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***The Potential of HERS-ST for
Welfare Analysis of Highway
Spending:
An Application to Texas***

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University of Texas in Austin

Transportation Research Forum - Annual Forum 2004
March 23, 2004

PROJECT OBJECTIVES

Assess the benefits and costs of investment in Texas transportation to identify warranted changes in:

- ✦ The amount Texas spends on Texas transportation infrastructure
- ✦ The optimal allocation of this expenditure among alternative investment categories

To estimate the net benefits that would result from implementation of these changes.

HERS-ST

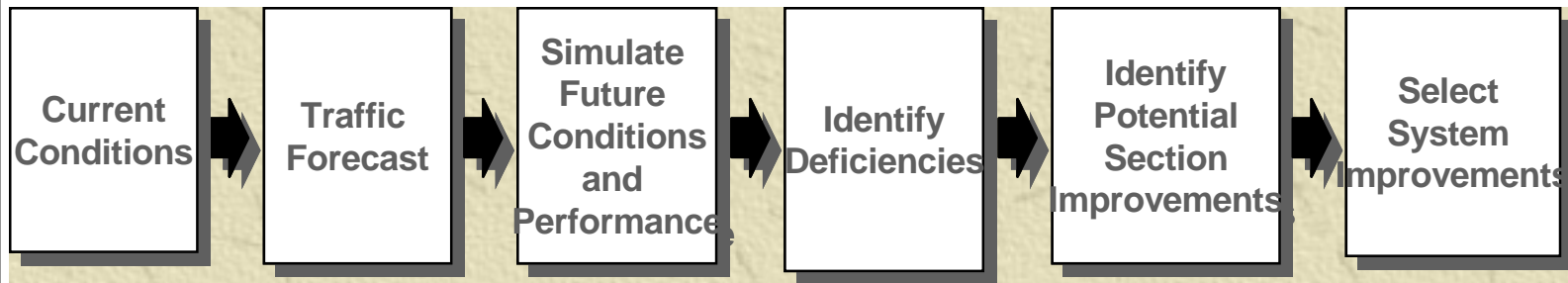
- ✦ Optimal programming of highway capital expenditures at state level
- ✦ FHWA committed to maintenance and further development
- ✦ Seven other States are using the model
 - esp. IN, OR, FL and WI

FHWA's Road Classification System

ARTERIALS	COLLECTORS	LOCAL ROADS
RURAL ROADS		
Interstate Highways	Major Collectors	Local Roads
Other Principal Arterials	Minor Collectors	
Minor Arterials		
URBAN ROADS		
Interstate Highways	Collectors	Local Roads
Freeways and Expressways		
Other Principal Arterials		
Minor Arterials		

KEY TO FIGURE:	Covered by the HERS Model
	Not Covered by the HERS Model

Simplified Representation of the HERS Modeling Process



Source: Ron Hagquist' Presentation, TxDOT Multimodal Section/TPP,
July 2002

Highway Data - HPMS Database

- ✦ Contains a sample of highway sections for each state with detailed information on traffic, pavement conditions, etc.
- ✦ HERS-ST is designed to run with sample in HPMS format
- ✦ HPMS sample for Texas:
 - 5,386 on-system sections
 - 1,954 off-system sections

