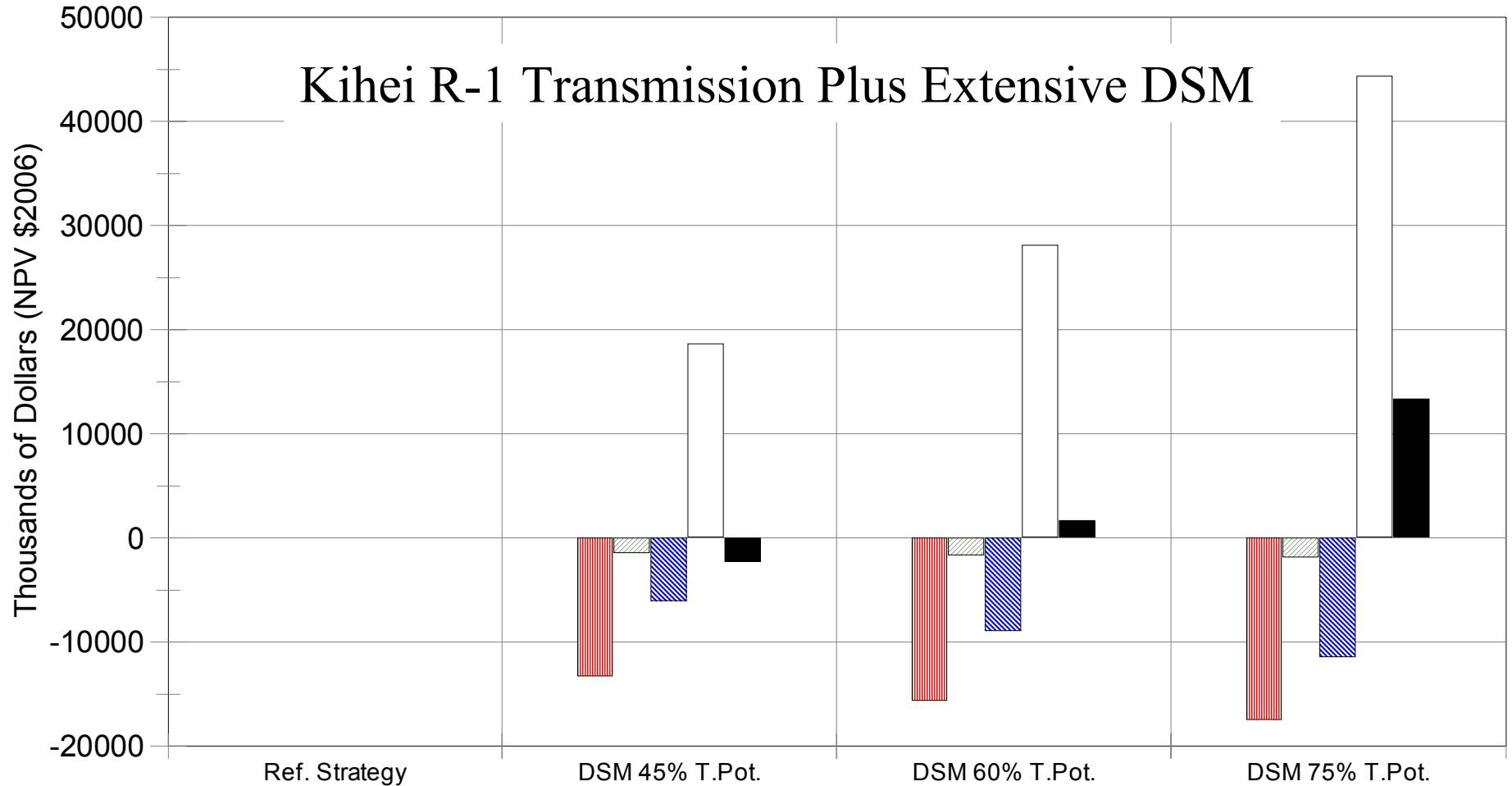
- Conservation / Demand-Side Management
  - Implementation Thresholds
    - Cost-effective Efficiency Measures
    - Subsidized Efficiency Measures
    - Use Restrictions
  - Implementation Measures
    - Incentives
    - Direct Installation
    - Mandates



