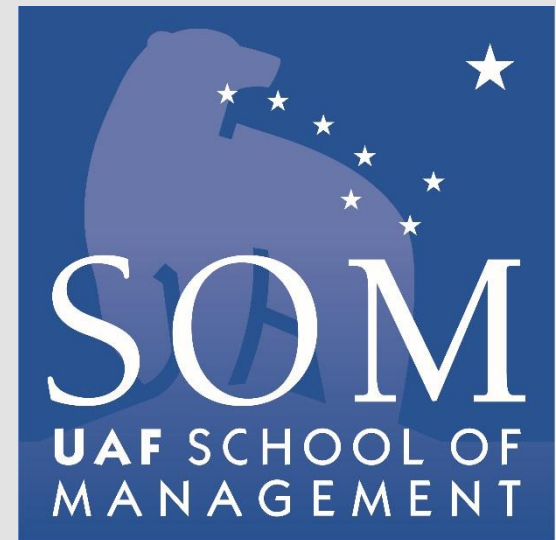


# A New Affordability Indicator for Rural Alaskan Water Utilities

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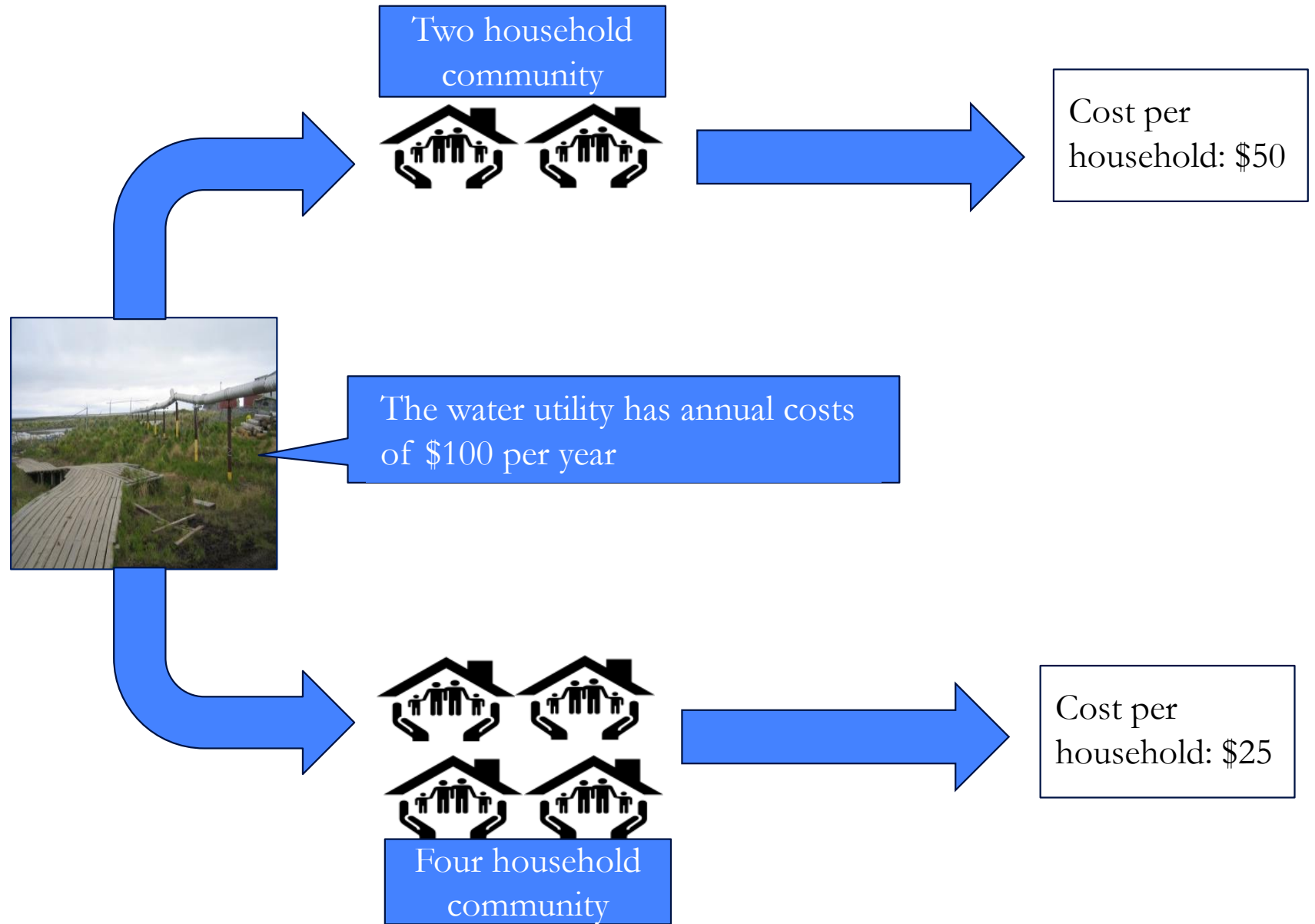