Parameter Data

Deficiency Thresholds

Parameter Model - Deficiency Thresholds

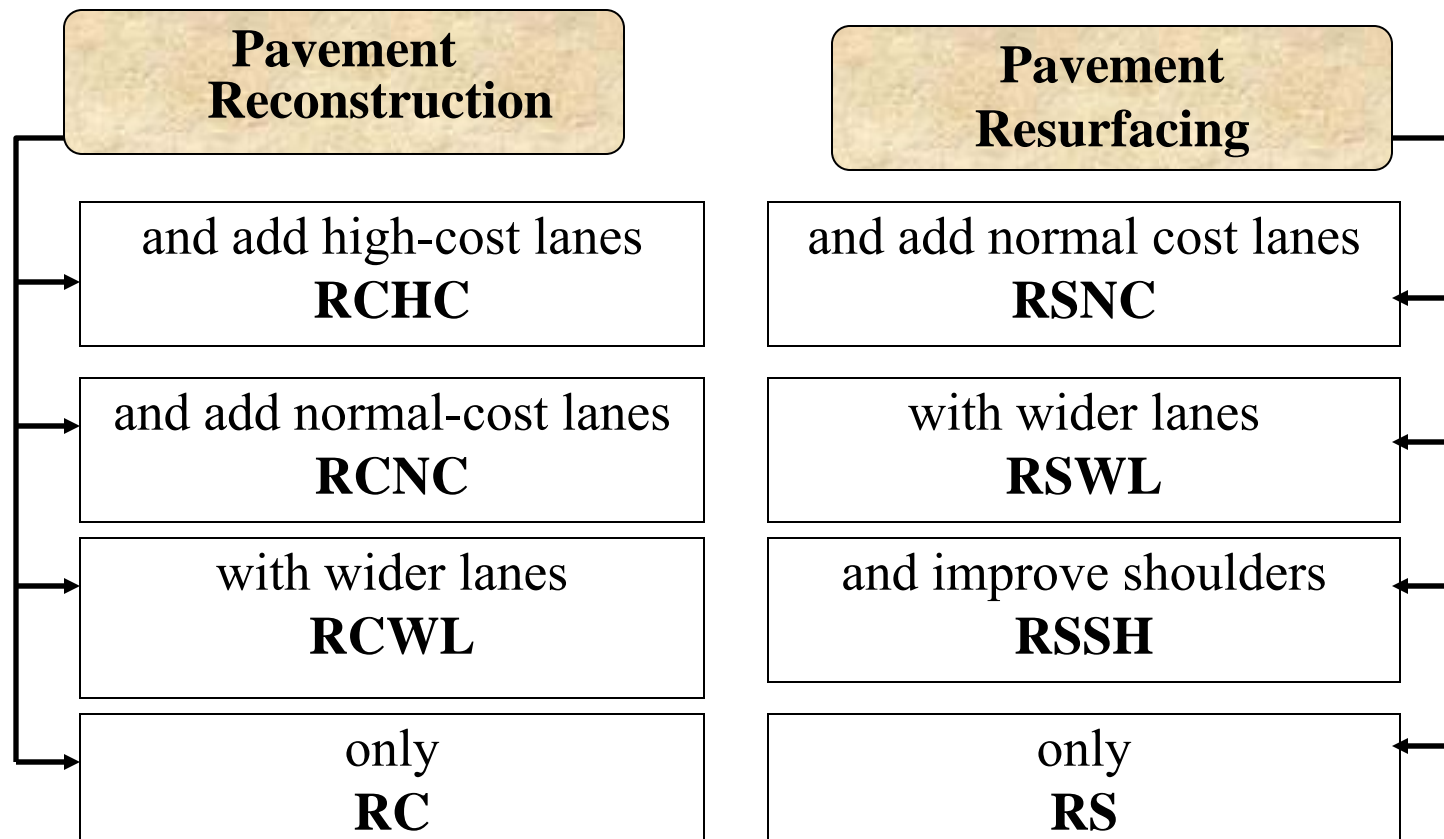
Deficiency Level (DL) Thresholds

		VCR	LnWidth	RSWidth	ShType
Interstate	Flat	.7	12	10	2 - Stabilized
	Rolling	.8	12	9	2 - Stabilized
	Mountainous	.9	12	7	2 - Stabilized
Principal Arterial ADT > 6000	Flat	.7	12	9	2 - Stabilized
	Rolling	.8	12	9	2 - Stabilized
	Mountainous	.9	12	7	2 - Stabilized
Principal Arterial ADT < 6000	Flat	.7	12	9	2 - Stabilized
	Rolling	.8	12	9	2 - Stabilized
	Mountainous	.9	12	7	2 - Stabilized
Minor Arterial ADT > 2000	Flat	.7	12	7	2 - Stabilized
	Rolling	.8	12	7	2 - Stabilized
	Mountainous	.9	12	6	2 - Stabilized
Minor Arterial ADT < 2000	Flat	.7	12	7	3 - Earth
	Rolling	.8	12	7	3 - Earth
	Mountainous	.9	12	6	3 - Earth
Major Collector	Flat	.7	12	6	3 - Earth