# Total Planning Period System Costs

Difference From Reference Strategy

## Kihei R-1 Transmission Plus Extensive DSM

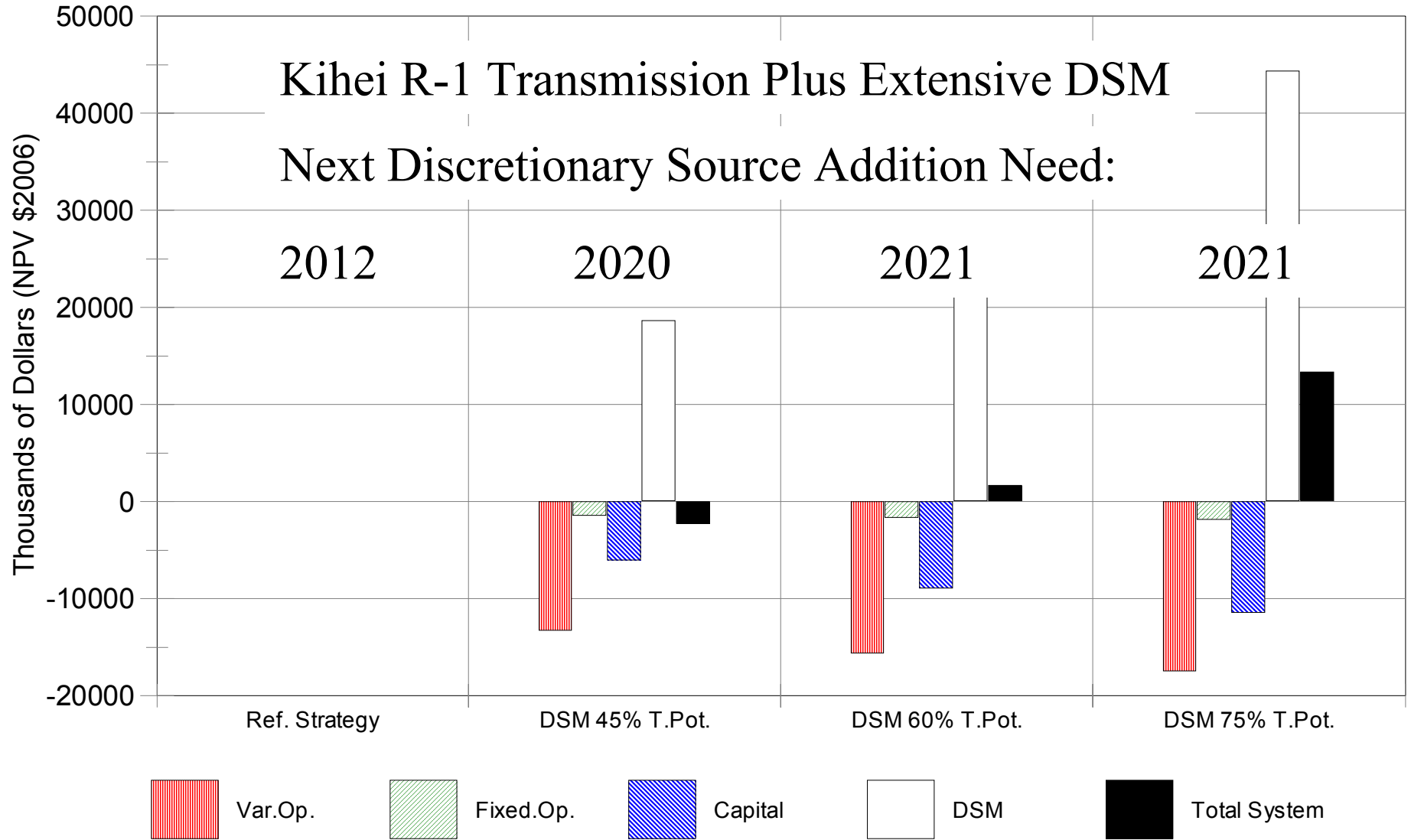


Var.Op. Fixed.Op. Capital DSM Total System

**Ref.Strategy w Kihei 1.5 MGD Recycle and Alt.DSM Penetration**  
Range of DSM program expenditures to attain fractions of technical potential