# Outline

- Background
  - The Economics of water utility
  - Defining Affordability
  - Evaluating the Current Affordability Indicator
- The New Affordability Indicator
- Results
  - Akiachak
  - Shageluk
  - Overview of unserved communities
- Further research

# The Economics of Water Utilities: Economies of scale

## Economies of scale



# The Economics of Water Utilities: Funding and pricing



Capital costs (construction costs) are funded by state and federal agencies



Once the utility is built the community is expected to cover the annual costs of running the utility.



Rates are set by dividing the annual costs by the number of customers.

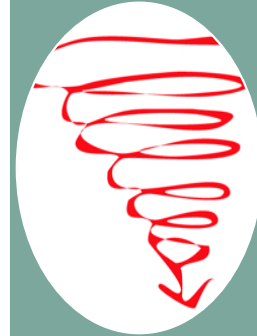


If rates are too high, some customers will be unable to pay their bills.



Utilities cut off non paying customers and re-calculate rates.

Rates increase.



Even less customers can afford the water bills and so more drop off.

Rates increase again.



# The Economics of Water Utilities

▶ ARUC - Alaska Rural Utility

**Collaborative**

May 19, 2015 - Saint Michael, AK, United States - 🌐

I wanna know how many villages have households paying \$250 a month for water service, only reason i wanna know is because I think residents of St. Michael, Alaska are over paying on their water service. My water bill is current to this month, but thats because I work year round and can afford it. But so many families in this village hardly have a chance at keeping up with this rate. Its for those families I am concerned. There's no question that sanitation is a lot easier with running water and flush toilets, and every household or community that desires such a system deserves one. But at what cost?

# The Economics of Water Utilities



**ARUC - Alaska Rural Utility Collaborative** Hello Scott, thank you for your question. The water and sewer rates for your community are based on expenses which must be paid in order to keep the water plant operating. As with all Alaska Rural Utility Collaborative (ARUC) communities, revenues must be equal to expenses.

Unfortunately, the collections are not generating enough revenue to pay water and sewer expenses. The annual operating expenses for providing water and sewer services for St. Michael is \$272,936. If all customers in St. Michael paid their water and sewer bills, the rate could decrease to \$196 a month.

We do understand that the rates for some communities are high. In 2014, the City agreed to a subsidy to decrease residential rates to \$175 per month. The agreed upon subsidy, however, was not sent to ARUC. Based on current service and collection rates and projected expenses, revenues will not be sufficient to cover current operating expenses, or reduce deficit or build critical equipment reserves.

Based on last year's finances, the ARUC Advisory Committee recommended that rates increase for residential users. However, the City is still working to get a subsidy for the residents. There are also some energy efficiency projects that will likely save in energy and fuel costs.

If you have additional questions or concerns please contact Rick Lind, the regional manager at 1-866-205-7581.



# Defining Affordability

## Affordability:

- **Individual (household level):** Whether a low income household is able to pay a water bill without giving up other essential goods and services

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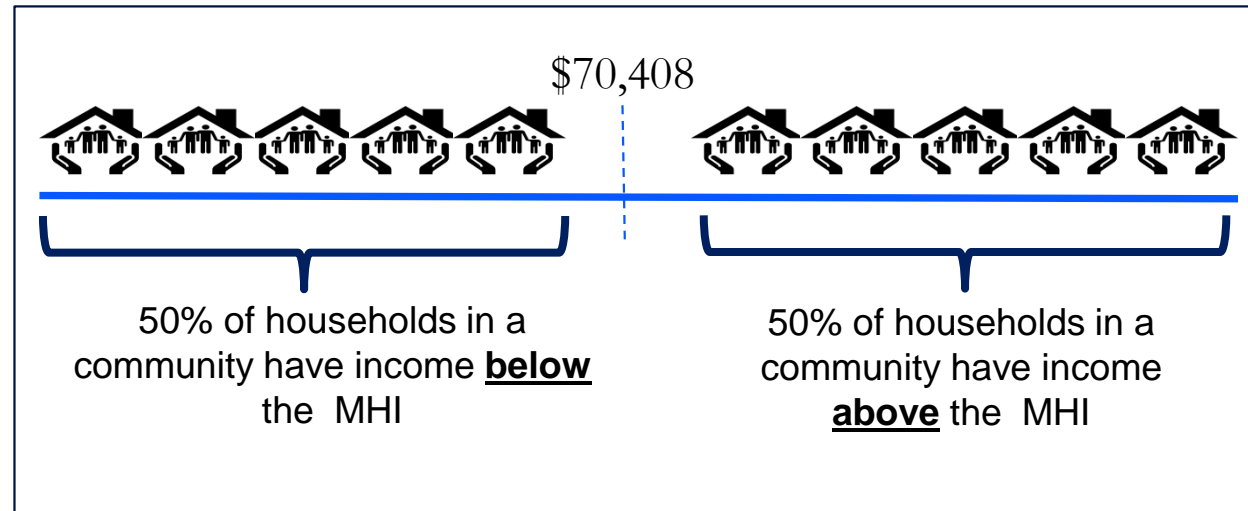
- **Community level:** The community is able to cover the utilities annual costs.