DL UST1

Cancel << Previous Next >> Finish

Highway Improvement Types in HERS



HERS-ST

Coverage of Highway Work

Includes

- ✦ Reconstruction
- ✦ “3R”
- ✦ Major widening

Excludes

- ✦ New roads and bridges
- ✦ Bridge preservation
- ✦ Operational improvements (e.g. ramp meters, signals)
- ✦ System enhancement (e.g. safety projects, pedestrian facilities)
- ✦ Local roads & minor rural collectors

HERS-ST

Cost-Benefit Coverage

Includes

Benefits from:

- ✦ Travel time savings
- ✦ Vehicle operating cost savings
- ✦ Pollution reductions
- ✦ Road maintenance cost savings

Excludes

Costs from:

- ✦ Traffic disruption during construction

Capital Outlay Data from **‘FHWA Highway Statistics’**

✦ For on-system highways by:

- State
- Highway functional class and
- Type of improvement

✦ For off-system highways, only the total by state

TxDOT Capital Outlay Estimate for the Types of Improvements in HERS-ST - FY 2000

(\$ millions)

RURAL ROADS	Interstates	Other Principal Arterials	Minor Arterials	Major Collectors	---	SUBTOTAL
	211	416	154	335	---	1,117
URBAN ROADS	Interstates	Other Freeways and Expressways	Other Principal Arterials	Minor Arterials	Collectors	SUBTOTAL
	444	307	301	78	4	1,134
TOTAL =						2,250

The total is about two-thirds of TxDOT's capital outlays on highways

Funding Scenarios

Scenario 1:

- ✦ Unconstrained funding
- ✦ BCR ≥ 1.0

Scenario 2:

- ✦ Constrained funding for the whole system at FY 2000 level
- ✦ \$11,251 million per funding period (\$2,250 million/year)
- ✦ BCR ≥ 0.0

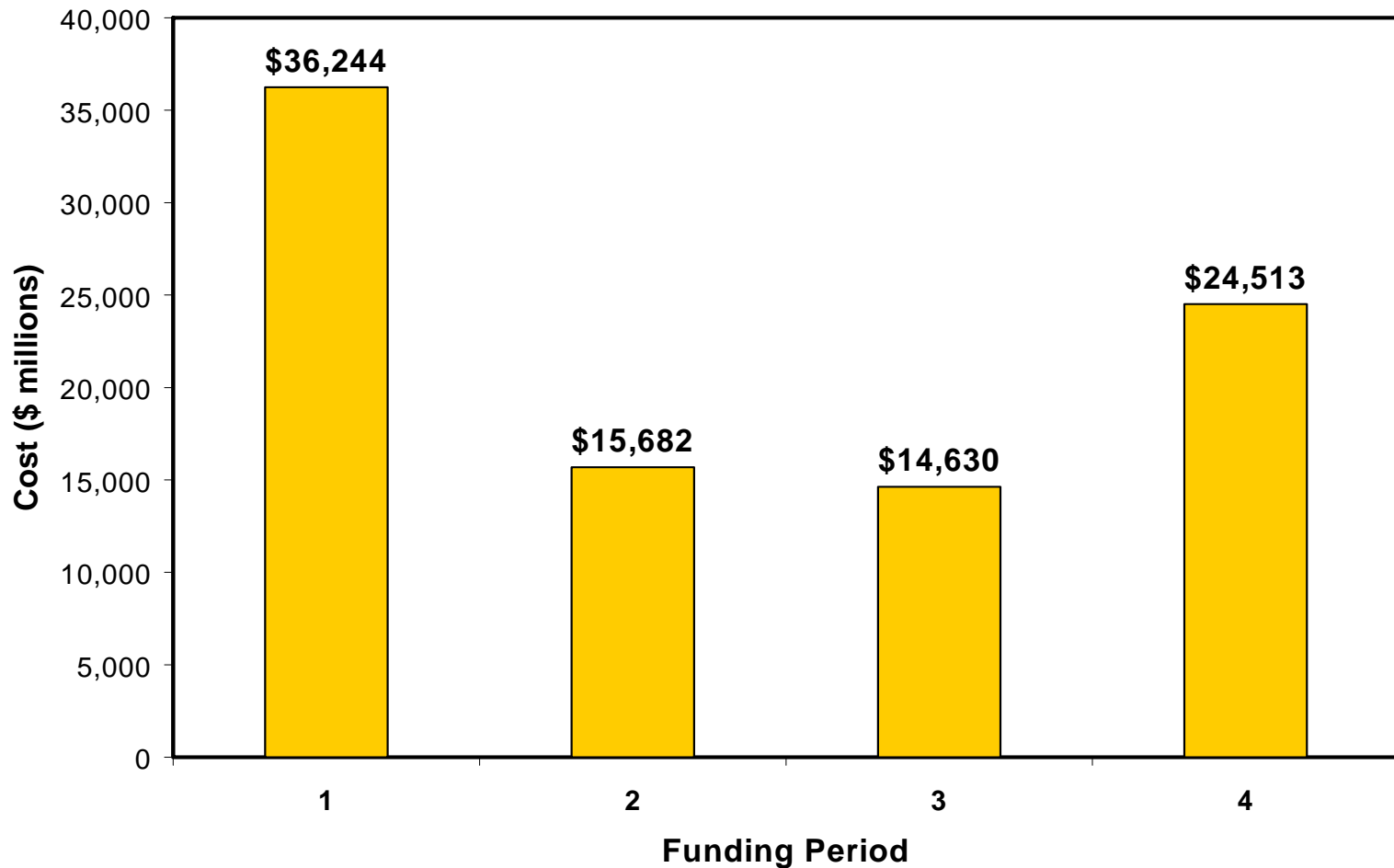
Scenario 3:

- ✦ Constrained Funding for area at FY 2000 level
- ✦ Rural Area = \$5,583 million per funding period (\$1,117 million/year)
- ✦ Urban Area = \$5,668 million per funding period (\$1,134 million/year)
- ✦ BCR ≥ 0.0

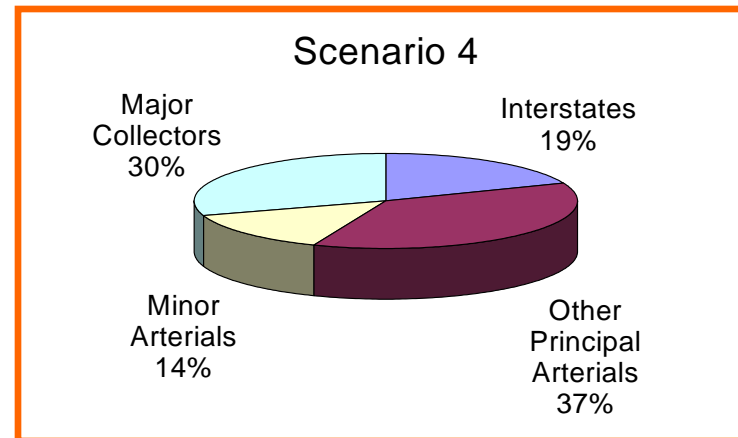
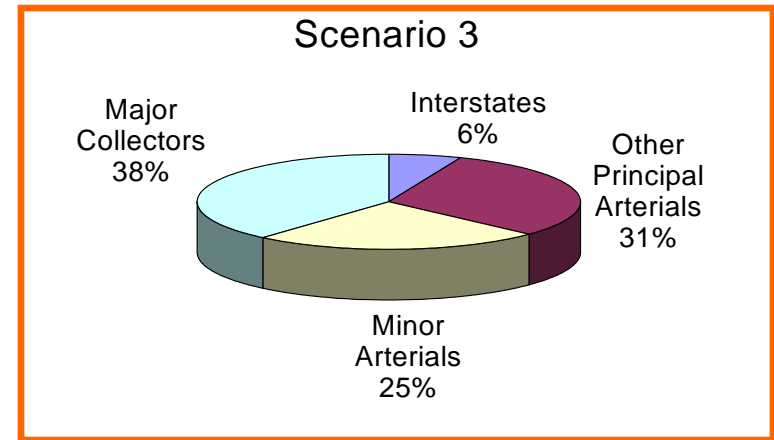
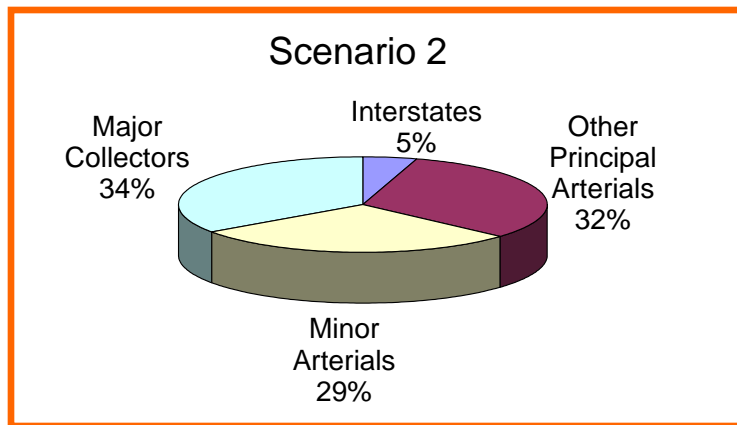
Scenario 4:

- ✦ Constrained Funding for each highway functional class at FY 2000 level
- ✦ BCR ≥ 0.0

Scenario 1 – Capital Cost of Selected Improvements

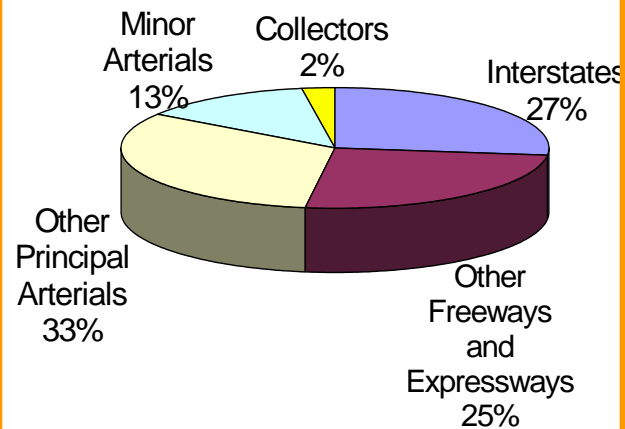


Capital Cost of Selected Improvements (%) in First Funding Period - Rural Areas

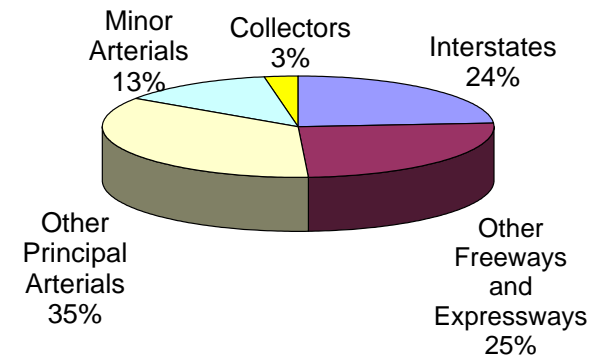


Capital Cost of Selected Improvements (%) in First Funding Period - Urban Areas

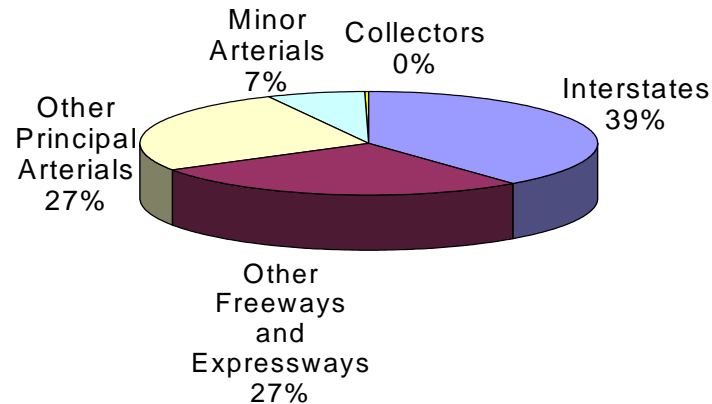
Scenario 2



Scenario 3



Scenario 4



Marginal Benefit-Cost Ratios for the First Funding Period (FY 2000-FY2004)

