

# Cost Benefit Analysis of Rural and Small Urban Transit in United States

Making the Case for Community Transportation  
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# Background

- The value of transit services in rural and small urban areas is largely unmeasured and impacts are often unidentified.
- Some benefits lend themselves easily to quantification while others do not.
- Information is needed for both costs and benefits of transit operations to support transit investment decisions.



# Outline of Presentation

- Review previous cost-benefit research for rural and small urban areas
- Methodology for assessing transit benefits at the national, regional, and statewide levels in US.
- Estimate the economic costs and benefits of rural and small urban transit in US.

# Previous Research

Skolnik and Schreiner  
(1998)

- Studied small urban area of Connecticut
- Benefit/cost ratio of 9.7 to 1

Burkhardt (1999)

- National and local analyses of rural systems
- Returns on investment of 3 to 1

Southworth et al.  
(2002, 2005)

- Rural and small urban systems in Tennessee
- Benefits of rural systems vary significantly
- Benefit/cost ratios greater than 1.0

HLB Decision  
Economics (2003, 2006)

- Studied Wisconsin
- Return on investment of 6 to 1

HDR Decision  
Economics (2011)

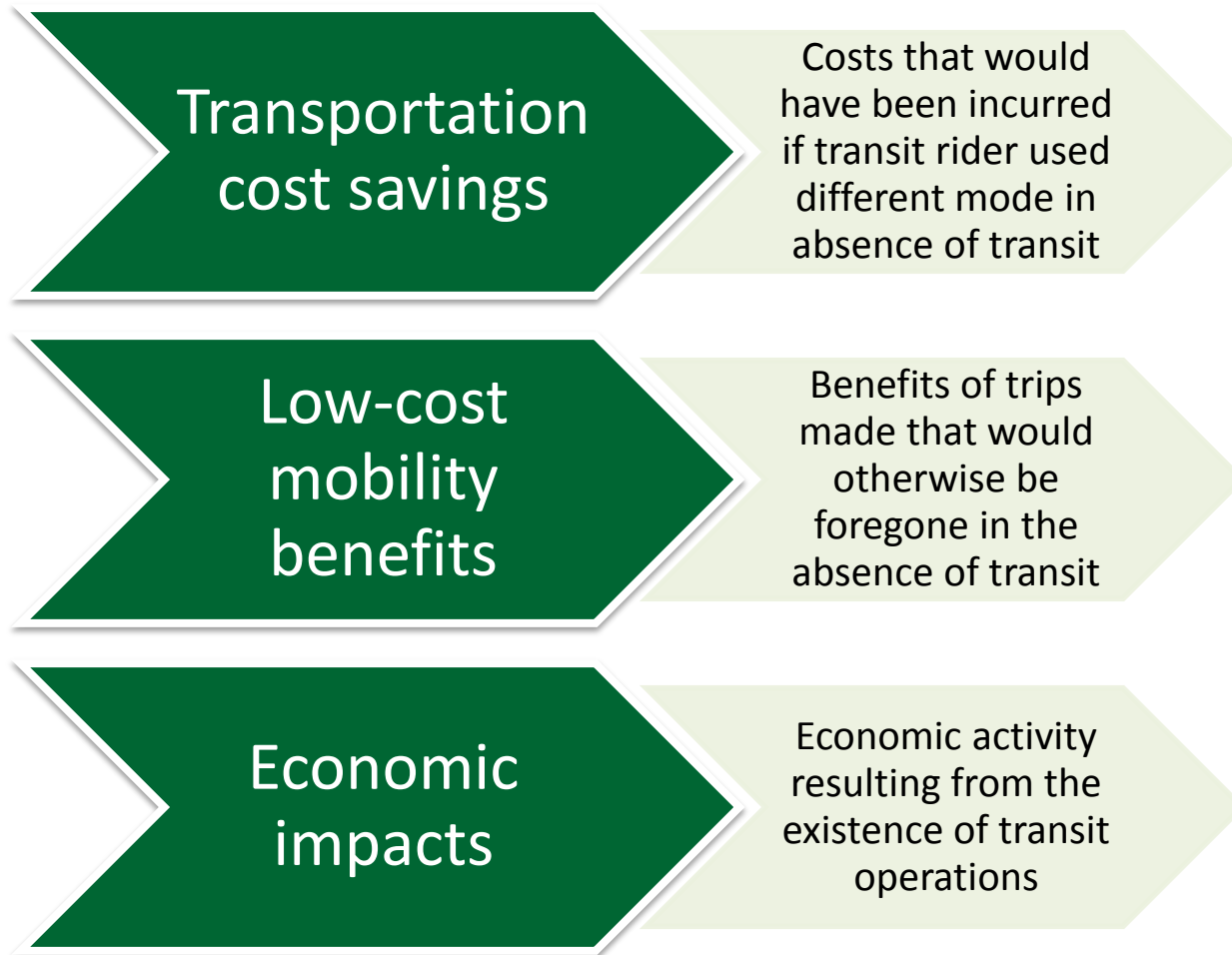
- Conducted in South Dakota
- Every dollar spent generated \$1.90 in economic activity