# Total Planning Period System Costs

Difference From Reference Strategy

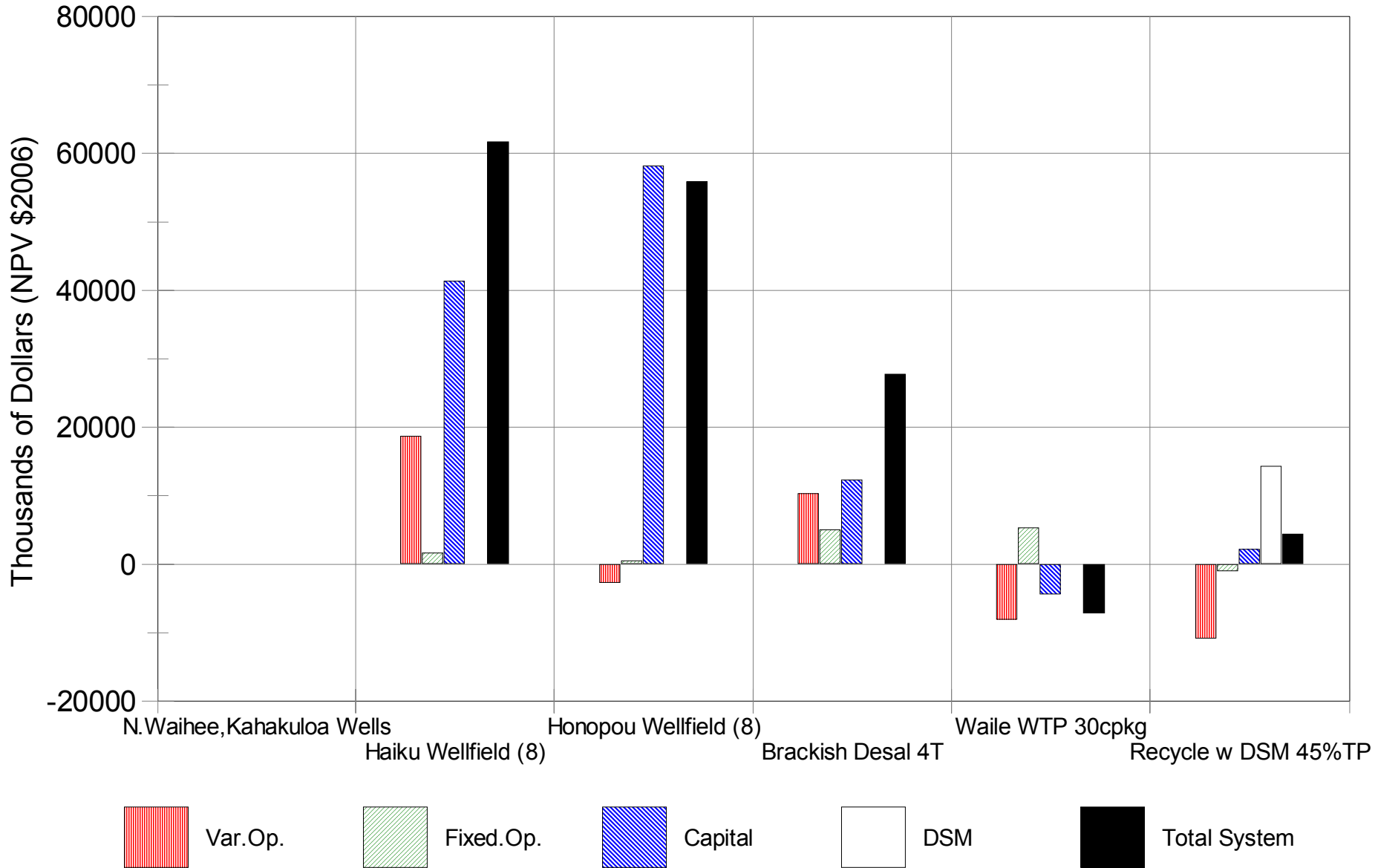


**Ref.Strategy w Kihei 1.5 MGD Recycle and Alt.DSM Penetration**

**Range of DSM program expenditures to attain fractions