Scenario 1	Scenario 2	Scenario 3	
1	9.6	Rural	Urban
		5.9	12.3

Scenario 4					
Urban Highway Classes	Interstates	Other Principal Arterials	Minor Arterials	Major Collectors	
	0.8	3.4	27.5	8.5	
Rural Highway Classes	Interstates	Other Freeways/ Expressways	Other Principal Arterials	Minor Arterials	Collectors
	8.4	11.7	15	22.8	79.2

***Benefits from Programmed Capital
Outlays in First Funding Period
(FY 2000 – FY 2004)***

Scenario	Average Benefit-Cost Ratio (BCR)	Total Capital Outlays (\$ millions)	Total Benefits (\$ millions)
1	13.3	36,244	483,495
2	33.5	11,247	376,437
3	33.0	11,284	372,936
4	31.5	11,369	358,237

Benefits per Texas Resident in First Funding Period (FY 2000 – FY 2004)

Texas Population	
2000 Census	20,736,000
2005 (estimate)	21,487,000
Average	21,111,500

Scenario	FY 2000 - FY 2004		PER YEAR
	Total Benefits (\$ millions)	Benefits per capita (\$ millions)	Benefits per capita (\$)
1	483,495	22,902	4,580
2	376,437	17,831	3,566
3	372,936	17,665	3,533
4	358,237	16,969	3,394

*Benefits from economically more efficient allocation of capital outlays:
Scenario 2 instead of Scenario 3*

Present value sum of the benefits in fiscal years 2004, 2009,2014, 2019 (the last years in the funding periods)				
(\$millions in FY 20004 value)				
Highway Category	Benefit Category			
	User Costs	TxDOT Maintenance Costs	Pollution Costs	Total
Rural	-4,597	-43	53	-4,587
Urban	13,228	-24	-10	13,193
Total	8,630	-67	43	8,606
Funding Period				
1	998	-32	20	986
2	2,373	-13	15	2,374
3	2,746	-13	6	2,740
4	2,513	-9	3	2,506
Total	8,630	-67	43	8,606

*Benefits from economically more efficient allocation of capital outlays:
Scenario 2 instead of Scenario 4*

Present value sum of the benefits in fiscal years 2004, 2009,2014, 2019 (the last years in the funding periods)				
(\$millions in FY 20004 value)				
Highway Category	Benefit Category			
	User Costs	TxDOT Maintenance Costs	Pollution Costs	Total
Rural	-4,201	-25	94	-4,132
Urban	12,126	-14	-1	12,111
Total	7,925	-39	93	7,978
Funding Period				
1	-191	-5	63	-133
2	1,863	-7	22	1,877
3	2,709	-10	6	2,705
4	3,543	-16	2	3,529
Total	7,925	-39	93	7,978

Exaggeration?

✦ Average benefit-cost ratios are high:

Scenario 1 13.3

Scenario 2 22.7

Scenario 2 21.6

✦ Possibly exaggerated by:

- Limitations of pavement modeling
- Specification of base case

Understatement?

- ✦ Additional opportunities for improved allocation of TxDOT capital outlays:
 - within highway functional classes (e.g. preservation versus capacity enhancement)
 - and among years
- ✦ About one-third of TxDOT capital outlays not represented in the HERS model

Future Improvements to HERS-ST

✦ Current:

- Pavement deterioration model
- Section-specific truck forecasts
- Traffic disruption costs from highway work

✦ Planned:

- Optimization of timing of investment
- Improved summary measures of benefit