# Defining Affordability

The DEC – VSW currently defines a system to be affordable if utility bills represent less than 5% of the community's Median Household Income (MHI)

## Median Household Income (MHI) in Fairbanks

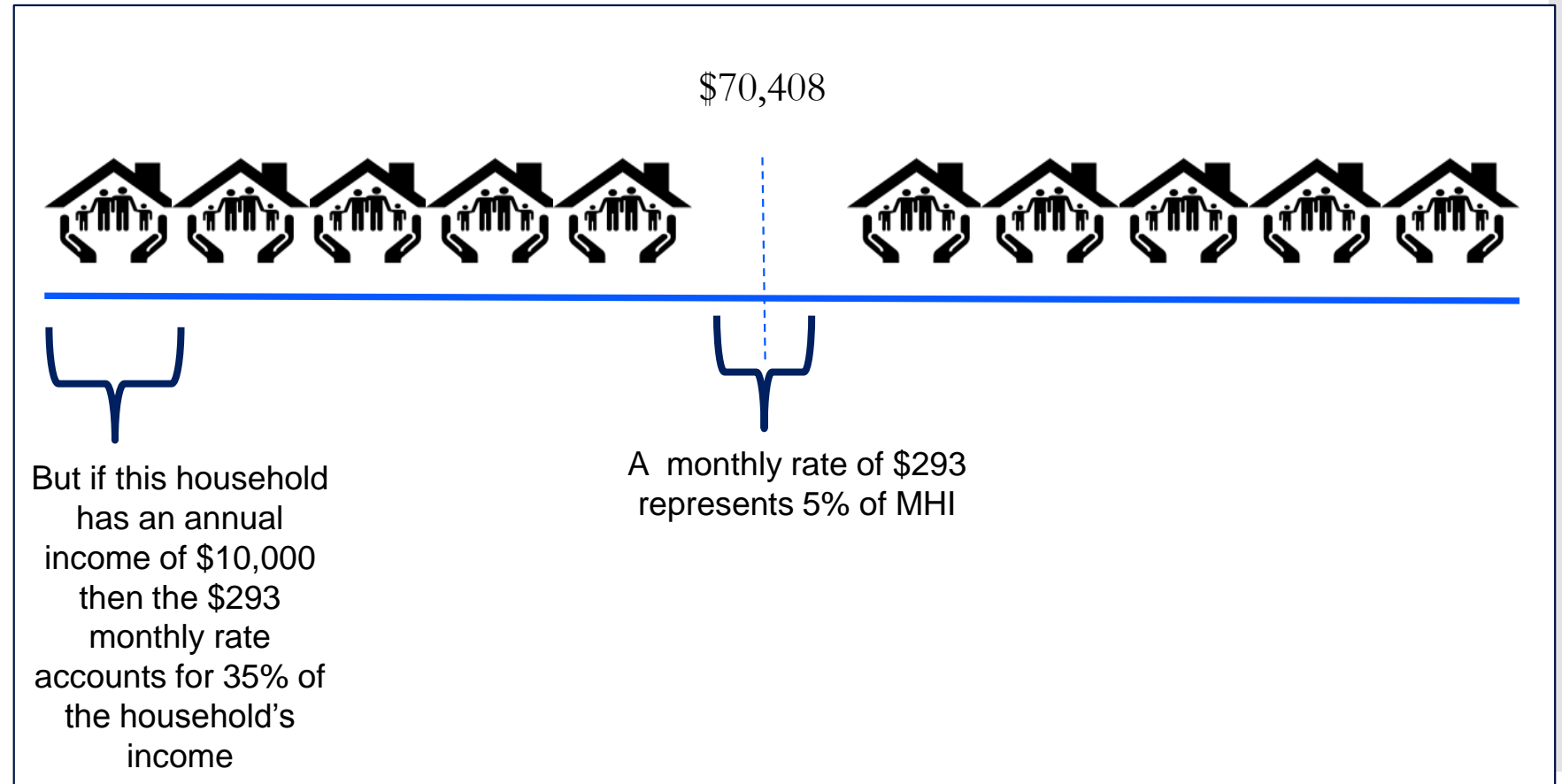