of technical potential**

# Total Planning Period System Costs

Difference From Reference Strategy

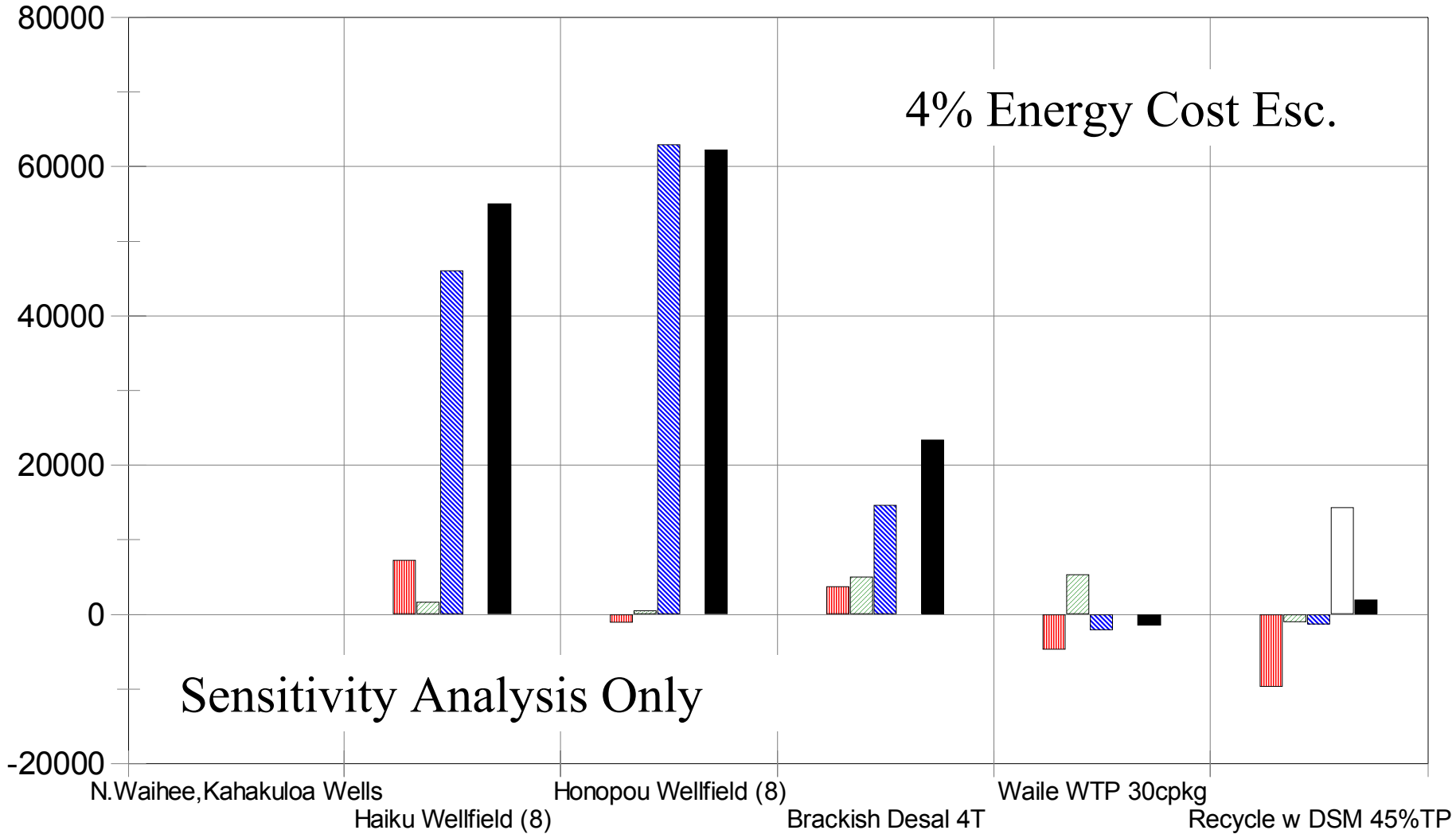


# Total Planning Period System Costs

Difference From Reference Strategy

4% Energy Cost Esc.