# Scope of Research Study

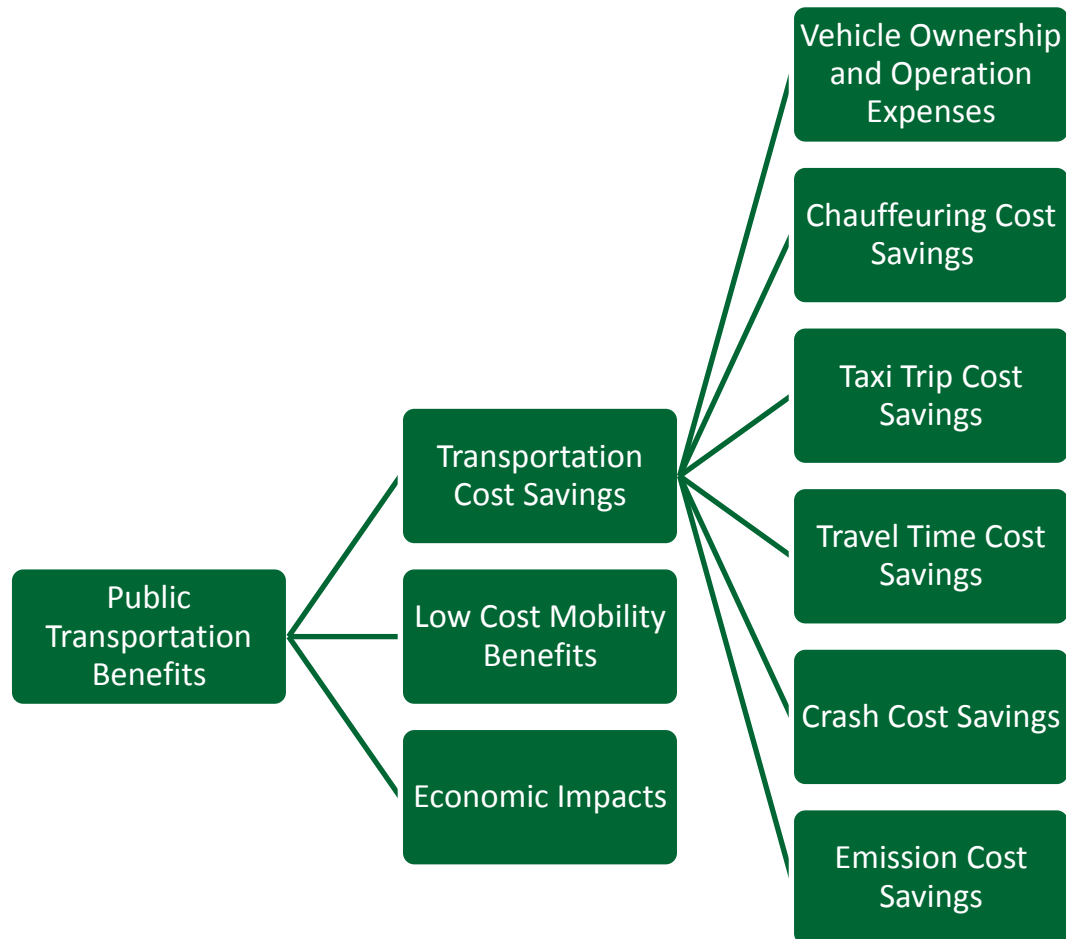
- Small urban and rural transit agencies considered across the country (USA)
- Small urban defined as urban transit agencies serving area with population under 200,000
- 2011 - Data from National Transit Database (NTD) and Rural NTD
- 1,392 rural agencies and 351 small urban agencies identified
- Fixed-route bus service and demand response service studied
- Results presented at national level and state level



# Categorization of Transit Benefits



# Categorization of Transit Benefits



# Study Methodology



Travel behavior in the absence of transit:  
alternative modes and foregone trips



Trip purpose information



Costs incurred on alternative modes



Value of foregone trips, by trip purpose

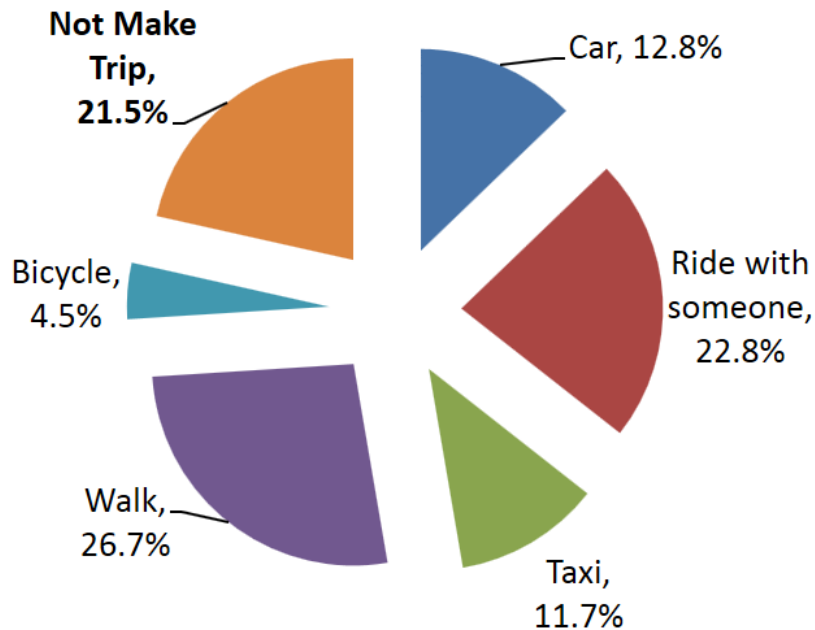


Compare calculated benefits with costs of  
providing transit



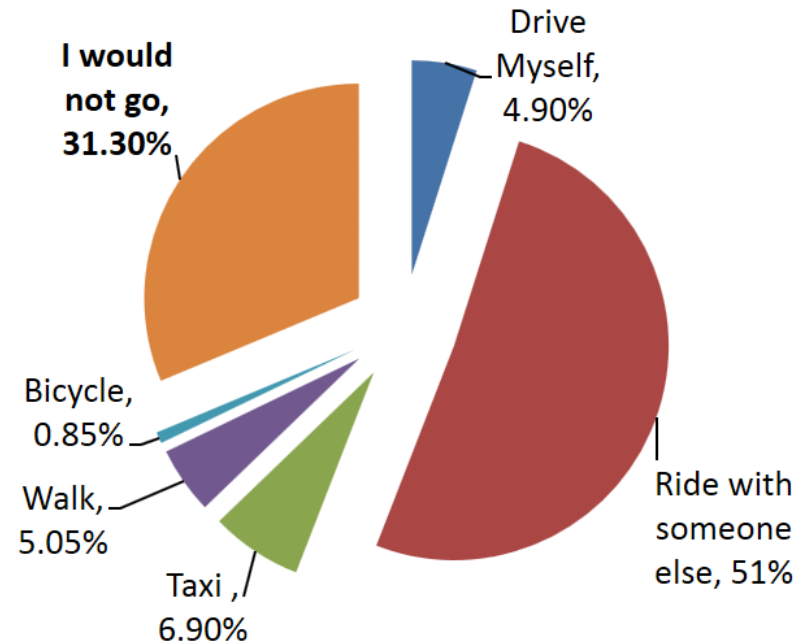
# Trip Alternatives in Absence of Transit

