Transportation & Climate Change

Brian Gibson
Executive Director
Oahu Metropolitan Transportation Organization

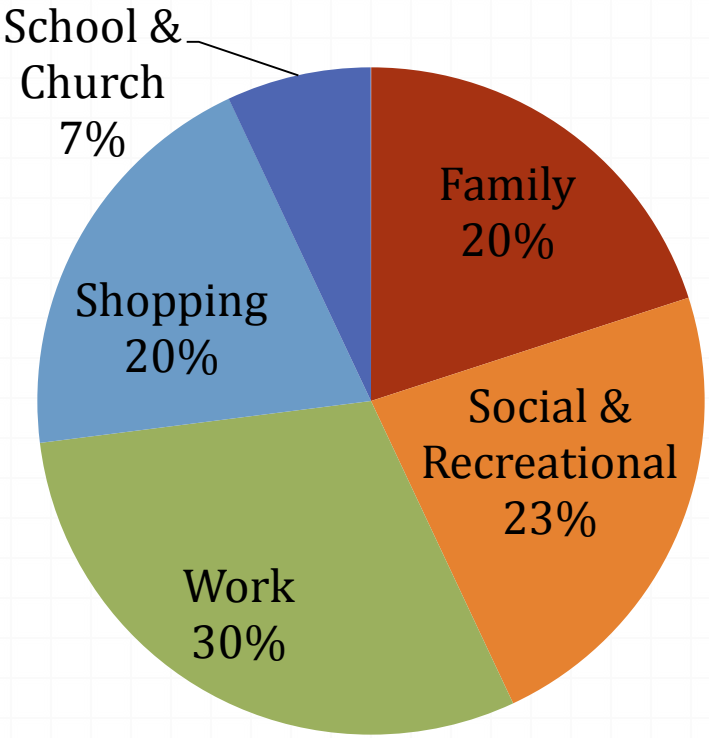
What is OahuMPO

- Federally mandated agency
- Designed for cooperative and comprehensive interagency planning (primarily for transportation)
- Exists between governments (like the U.N.)

Purpose of Transportation

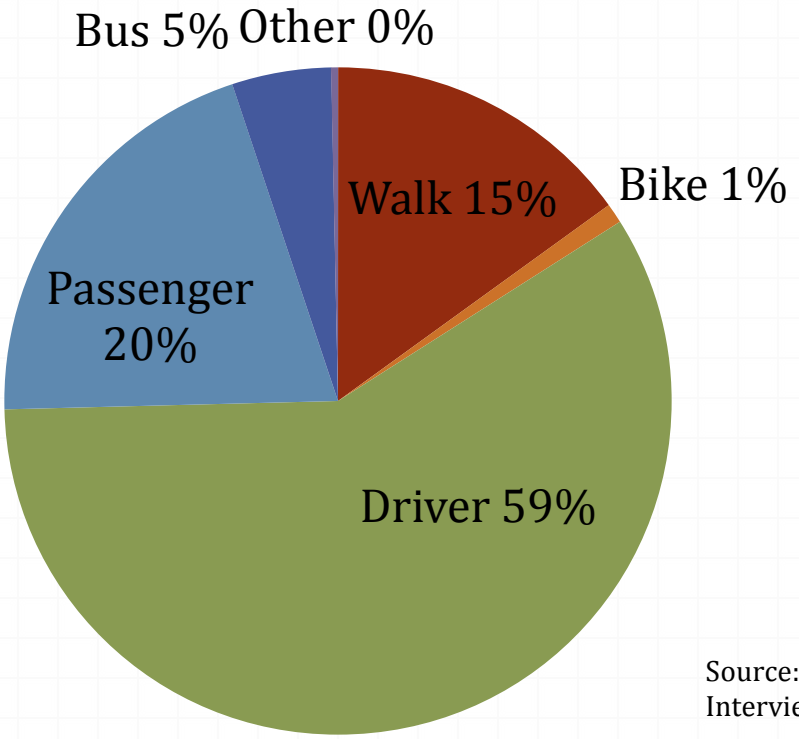
- Economic Development
  - I want to go to shopping
    - Consumer choice
    - Industry
    - Agriculture
    - Work place choice
- Social
  - I want to go see aunty
- Quality of Life
  - I want to go to the beach
    - Education