Sensitivity Analysis Only



Var. Op.



Fixed. Op.



Capital



DSM



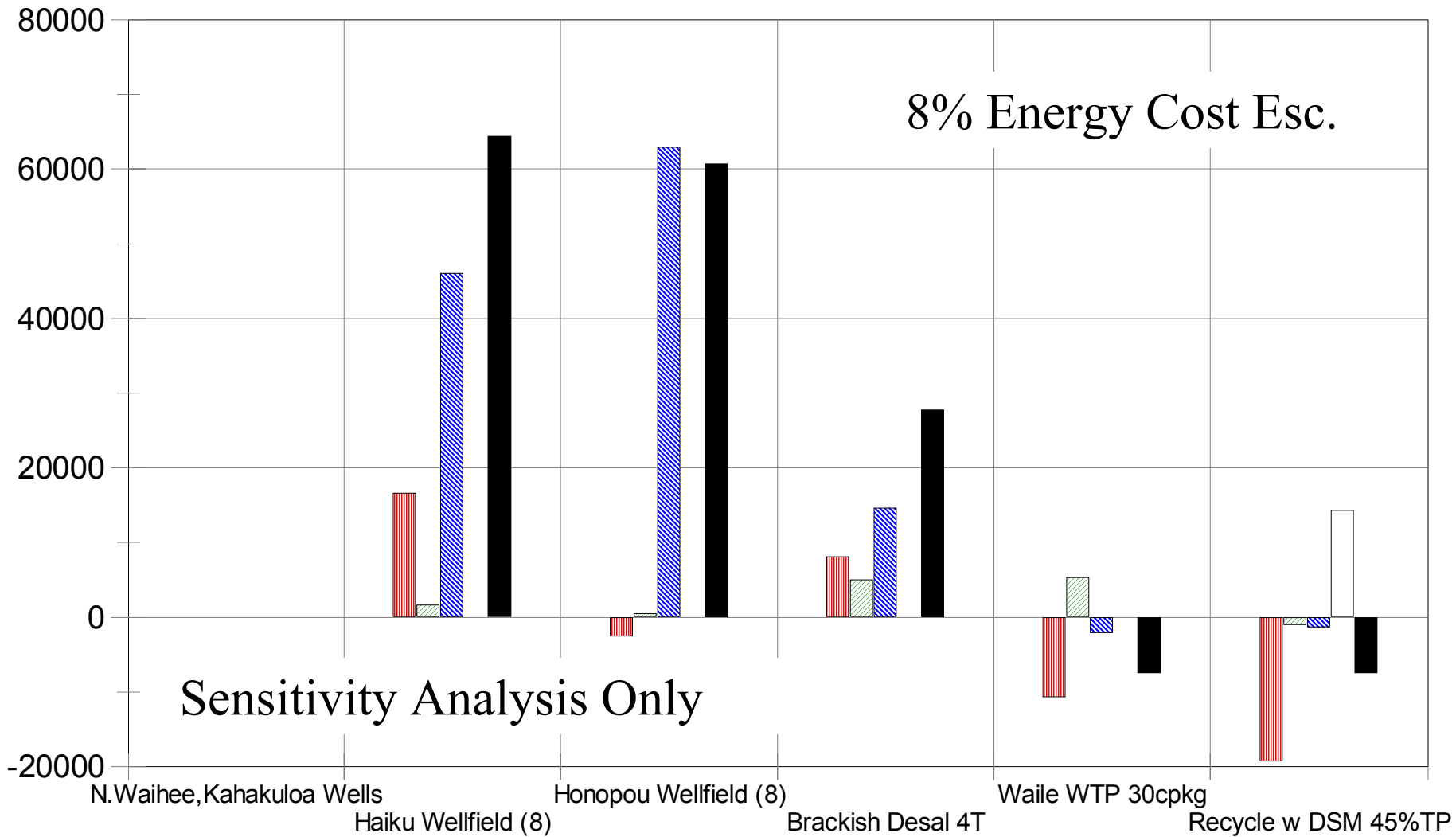
Total System

# Total Planning Period System Costs

Difference From Reference Strategy

8% Energy Cost Esc.

Sensitivity Analysis Only



Var. Op.



Fixed. Op.