## Fixed-Route Bus



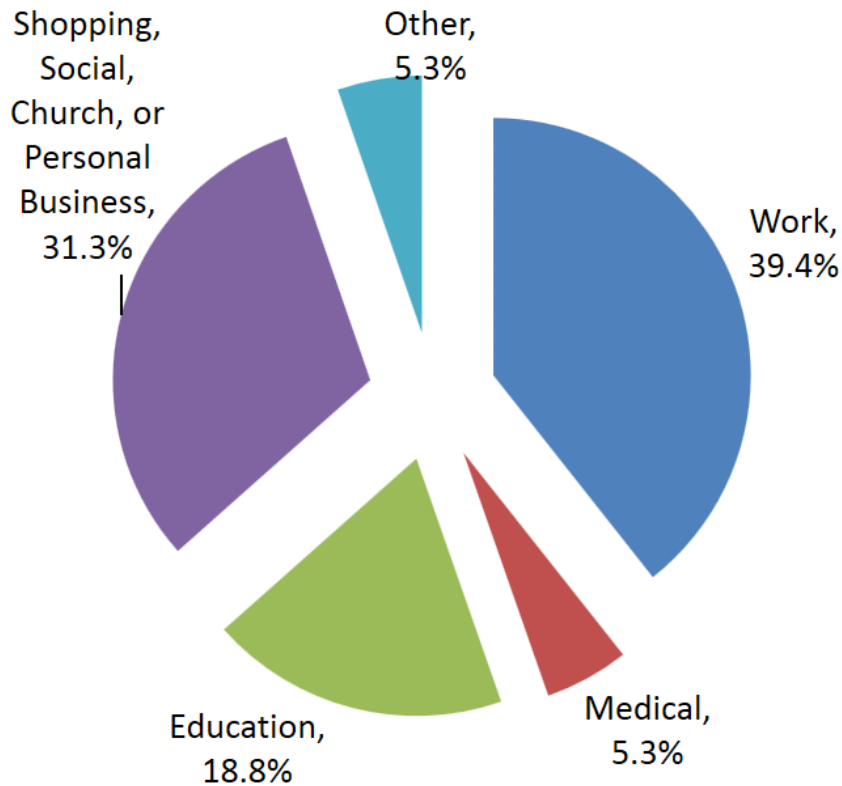
**Source:** Transit Performance Monitoring System (TPMS) (2002)

## Demand Response Service



**Source:** Mattson et al. (2014) Report # 21177060-NCTR-NDSU05

# Transit Trip Purpose



**Source:** Transit Performance Monitoring System (TPMS) (2002)

Trip Purpose	Transit Trips	
	Urban	Rural
Work	41.0%	40.6%
Medical	6.3%	7.4%
Education	10.4%	20.4%
Shopping, Recreation and Tourism	38.0%	29.1%
Other	4.4%	2.5%

**Source:** 2012 Rural Transit Fact Book



## **Benefit Category 1: Transportation Cost Savings**



## Vehicle Ownership and Operation Cost Savings

- Some riders would choose to drive in the absence of transit
- AAA cost estimates used: \$0.65 per mile



## Avoided Chauffeuring Costs

- Some would get a ride from a family member or friend
- Litman (2012) estimated the cost as \$1.05 per chauffeured mile



## Taxi Fare Savings

- Some would take a taxi
- An average taxi fare of \$2.25 per mile was used from Litman (2012)



## Travel Time Savings

- Travel time differences between transit and other modes monetized



## Crash Cost Savings

- Differences in crash costs between transit and other modes



## Environmental Emission Cost Savings

- Differences in emissions costs between transit and other modes



## **Benefit Category 2: Low-Cost Mobility Benefits**

# Benefit of Providing New Trips

## Medical trips

- Cost difference between well-managed and poorly-managed care, plus improvements in quality of life, minus additional medical costs incurred, divided by number of trips required

## Work trips

- Reduction in Temporary Assistance for Needy Families (TANF) and Supplemental Nutrition Assistance Program (SNAP) benefits

## Other trips

- Change in consumer surplus

# Unit Costs Used for Monetizing Transit Benefits

Parameter	Value
Vehicle ownership and operating cost (\$/mile)	\$0.65
Chauffeuring costs (\$/mile)	\$1.05
Taxi fare (\$/mile)	\$2.25
Value of travel time (\$/hour)	\$4.14
Crash costs (\$/vehicle mile)	
Transit	\$0.29
Automobile	\$0.10
Emission costs (\$/vehicle mile)	
Transit	\$0.15
Automobile	\$0.06
Cost of foregone trips (\$/one-way trip)	
Medical	\$357
Work	\$49



## **Benefit Category 3: Economic Impacts**



# Economic Impacts of Spending on Transit

## Direct effects

- Jobs created directly by the transit system

## Indirect effects

- Jobs and income spent in industries that supply inputs to transit

## Induced economic activity

- Economic activity resulting from income generated through both direct and indirect effects

# Economic Impacts of Spending on Transit

- Chu (2013) developed a tool to estimate economic impacts of spending on transit
- Regional Input-Output Modeling System (RIMS II) multipliers
- Economic impacts vary based on source of funds and share of spending that occurs within the community
- Chu's tool was applied to the state of North Dakota