According to the DEC definition, water utility rates of \$293 per month or less are affordable in Fairbanks.



# Evaluating the Current Affordability Indicator

1. The MHI fails to reflect the cost burden experienced by below median income households:



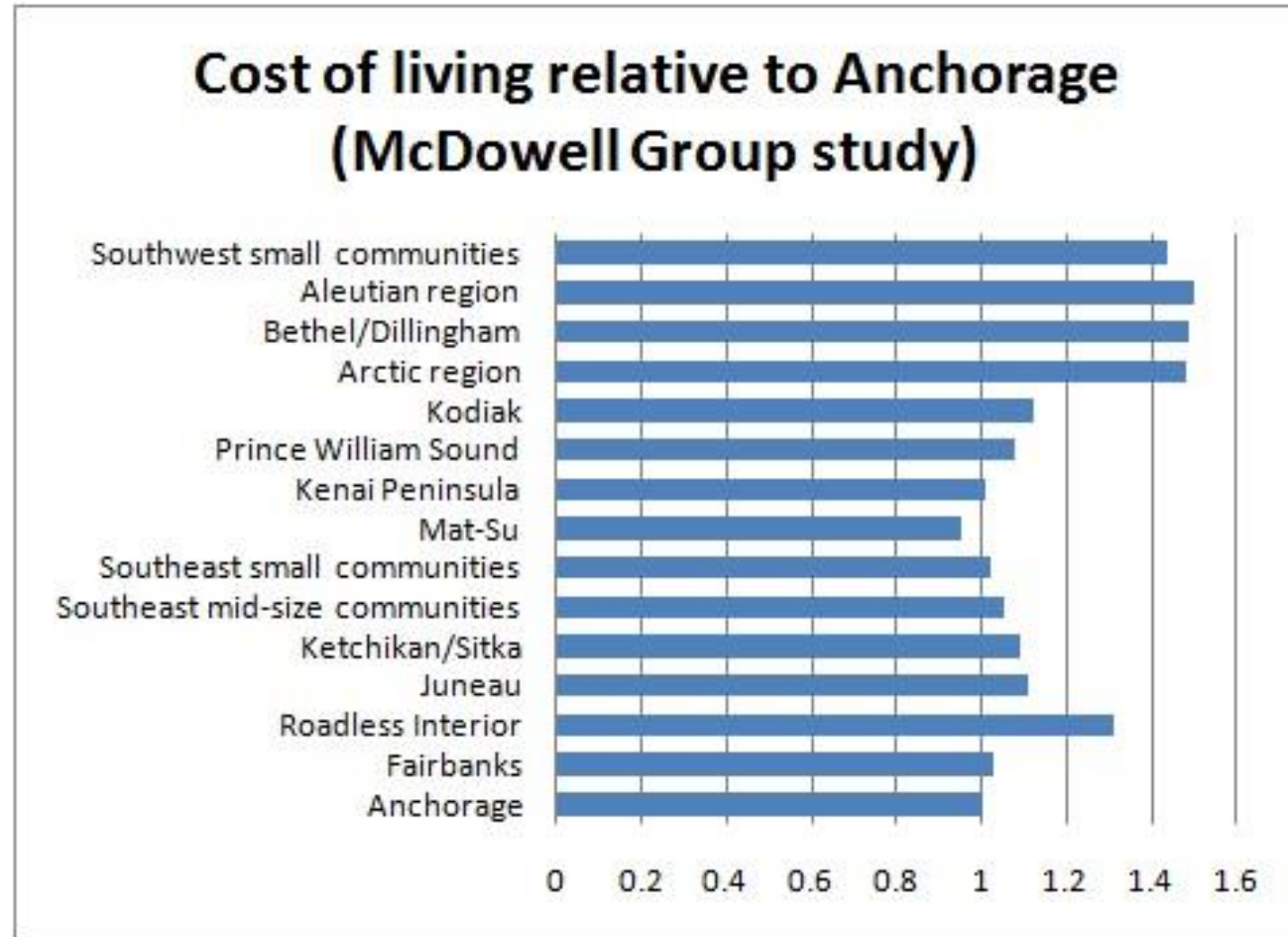
# Evaluating the Current Affordability Indicator