Capital



DSM



Total System

# Central District

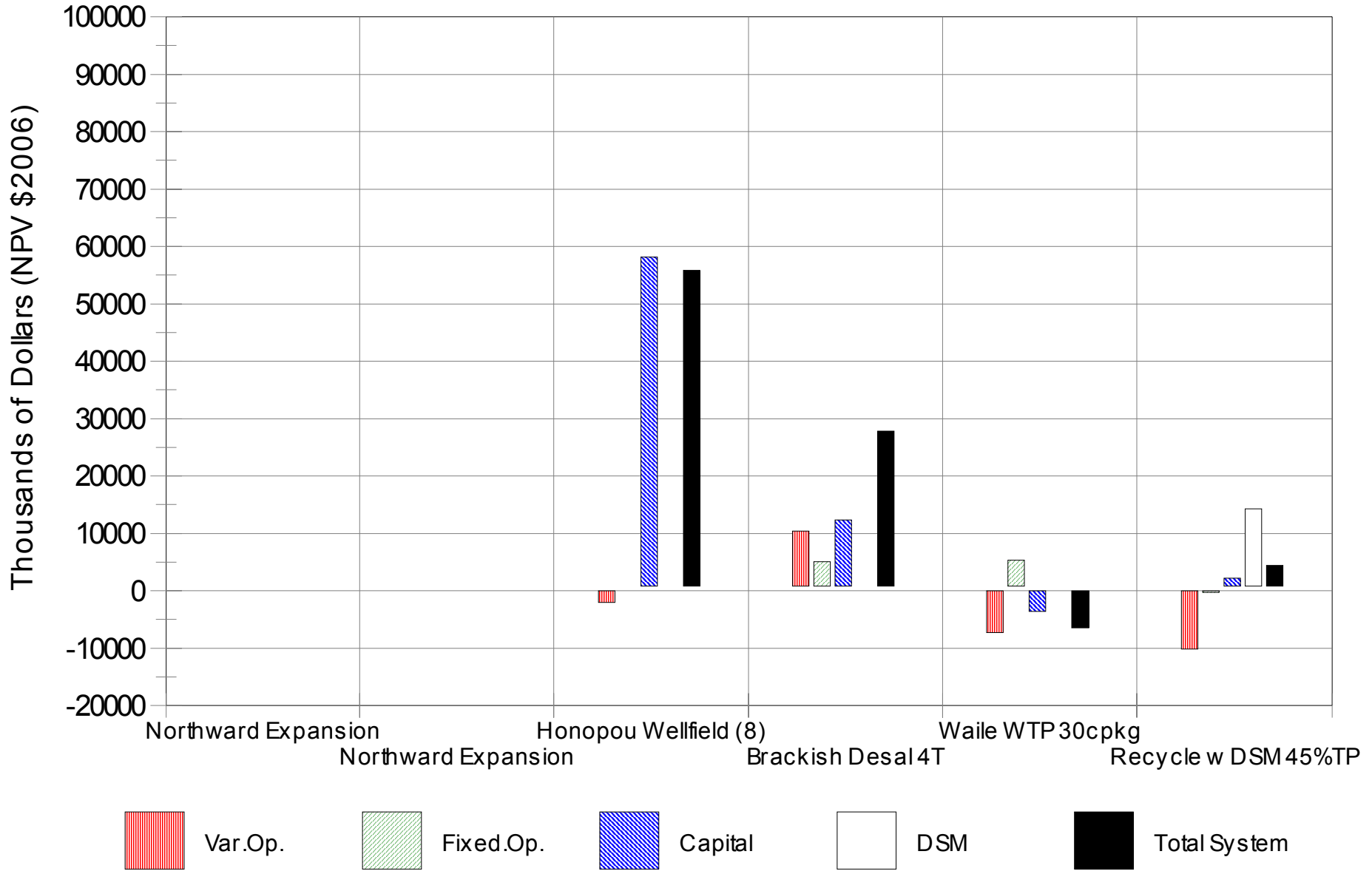
## Final Candidate Strategies

- A. Na Wai Eha Surface Water Treatment
- B. Northward Basal Groundwater
- C. Eastward Basal Groundwater
- D. Desalination
- E. Extensive Conservation and Wastewater Recycling

All of the Plans Are  
EXPENSIVE!