# Results

# Estimated Transportation Cost Savings and Low-Cost Mobility Benefits, 2011

## Rural Transit

	Total Benefits	Benefits per Trip
Fixed-route	\$934 million	\$13.50
Demand-response	\$673 million	\$16.35
Total	\$1.6 billion	\$14.56

# Rural Transit: Benefits Summary (2011, US)

Transit Benefit Category	Fixed Route Bus (million \$)	Demand Response (million \$)	Total (million \$)
<b>Transportation Cost Savings</b>			
Vehicle Ownership and Operation Costs	\$35	\$8	\$42
Chauffeuering Costs	\$50	\$84	\$134
Taxi Cost Savings	\$109	\$38	\$148
Travel Time Cost Savings	-\$20	-\$36	-\$56
Accident Cost Savings	\$29	-\$13	\$16
Emission Cost Savings	-\$7	-\$47	-\$54
<i>Total Transportation Cost Savings</i>	\$196	\$34	\$230
<b>Low Cost Mobility Benefits</b>			
Foregone Medical Trip Benefits	\$393	\$340	\$733
Foregone Work Trip Benefits	\$296	\$256	\$552
Other Foregone Trip Benefits	\$49	\$42	\$92
<i>Total Low Cost Mobility Benefits</i>	\$738	\$639	\$1,377
<b>Total Transit Benefits</b>	<b>\$934</b>	<b>\$673</b>	<b>\$1,607</b>

# Estimated Transportation Cost Savings and Low-Cost Mobility Benefits, 2011

## Small Urban Transit

	Total Benefits	Benefits per Trip
Fixed-route	\$3.4 billion	\$10.23
Demand-response	\$244 million	\$14.31
Total	\$3.7 billion	\$10.43

# Small Urban Transit: Benefits Summary (2011, USA)

Transit Benefit Category	Fixed Route Bus (million \$)	Demand Response (million \$)	Total (million \$)
<b>Transportation Cost Savings</b>			
Vehicle Ownership and Operation Costs	\$110	\$4	\$113
Chauffeuring Costs	\$158	\$40	\$198
Taxi Cost Savings	\$346	\$18	\$365
Travel Time Cost Savings	-\$148	-\$17	-\$165
Accident Cost Savings	\$42	-\$18	\$24
Emission Cost Savings	\$5	-\$9	-\$3
<i>Total Transportation Cost Savings</i>	\$513	\$18	\$531
<b>Low Cost Mobility Benefits</b>			
Foregone Medical Trip Benefits	\$1,362	\$101	\$1,463
Foregone Work Trip Benefits	\$1,390	\$103	\$1,493
Other Foregone Trip Benefits	\$160	\$22	\$182
<i>Total Low Cost Mobility Benefits</i>	\$2,913	\$226	\$3,139
<b>Total Transit Benefits</b>	<b>\$3,425</b>	<b>\$244</b>	<b>\$3,669</b>



# Benefit-Cost Analysis



# National Summary: Transit Benefits, Costs, and Their Analysis Results

	Small Urban Areas	Rural Areas
<b>Transit Benefits</b>	Benefits/Trip	Benefits/Trip
Vehicle ownership and operation cost savings	\$0.32	\$0.38
Chauffeuring Cost Savings	\$0.56	\$1.21
Taxi cost savings	\$1.04	\$1.34
Travel time cost savings	-\$0.47	-\$0.58
Accident cost savings	\$0.07	\$0.15
Emission cost savings	-\$0.01	-\$0.49
Cost of foregone medical trips	\$4.16	\$6.65
Cost of foregone work trips	\$4.24	\$5.00
Cost of other foregone trips	\$0.52	\$0.83
<b><i>Total Transit Benefits</i></b>	<b><i>\$10.43</i></b>	<b><i>\$14.49</i></b>
<b>Transit Costs</b>	Cost/Trip	Cost/Trip
Operational Expenses	\$4.49	\$10.78
Capital Expenses	\$0.33	\$1.03
<b><i>Total Transit Costs</i></b>	<b><i>\$4.83</i></b>	<b><i>\$11.81</i></b>
<b><i>Benefit/Cost Ratio</i></b>	<b><i>2.16</i></b>	<b><i>1.20</i></b>

# Transit Benefits Measured in the Study

## Transportation cost savings

Costs that would have been incurred if transit rider used different mode in absence of transit

## Low-cost mobility benefits

Benefits of trips made that would otherwise be foregone in the absence of transit

## Economic impacts

Economic activity resulting from the existence of transit operations

*“Economic impacts of transit operations were estimated for the state of North Dakota. Results show that every **\$1** invested in public transportation results in **\$1.35** in output, **\$0.57** in value added, and **\$0.37** in earnings, and 10.3 jobs are supported for every **\$1** million invested.”*

*“HDR Decision Economics studies economic impacts of Transit in South Dakota and found that for every **\$1** spent on public on Transit generated **\$1.90** in economic activity.”*



# Sensitivity Analysis

# Sensitivity Analysis

- For monetizing the transit benefits, many assumptions were made regarding travel behavior and unit costs from previous studies.
- Useful to understand national transit benefits by using different unit costs and travel behavior from base condition.
- Six scenarios were considered for sensitivity analysis.