2. The MHI is a static snapshot of income:

- Rural Alaskan MHI values are collected every 5 years.
- Evidence suggests that income in this region can vary significantly from year to year.
- Thus if the data was collected in a year with a higher than usual number of cash paying jobs the MHI figure would overestimate the community's income. Conversely if the data was captured in a bad year, the MHI could be underestimated.

# Evaluating the Current Affordability Indicator

3. It does not account for high costs of living:



# Evaluating the Current Affordability Indicator

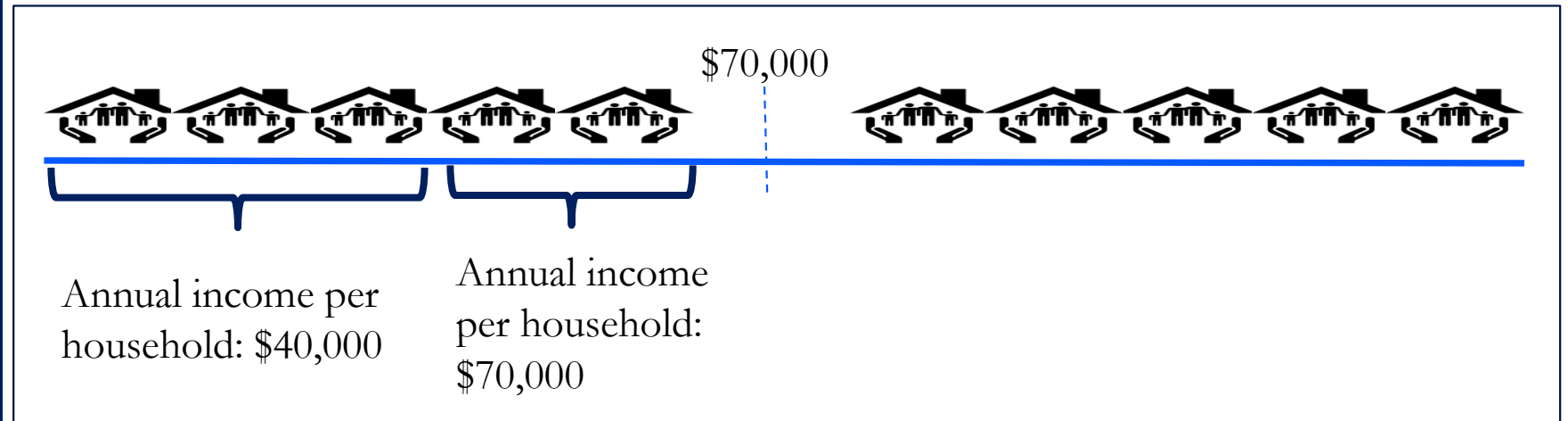
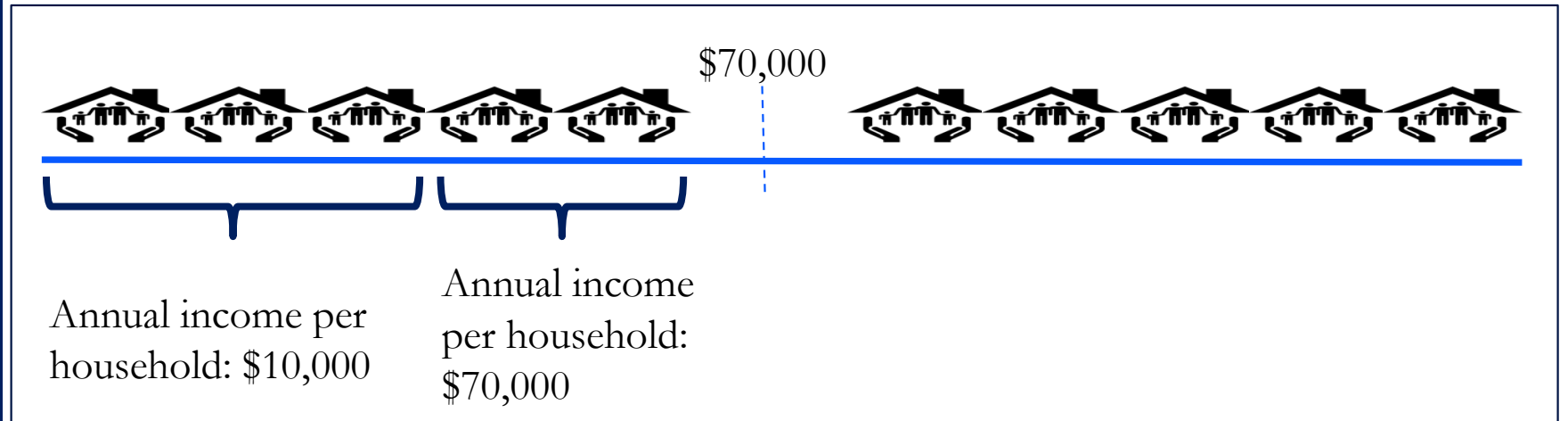
4. It does not account for the demographic composition of a community:



\*Age dependency ratio:  $\frac{\text{number of people under the age of 18} + \text{people over the age of 65}}{\text{number of people between the ages of 18 - 65}}$

# Evaluating the Current Affordability Indicator

5. MHI does not take into account income distribution:



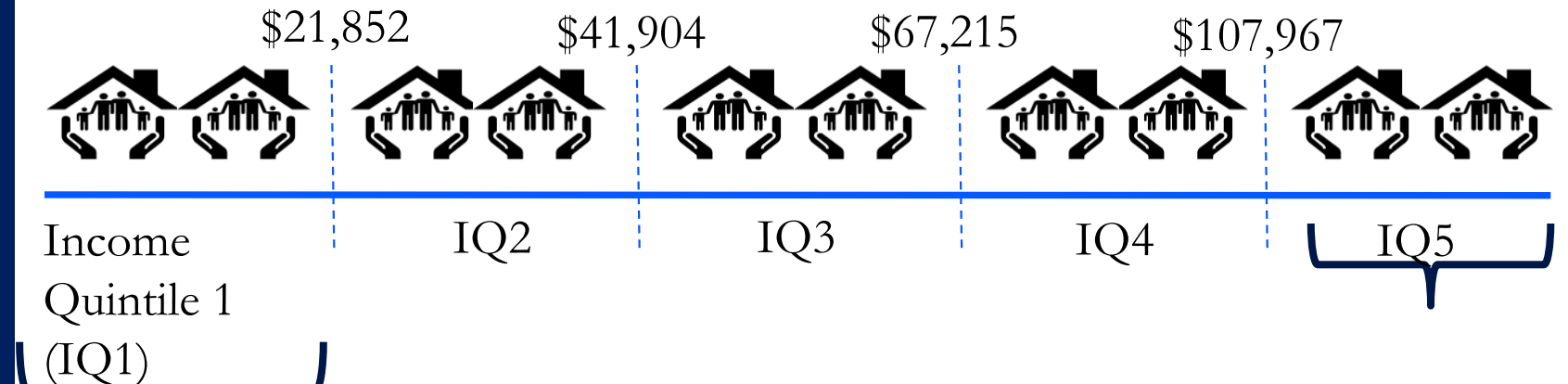
# The New Affordability Indicator

Financial Capability Indicator (FCI)	Residential Index (RI)		
	Low $\leq 2\%$	Mid-Range $2\% < RI \leq 5\%$	High $> 5\%$
Strong $> 2.5$	Low Burden	Low Burden	Medium Burden
Mid-Range $1.5 < x \leq 2.5$	Low Burden	Medium Burden	High Burden
Weak $\leq 1.5$	Medium Burden	High Burden	High Burden



# The New Affordability Indicator

- Residential Index (RI) calculated for every income quintile, in particular for those below the median values.
  - Low Impact- is an RI of less than 2%
  - Medium Impact- is an RI between 2% and 5%
  - High Impact- is an RI of over 5%



20% of the population in Fairbanks has an income between \$0-and \$21,852.

The US Census calculates the lowest limit of the top 5% of IQ5. In Fairbanks this is \$200,460.



# Residential Index

## Residential Index Calculations for Adak

IQ1	IQ2	IQ3	IQ4	IQ5
\$ 67,583	\$ 75,700	\$ 93,833	\$ 114,500	\$ 127,167
<b>Divide each Income Quintile (IQ) by the annual user fees: \$720</b>				
Residential Index for each quintile:				
$720/67,583$ = 1.07%	0.95%	0.77%	0.63%	0.57%
<b>Average RI(IQ1-IQ3): 0.93%</b>				

Income Quintile: American Community Survey 2014  
 User Fees: Dec 2015

# The Financial Capability Indicator

- A Financial Capability Indicator (FCI) that is calculated by assigning values from 1 (weak) to 3 (strong) to the following:
  - Percentage of households which are Supplemental Nutrition Assistance Program (SNAP) recipients in the community,
  - Percentage of households which receive public assistance,
  - Percentage of households living under the poverty level,
  - Percentage of people over the age of 16 with full time jobs,
  - Percentage of MHI spent on an average electric bill and
  - Cross-price elasticity of demand of water with respect to electricity prices.