Trip Purpose



Source: Motor Vehicle Manufacturers Association, 1988

Oahu Distribution of Travel Mode

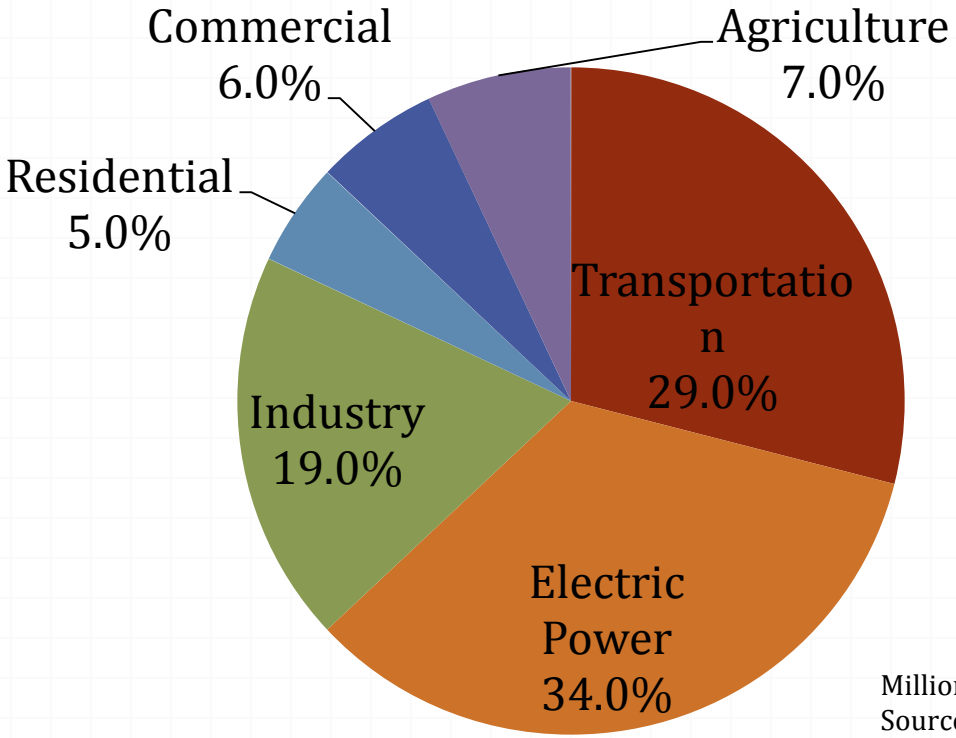


Source: 2012 Oahu Household Interview Travel Survey (Raw

Relationships

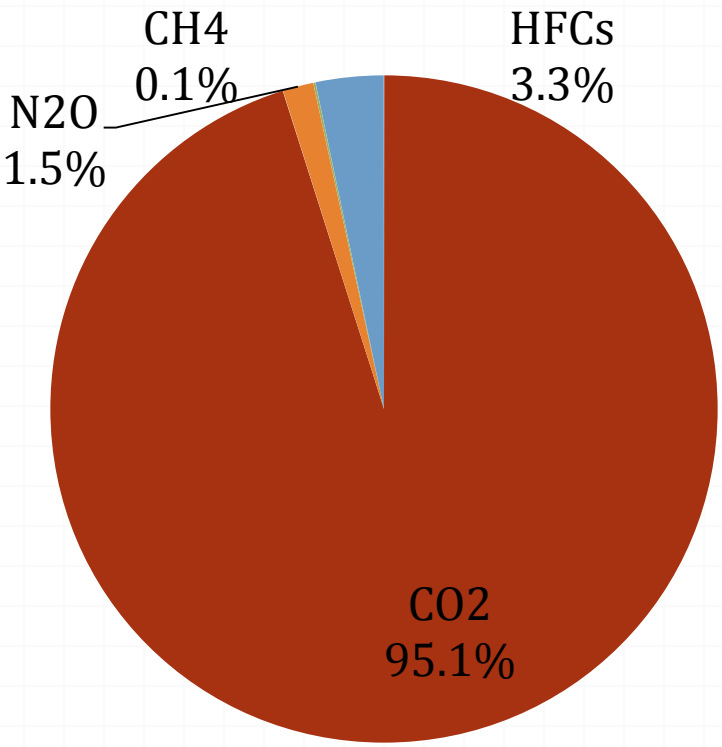
- Reducing air pollution & GHG emissions is usually correlated to Vehicles Miles Traveled (VMT)
  - Covers all trip types by all vehicles
    - Freight Movement
    - Work Trips
    - Social Trips
    - Recreational Trips
  - Fuel efficiency is an interrelated factor