# Sensitivity Analysis

## Scenario 1

- Foregone trips increased to 50%

## Scenario 2

- Walk/bicycle trips decreased by half for fixed-route

## Scenario 3

- Automobile cost increased from \$0.65 to \$0.84 per mile

## Scenario 4

- Cost of foregone medical and work trips increased 25%

## Scenario 5

- Cost of foregone medical and work trips decreased 25%

## Scenario 6

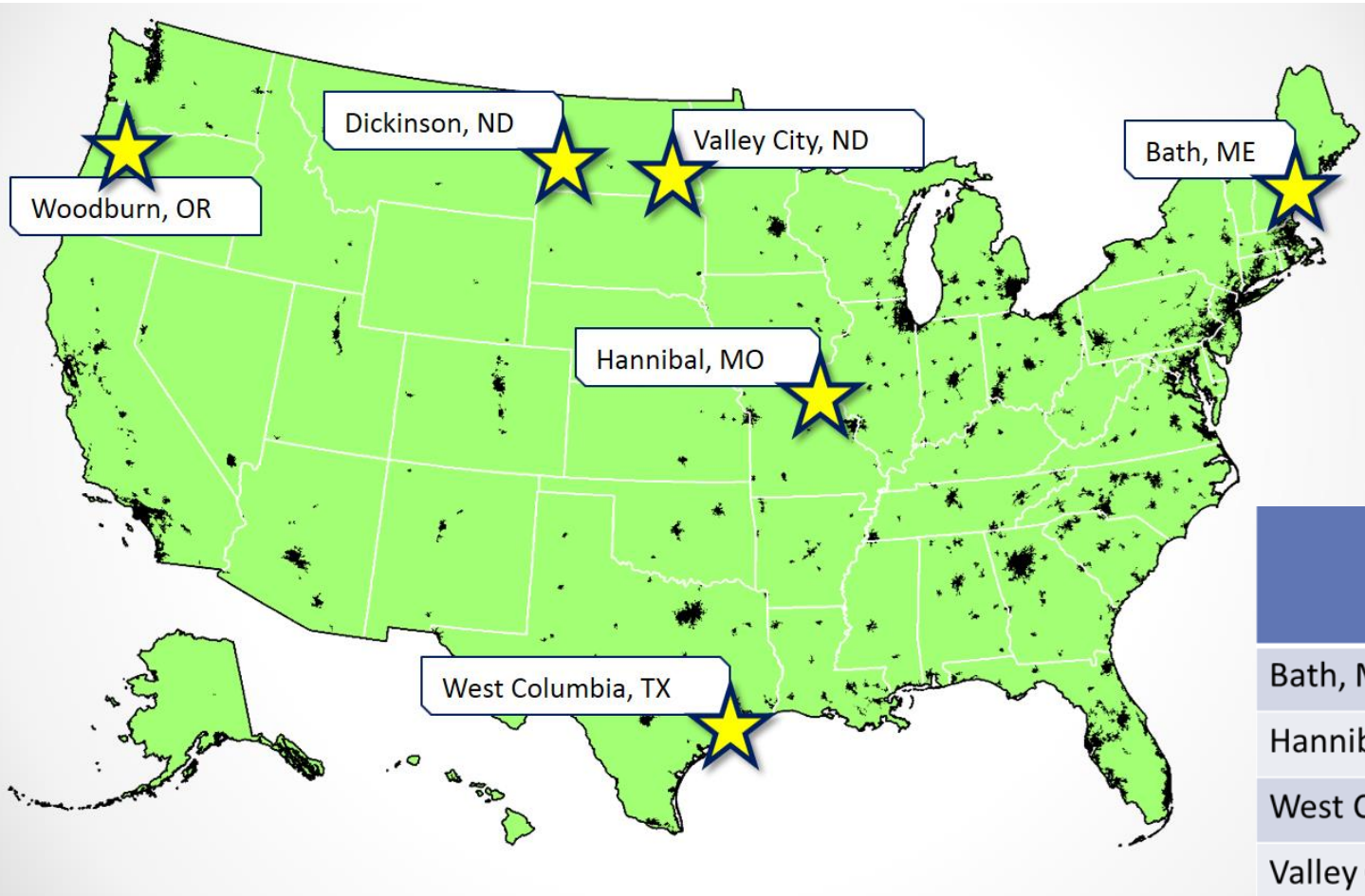
- Value of travel time for transit and automobile set equal

Sensitivity Analysis Results	Transit Benefits (in Millions)						
	Base Case	Scenarios					
		1	2	3	4	5	6
Total Transit Benefits	5,277	9,935 (88%)	5,287 (0%)	5,322 (1%)	6,337 (20%)	4,216 (-20%)	5,327 (1%)
Benefit Cost Ratio	1.68	3.17	1.69	1.70	2.02	1.35	1.70



## **Rural Community Case Studies: Survey of Residents, Transit Riders, and Transit Stakeholders.**

# Six Rural Community Case Studies Conducted in US



	2010 Population
Bath, ME	8,514
Hannibal, MO	17,916
West Columbia, TX	3,905
Valley City, ND	6,585
Dickinson, ND	17,787
Woodburn, OR	24,080



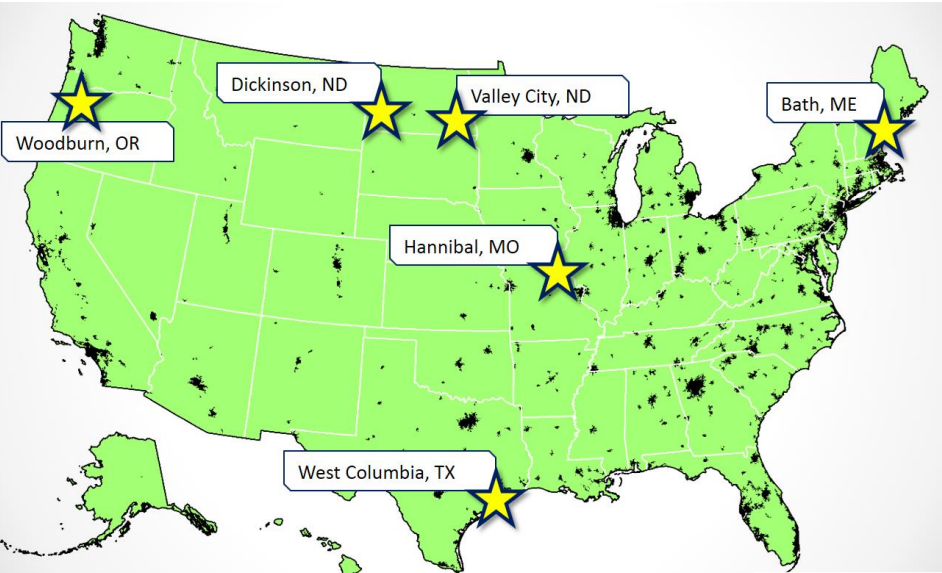
# Three-Pronged Outreach

- Survey random sample of residents
- Survey random sample of transit riders
- Interview key stakeholders