# The Financial Capability Indicator

## Energy Impact

Energy cost account between 40%-70% of utility expenditures. Furthermore, anecdotal evidence suggest that energy and water are *complementary goods*.

This means that they go together - let's imagine that right and left shoes were sold separately. In general, consumers would buy a right shoe with every left shoe.



# Thresholds

% cost to quintile	$\leq 2\%$	$2\% < x \leq 5\%$	$> 5\%$
<b>Affordability value</b>	Low Burden	Medium Burden	High Burden
% over the age of 16 employed full time	$\leq 30\%$	$30\% < x \leq 50\%$	$> 50\%$
<b>Affordability value</b>	1	2	3
% households under the poverty level	$> 20\%$	$10\% < x \leq 20\%$	$< 10\%$
<b>Affordability value</b>	1	2	3
% of households which are SNAP recipients	$> 20\%$	$10\% < x \leq 20\%$	$< 11\%$
<b>Affordability value</b>	1	2	3
% of households receiving public assistance	$> 30\%$	$10\% < x \leq 20\%$	$< 11\%$
<b>Affordability value</b>	1	2	3
Electric bill % of MHI	$> 5\%$	$2\% < x \leq 5\%$	$< 2\%$
<b>Affordability value</b>	1	2	3
Cross Price Elasticity of Water	$< -0.66$	$-0.66\% < x \leq -0.33$	$> -0.33$
<b>Affordability value</b>	1	2	3

# Results- Akiachak



Annual Fee	RI(MHI)	RI(IQ1)	RI(IQ2)	RI(IQ3)	RI(IQ4)	RI(IQ5)	RI(IQ1-IQ3)
\$1,416	4.0%	8.0%	5.0%	4.0%	3.0%	1.0%	6%

FCI indicator	Value	FCI Value	FCI Score
% of adults with full time employment	16%	1	1.33
% household below poverty level	17%	1	
% households on SNAP	32%	2	

Financial Capability Index (FCI)	Residential Index (RI)		
	Low $\leq 2\%$	Mid-Range $2\% < RI \leq 5\%$	High $> 5\%$
Strong $> 2.5$			
Mid-Range $1.5 < x \leq 2.5$			IQ1
Weak $\leq 1.5$	IQ5	IQ2, IQ3, IQ4	

# Shageluk

Annual Fee	RI(MHI)	RI(IQ1)	RI(IQ2)	RI(IQ3)	RI(IQ4)	RI(IQ5)
1200 (A)	7.38%	10.85%	8.89%	4.66%	2.32%	1.36%

FCI indicator	Value	FCI Value:	FCI Score:
% of adults with full time employment	32%	2	1.5
% household below poverty level	59.26%	1	
% households on SNAP	40.70%	1	
% households on public assistance	81%	1	
% MHI Electric Bill	17.5%	2	
Estimated impact of E prices on H2O	-0.36	2	

Financial Capability Index (FCI)	Residential Index (RI)		
	Low $\leq 2\%$	Mid-Range $2\% < RI \leq 5\%$	High $> 5\%$
Strong $> 2.5$			
Mid-Range $1.5 < x \leq 2.5$			
Weak $\leq 1.5$	IQ5(A)	IQ3-IQ4(A)	IQ1-IQ2 (A)

# Shageluk

Annual Fee	RI(MHI)	RI(IQ1)	RI(IQ2)	RI(IQ3)	RI(IQ4)	RI(IQ5)
1512 (B)	9.30%	13.67%	11.20%	5.87%	2.93%	1.71%

FCI indicator	Value	FCI Value:	FCI Score:
% of adults with full time employment	32%	2	1.5
% household below poverty level	59.26%	1	
% households on SNAP	40.70%	1	
% households on public assistance	81%	1	
% MHI Electric Bill	17.5%	2	
Estimated impact of E prices on H20	-0.36	2	