U.S. GHG Emissions by End Use



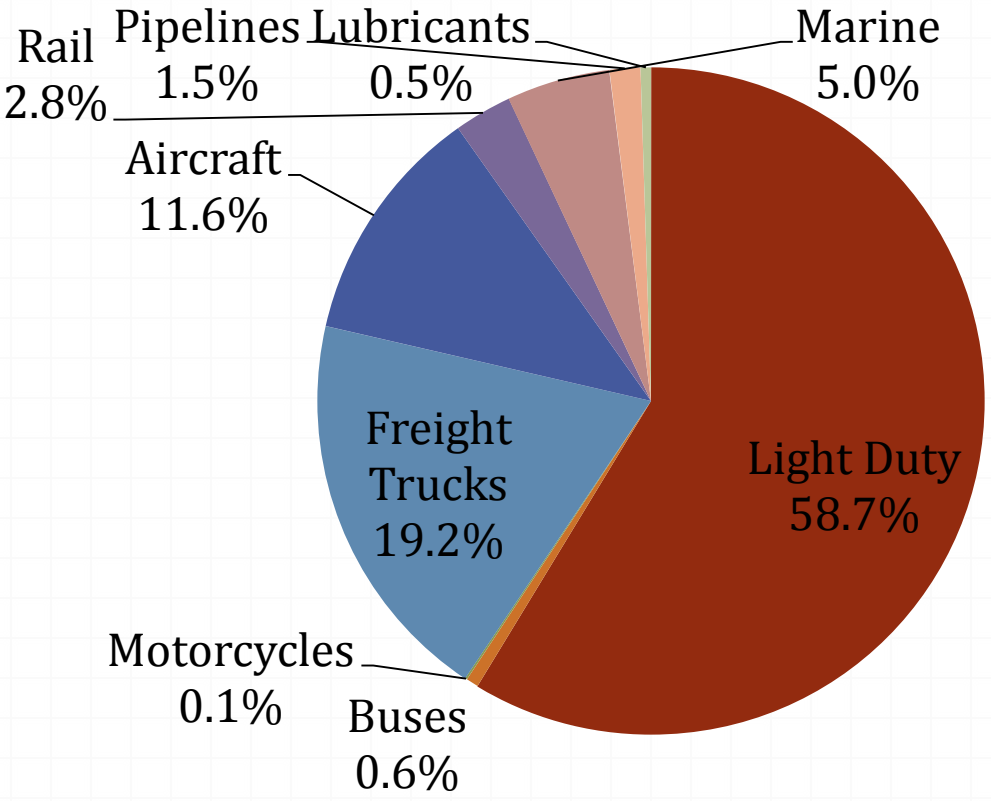
Millions of metric tons, 2006
Source: U.S. EPA (2008)