# Outreach Success



	2010 Population	Resident Survey Responses (N=)	Transit Rider Survey Responses (N=)	Stakeholder Interviews
Bath, ME	8,514	363	90	7
Hannibal, MO	17,916	488	65	10
West Columbia, TX	3,905	109	10	5
Valley City, ND	6,585	241	48	9
Dickinson, ND	17,787	175	78	8
Woodburn, OR	24,080	497	64	9



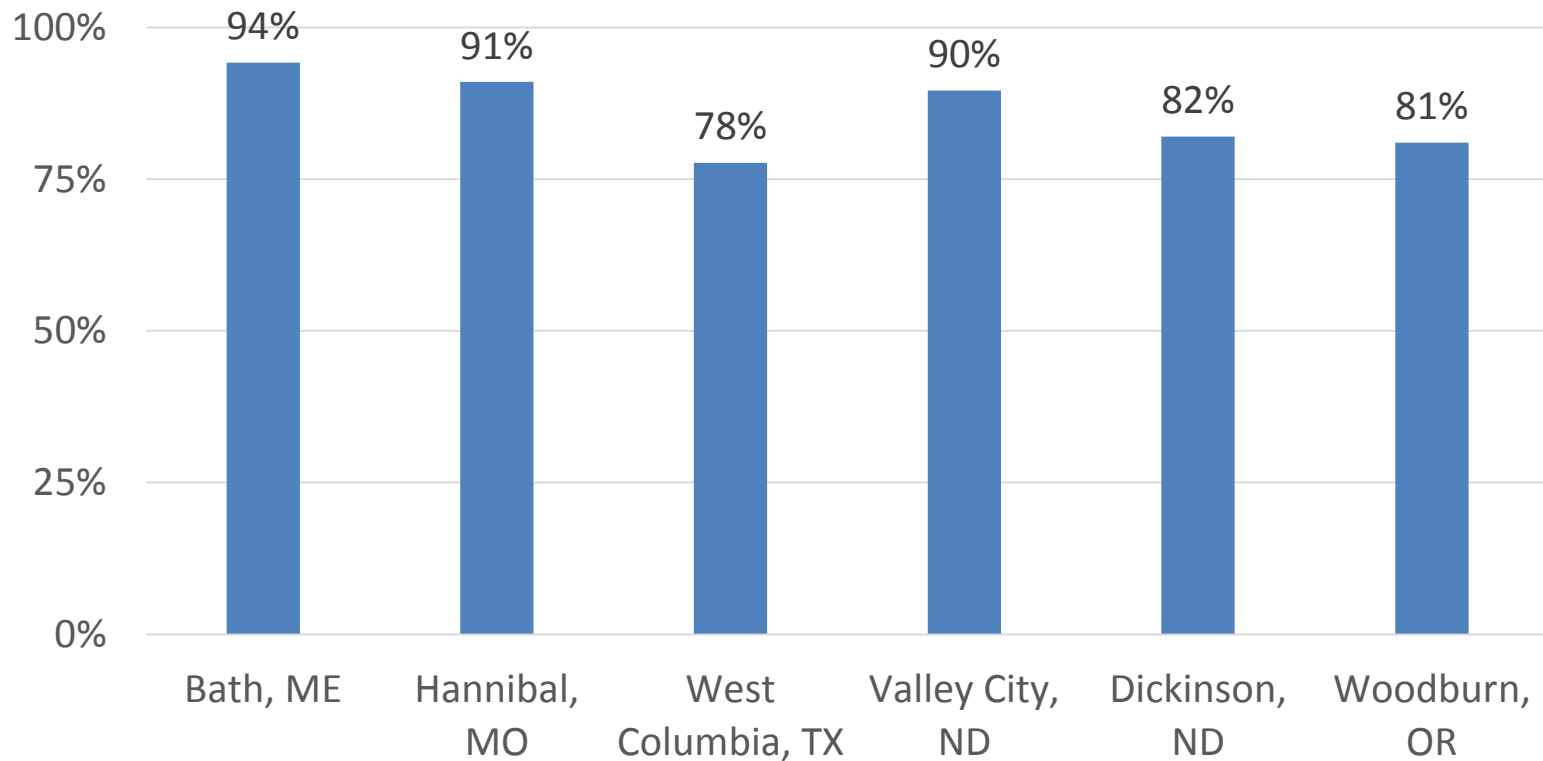
# Resident Survey Responses from Six Communities

# Awareness and Use of Transit

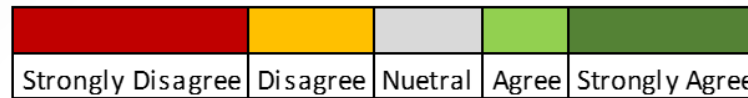
	Bath, ME	Hannibal, MO	West Columbia, TX	Valley City, ND	Dickinson, ND	Woodburn, OR
Has used transit personally	36%	20%	12%	22%	10%	21%
Does not use, but knows someone who has used transit	24%	53%	<i>Not asked</i>	61%	48%	28%
Does not use, does not know someone who uses transit, but aware service exists	30%	21%	39%	12%	32%	40%
Does not use, not aware transit service exists	11%	6%	49%	5%	10%	11%