# Total Planning Period System Costs

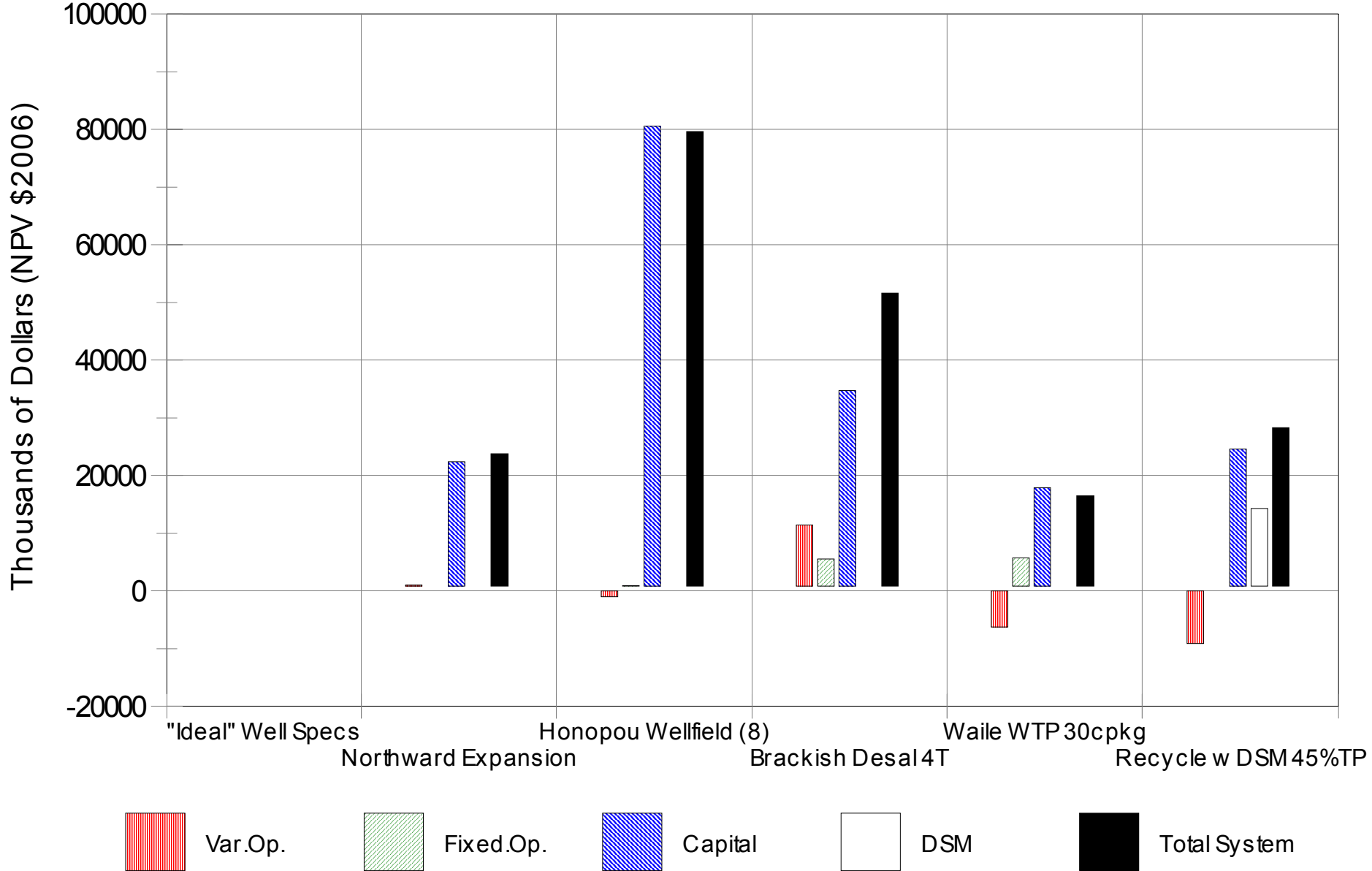
Difference From Reference Strategy





# Total Planning Period System Costs

Difference From Reference Strategy



# WUDP Planning Objectives

Availability	Provide Adequate Volume of Water Supply
Cost	Minimize Cost of Water Supply
Efficiency	Maximize Efficiency of Water Use
Environment	Minimize Adverse Environmental Impacts
Equity	Manage Water Equitably
Sustainability	Maintain Sustainable Resources
Quality	Maximize Water Quality
Reliability	Maximize Reliability of Water Service
Streams	Protect and Restore Streams
Resources	Protect Water Resources
Culture	Protect Cultural Resources
DHHL	Provide For Department of Hawaiian Homelands Needs
Agriculture	Provide For Agricultural Needs
Conformity	Maintain Consistency with General and Community Plans
Viability	Establish Viable Plans

CANDIDATE STRATEGIES	Planning Objectives														
	Availability	Cost	Efficiency	Environment	Equity	Sustainability	Quality	Reliability	Streams	Resources	Culture	DHHL	Agriculture	Conformity	Viability
	MGD Average	\$/kgal 20YR Lev.	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -	+ / -
<b>CANDIDATE STRATEGIES</b>															
NORTHWARD BASAL WELL DEVELOPMENT	Green	Yellow						Green				Green	Green		Yellow
EASTWARD BASAL WELL DEVELOPMENT	Green	Pink						Green				Green	Green	Pink	Pink