U.S. Transportation GHG Emissions by Gas



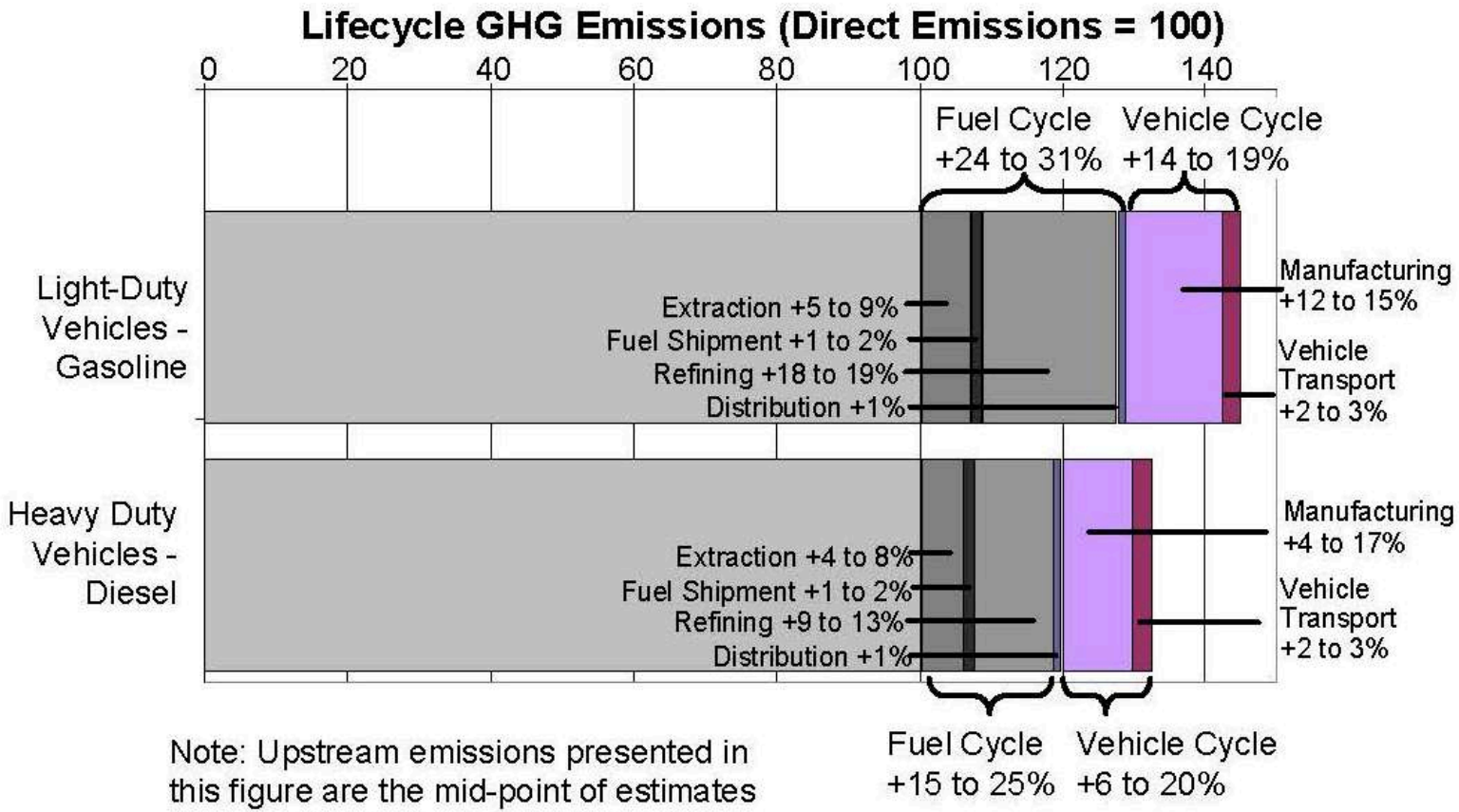
Source: U.S. EPA (2008)

U.S. GHG Emissions by Transportation Mode



Source: U.S. EPA (2008)

Figure 2.14 Direct GHG Emissions Plus Fuel and Vehicle Cycle GHG Emissions



Note: Upstream emissions presented in this figure are the mid-point of estimates developed based on an analysis of the GREET model and the Lifecycle Emissions Model (LEM).

Source: U.S. EPA (2006). *Greenhouse Gas Emissions from the U.S. Transportation Sector, 1990-2003* (EPA 420-R-06-003).