# Transit's Importance for the Community

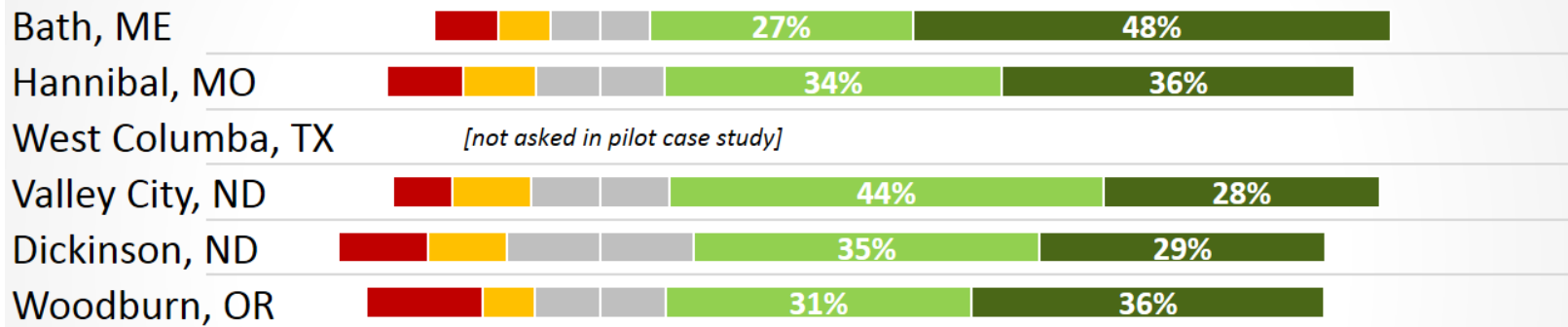
Residents Who Strongly Agree or Agree it is Important for Transit Service to Continue to be Available



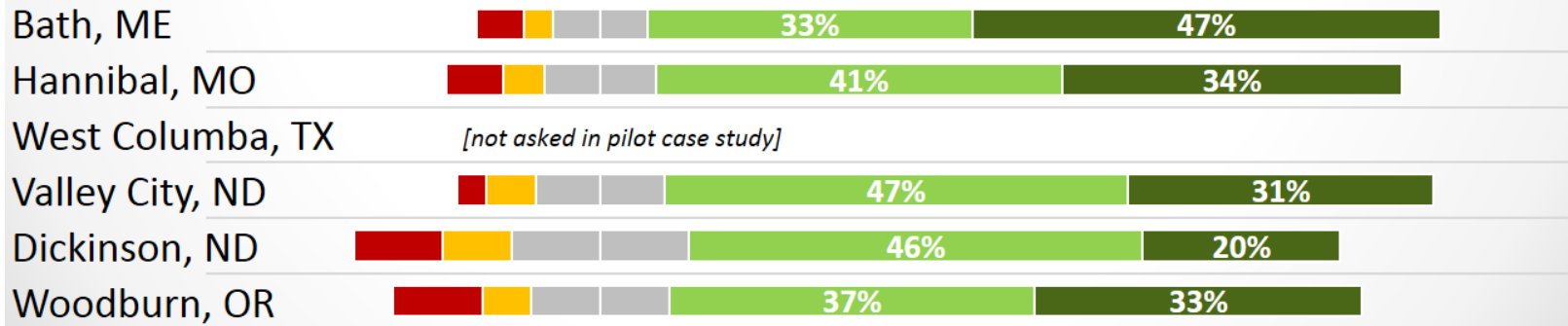
# Support for Funding Sources



## “I support using federal funds for public transit service.”



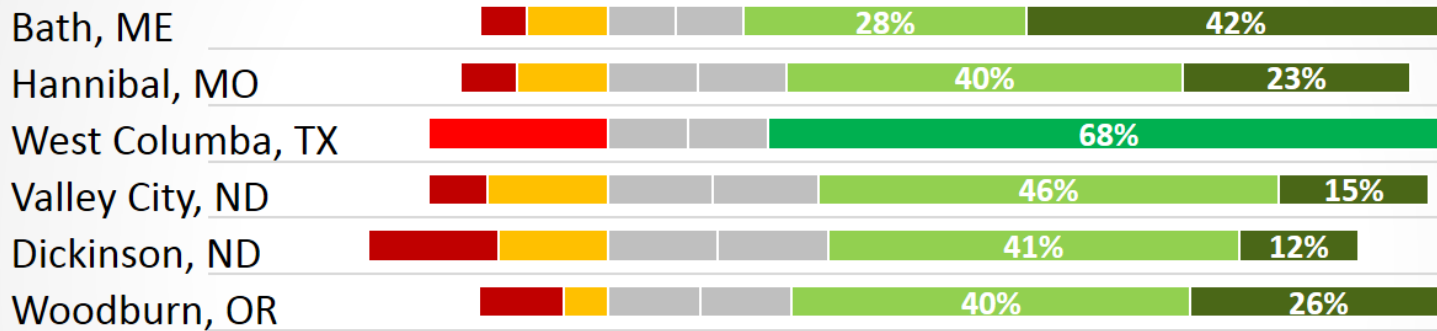
## “I support using state funds for public transit service.”