EXTENSIVE CONSERVATION AND RECYCLING	Green	Yellow	Green	Green		Green		Green		Green		Green	Green		
NAWAHA SURFACE WATER TREATMENT	Green	Green			Yellow		Yellow	Green	Yellow			Green	Pink		Green
BRACKISH WATER DESALINATION	Green	Pink	Pink	Pink				Green				Green	Green		Green
<b>COMPONENTS IN ALL STRATEGIES</b>															
COMMITTED RESOURCE OPTIONS	Green							Green							
NEAR TERM RESOURCE OPTIONS	Green							Green							Yellow
DEMAND SIDE MANAGEMENT PROGRAMS	Green	Green	Green					Green							
<b>INDEPENDENT STRATEGY COMPONENTS</b>															
SUPPLY SIDE LEAK REDUCTION	Green	Green	Green												
ENERGY PRODUCTION AND EFFICIENCY MEASURES		Green	Green												
STREAM RESTORATION MEASURES		Pink		Green		Green	Green		Green	Green	Green		Blue		
WATERSHED PROTECTION AND RESTORATION	Green			Green		Green	Green		Green	Green	Green		Green		
WELL DEVELOPMENT POLICIES AND REGULATIONS				Green	Green	Green	Green		Green	Green					
WELLHEAD PROTECTION ORDINANCE				Green	Yellow	Green	Green		Green	Green					
LANDSCAPE ORDINANCE	Green	Green	Green					Green	Green	Green					
DROUGHT WATER USE RESTRICTIONS	Pink												Blue		
WATER RATE DESIGN AND PRICING POLICIES			Green										Green		

Comments Are Encouraged:

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Ellen Kraftsow

Department of Water Supply

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