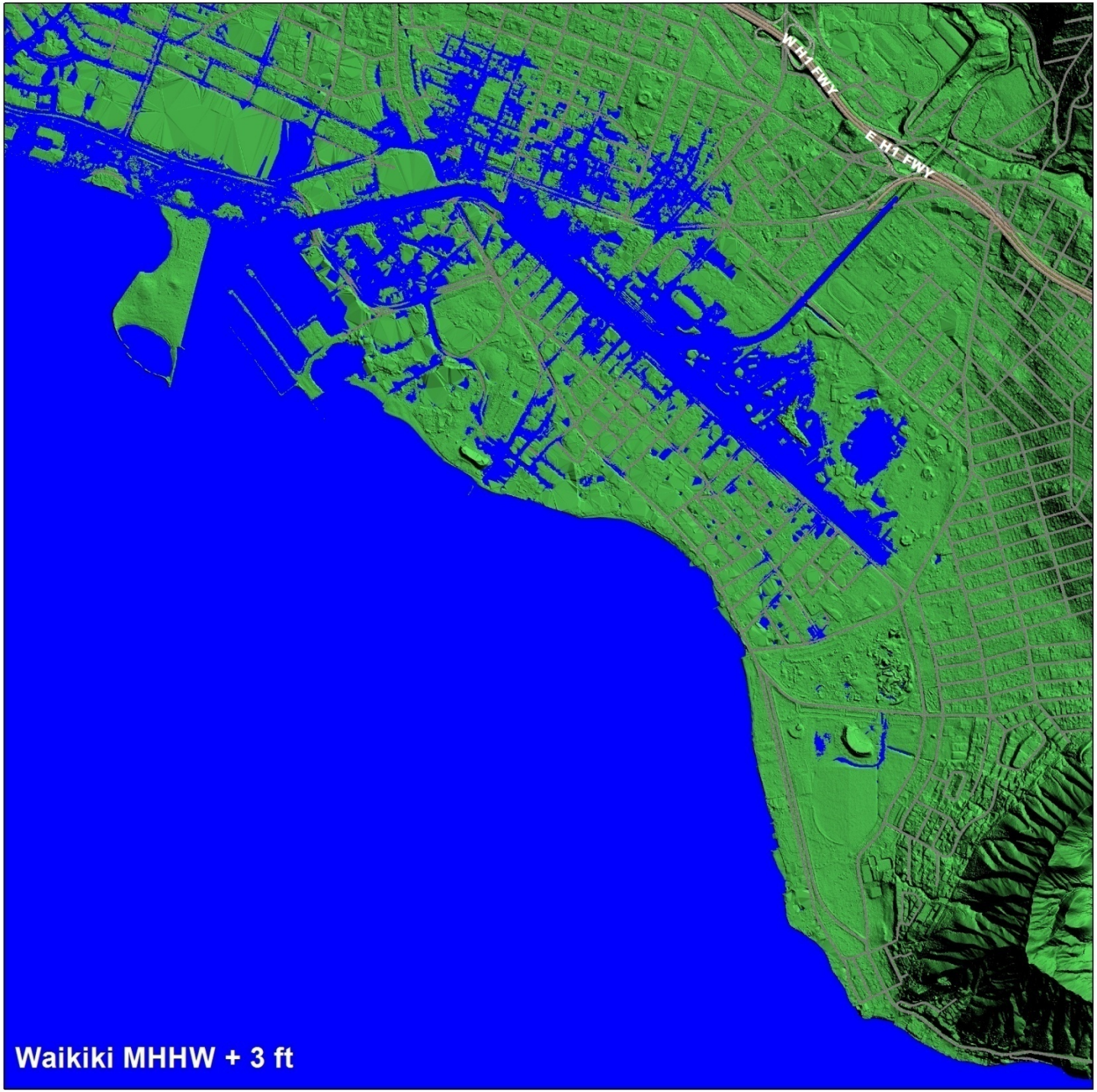
Measured Climate Changes for Hawaii

- Rainfall (-15%) and stream discharge have decreased
- Air temperature is increasing (0.3^{o}F/decade)
- Rainstorm intensity has increased (+12%)
- Sea surface temperature is rising (0.22^{o}F/decade)
- Ocean has grown more acidic
- Sea level is rising

Planning for Climate Change

- Flooding
  - Rain in large quantities; also extended periods of drought between rain events (less rain overall)
  - Possibility of wild fires and vegetation destabilization leading to increased rockfall and slope instability
- More Severe Storm Events
  - Increased frequency and intensity of tropical storms and hurricanes; damage from storm surge and wind
- Rising Sea Level
  - Likely rise of one foot by 2050; +3 feet by 2100
  - Water table will also rise, potentially affecting roadway foundations and aquifer integrity
  - Inland, as well as coastal impacts

NA HOKU II



Waikiki MHHW + 3 ft

A War on Two Fronts

- Adaptation
  - How do we adapt to the climate change that is already happening?
- Mitigation
  - How do we reduce GHG emissions to reduce the long-term impact of climate change?