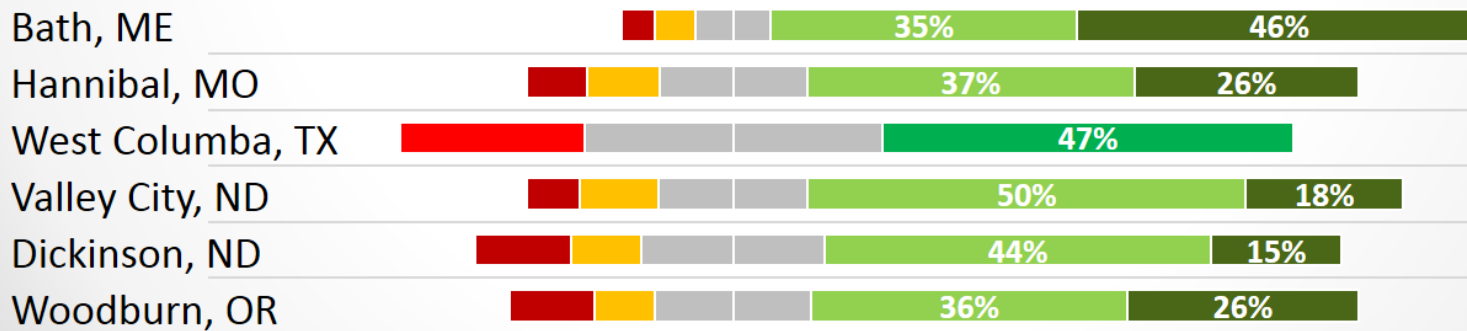
# Support for Funding Sources



## “I support using county funds for public transit service.”



## “I support using city funds for public transit service.”

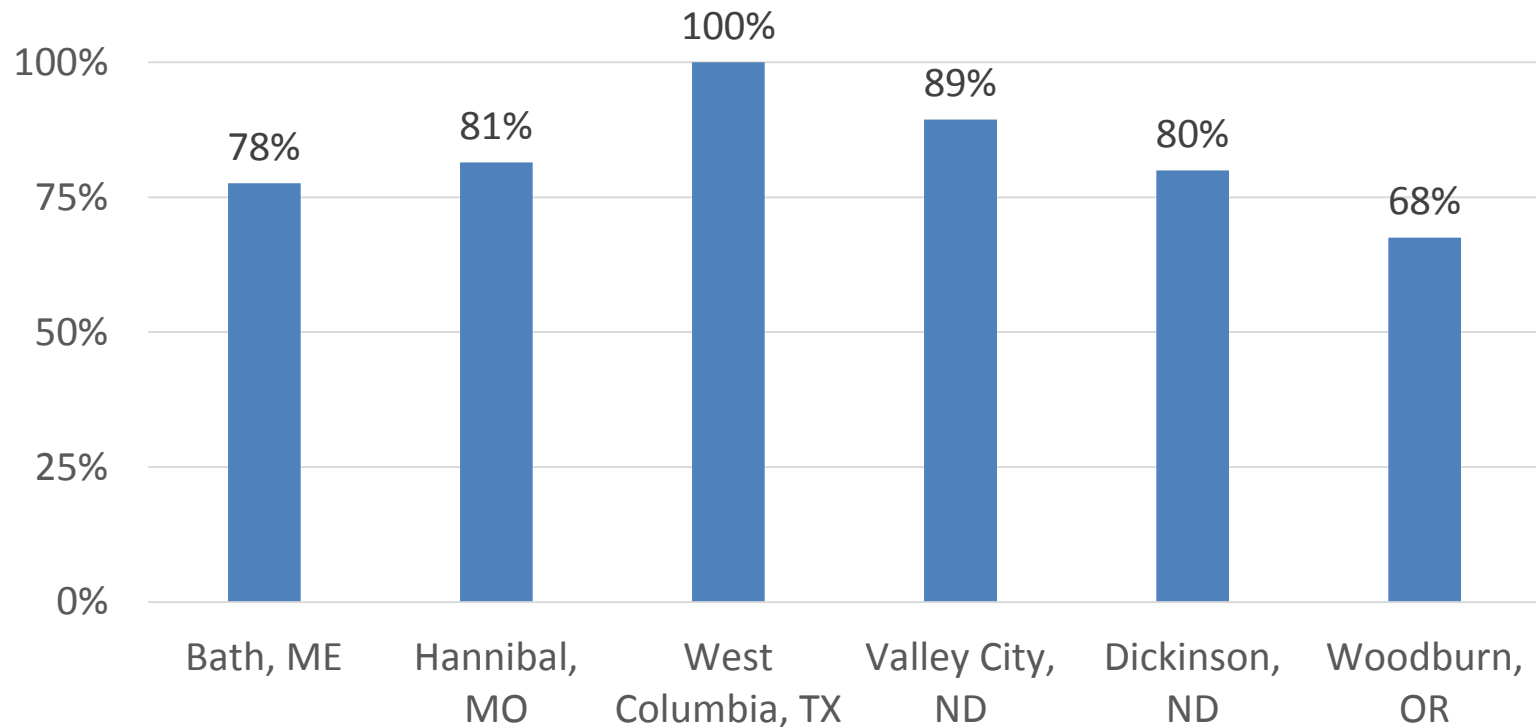




## Transit Rider Survey Responses from Six Communities

# Transit's Importance for Rider Quality-of-life

Transit Riders Who Strongly Agree or Agree Transit Service is Very Important to their Quality of Life





# Rider Trip Purposes

	Bath, ME	Hannibal, MO	West Columbia, TX	Valley City, ND	Dickinson, ND	Woodburn, OR
Medical appointments, health care, dental services	44%	79%	67%	46%	68%	80%
Work	15%	16%	0%	6%	29%	24%
School, college, job training	3%	5%	11%	35%	4%	8%
Volunteering	11%	12%	22%	6%	12%	6%
Family, personal business	38%	16%	22%	21%	22%	16%
Social, recreational	36%	14%	22%	19%	14%	18%
Shopping, errands	72%	53%	56%	23%	44%	54%
Other	10%	11%	11%	17%	10%	14%



# Transit Stakeholder Interviews

# Transit Stakeholder Interviews

- All the stakeholders expressed the sentiment that the local transit agency is a critical lifeline to their community for:
  - people who are elderly and/or have a disability
  - important transportation option for children to attend pre-school and schools,
  - people who need to travel out-of-town for dialysis or special medical treatment,
  - individuals with no vehicle,
  - and those who cannot drive.



# Summary and Conclusions

# Conclusions

- Benefit-cost ratios being greater than 1, the results show that benefits provided by transit in rural and small urban areas in US are greater than costs of providing services.
- Benefit-cost ratios are higher in small urban areas than in rural areas.
- Fixed route service had higher benefit-cost ratio than demand response service.
- Most of the benefits of small urban and rural transit services are generated by creating trips for individuals who would not be able to make the trip if the service was not available.

- Results are highly sensitive to percentage of trips that would be foregone in the absence of transit, cost of value assigned to those foregone trips, and percentage of trips that are for medical purposes.
- The implication of the results is that transit services that serve a higher percentage of transit-dependent riders and those that provide a great percentage of medical or work trip will provide more benefits per trip.



Thank you!  
Questions?

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