Financial Capability Index (FCI)	Residential Index (RI)		
	Low $\leq 2\%$	Mid-Range $2\% < RI \leq 5\%$	High $> 5\%$
Strong $> 2.5$			
Mid-Range $1.5 < x \leq 2.5$			
Weak $\leq 1.5$	IQ5(B)	IQ4(A,B)	IQ1-IQ3 (B)



# Unserved Communities

Geography	Matrix Score	% MHI
Allakaket	High	12%
Arctic Village	High	15%
Atmautluak	High	6%
Beaver	High	20%
Birch Creek	High	77%
Chalkyitsik	High	7%
Chefornak	High	7%
Circle	High	35%
Crooked Creek	High	10%
Diomedea	High	14%
Eagle	High	6%
Kipnuk	High	8%
Kongiganak	High	8%
Koyukuk	High	12%
Kwigillingok	High	10%
Lime Village	High	30%
Napakiak	High	16%
Napaskiak	High	13%
Nightmute	Medium	3%
Shageluk	High	9%
Stebbins	High	20%
Stevens Village	High	20%
Stony River	High	18%
Takotna	High	6.9%
Teller	High	7.1%
Tetlin	High	6%
Tuluksak	High	10%
Tuntutuliak	High	8%
Venetie	High	8%
Wales	High	7%

# Unserved Communities

Geography	Matrix Score	% MHI
Alatna	High	-
Mekoryuk	High	4.2%
Nunapitchuk	High	3.0%
Platinum	High	2.9%
Tununak	High	3.9%

## Acknowledgements & Disclaimer

This research project was made possible thanks to funding from the Alaska Department of Environmental Conservation (DEC) and the guidance of Mr. Bill Griffith, Ms. Camilla Kennedy and Mr. Dennis Wagner (EPA) as well as my committee members (Dr Joe Little, Dr Jungho Baek, Dr Christopher Wright and Ms Kennedy).

The analysis and conclusions contained in this study are those of the author alone and do not necessarily represent the point of view of the DEC or the EPA.

This document contains statements and models that are based on current estimates and assumptions that may be changed.

# Questions?



# Further Research

- Thresholds
  - Using pre-established thresholds used in the Lower 48
  - Investigate affordability thresholds in rural Alaskan communities
  - Is a medium burden affordable?
- Price elasticity of water
  - Determine price elasticity of water in rural Alaskan areas
- Affordability of other utilities
  - Burden on households by other utilities
  - Determine if other utilities are affordable

# Financial Capability Index

## Proportionally calibrated almost ideal demand system (PCAIDS) model

We need:

1. The industry elasticity
2. The elasticity of demand of the products
3. The market shares

What we did:

- *Industry elasticity* : assumed it is equal to 1 (backed by literature)
- *Product Elasticity of Demand*
  - *Electricity elasticity*: A previous Ms Econ student calculated the elasticity of demand of PCE communities
  - *Water elasticity* – used the average of elasticity of demand figures found in the literature for flat rate systems
- *Market shares*: Assumed communities only have two utilities (water and electricity).

# Financial Capability Index

Economic theory suggest that as the price of a good goes up, the quantity of the complementary good consumed decreases. In other words, as the price of energy increases, we would expect people to consume less water - even with flat rates in effect.

We used the concept of *cross price elasticity of water*.

$$\epsilon_{WaterElectric} = \frac{\% \Delta Q_{water}}{\% \Delta P_{Electric}}$$



# Financial Capability Index

Proportionally Calibrated Almost Ideal Demand System (PCAIDS)

- $dS_{water} = -0.23 \left( \frac{dP_{water}}{P_{water}} \right) + 0.23 \left( \frac{dP_{electric}}{P_{electric}} \right)$
- $dS_{Electric} = -0.03 \left( \frac{dP_{Electric}}{P_{Electric}} \right) + 0.03 \left( \frac{dP_{Water}}{P_{Water}} \right)$
- $\varepsilon_{WaterElectric} = \frac{\varepsilon_E}{s_w} + s_w(\varepsilon_{market} + 1)$

# Summary of Results

## Served Communities

- Average MHI: \$43,876
- Average Fee: \$105
- Most projects are in the medium burden level

## Unserved Communities

- Average MHI: \$31,749
- Average Fee: \$254
- Most projects are in the high burden level

# Summary of Results

## MHI vs. New Indicator

- The two indicators often differ
- The MHI indicator **tends to underestimate** the fee burden
- Chignik Lake is the only community where the MHI overestimates the fee burden with respect to the new indicator

## Served and unserved communities

- Most projects in unserved communities are found to be unaffordable by both indicators
- Unserved communities have an average MHI of \$31,749 (vs \$43,876 for served communities)