Strategies to Reduce Transportation GHG Emissions

- Reduce VMT (MPO can impact)
  - Improve transportation system efficiency
  - Reduce travel activity
- Technology (MPO has no impact)
  - Alternative fuels
  - Increase vehicle fuel economy
- Economic
  - Pricing strategies

Improving System Efficiency

- Traffic Operations Management
- Relieving Bottlenecks
- Lower Speed Limits
- Coordinated Transportation & Land-Use Decision-Making

Traffic Operations Management

- Examples
  - Signal coordination
  - Ramp metering
  - Incident response
  - Traveler information
- 0.6% GHG-E reduction, assuming the projects themselves do not create new E (*Moving Cooler,* Urban Land Institute, 2009)
- Improving travel times and lower shipping costs are nice co-benefits, even if GHG-E does not decrease
- Relatively easy to implement

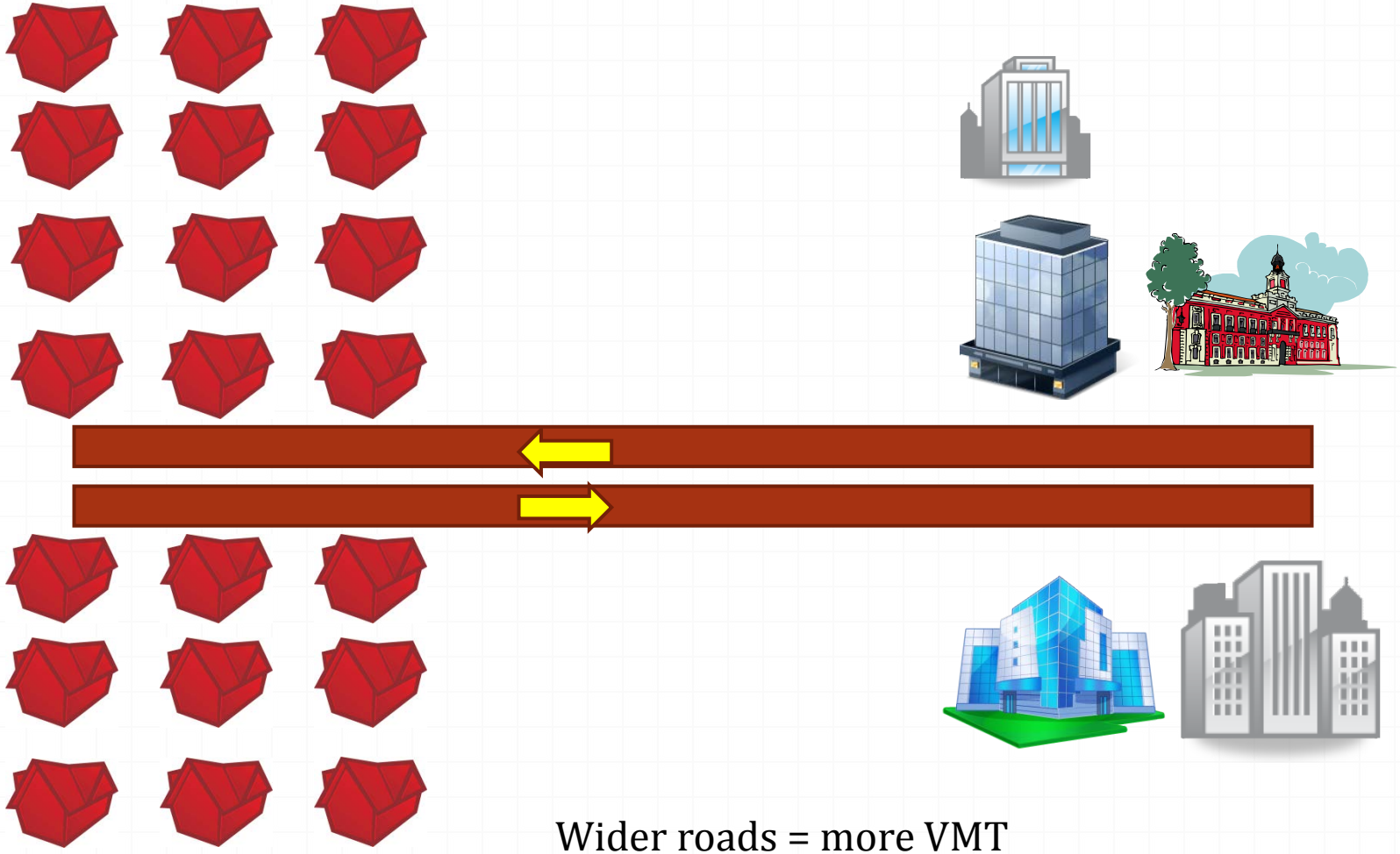
Bottleneck Relief

- Increasing roadway capacities at specific points where demand exceeds capacity
- 0.3% decrease in short-term; but 0.7% increase in long-term *(Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, USDOT, 2010)*
  - Induced demand
  - Analysis did not include GHG-E from construction
- Often very expensive

Basic Travel Model

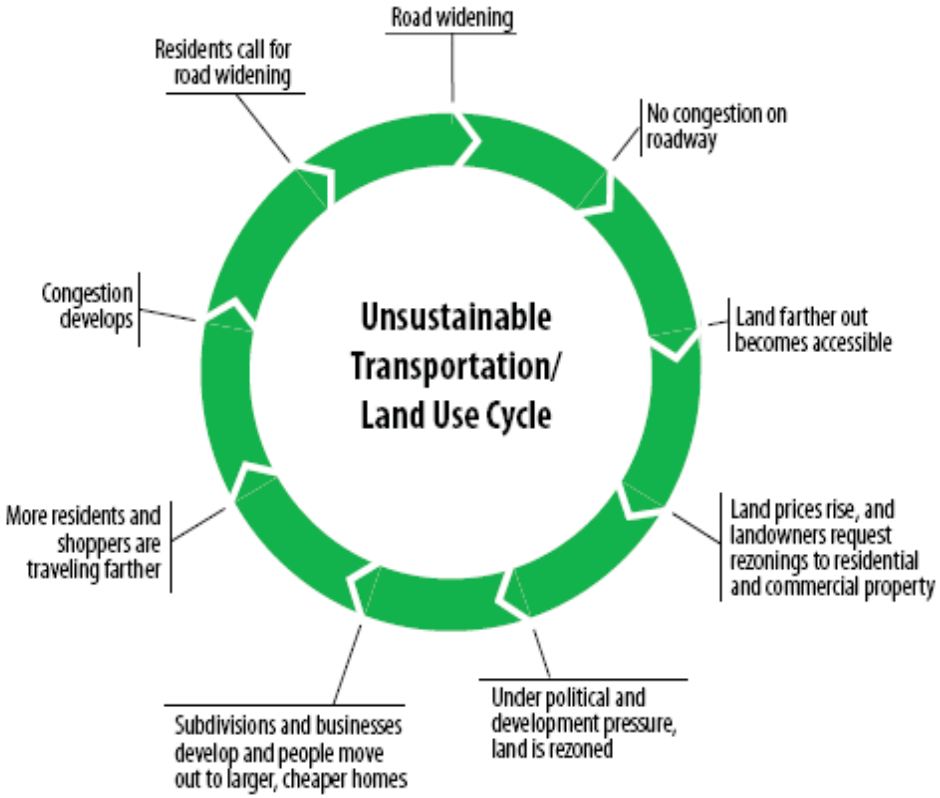
Trip Generator

Trip Attractor



Wider roads = more VMT

Unsustainable Land-Transportation Cycle



Lower Speed Limits

- Immediate benefits of 1.2 – 2.0% GHG-E reduction for transportation sector (lowering highway speeds to 55 mph)
- Easy to implement
- Requires greater enforcement, unless roads are re-engineered
  - Construction costs & GHG-E
- Travel times (and shipping costs) increase
  - Can be partially offset by better operations management

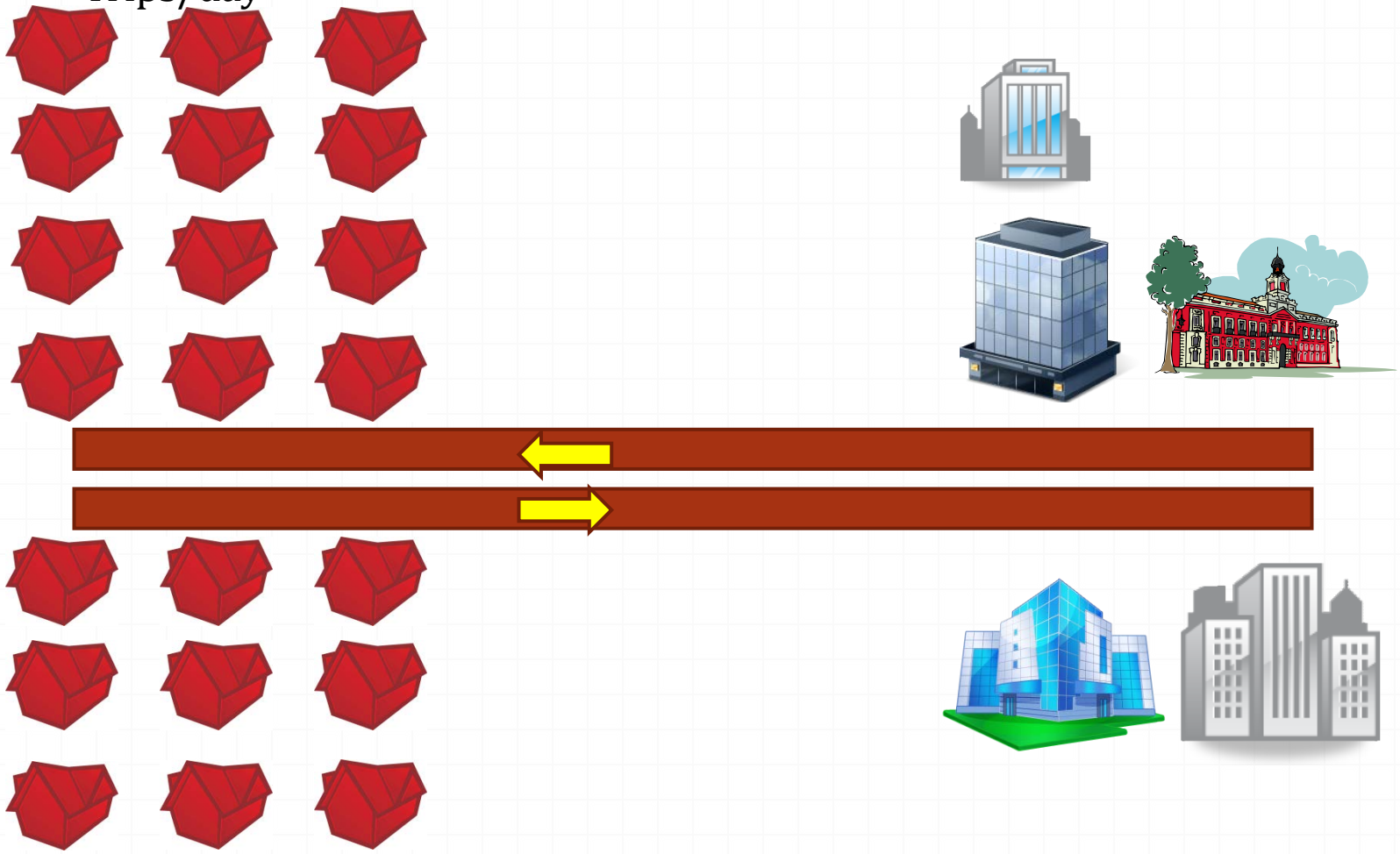
Coordinated Land-Use & Transportation Decision-Making

- Enhances the effectiveness of both and increases efficiency
  - Jobs & Household match
  - Right sizing
  - Multi-modal is more viable
  - Data driven

Basic Travel Model

Trip Generator = 10,000 Trips/day

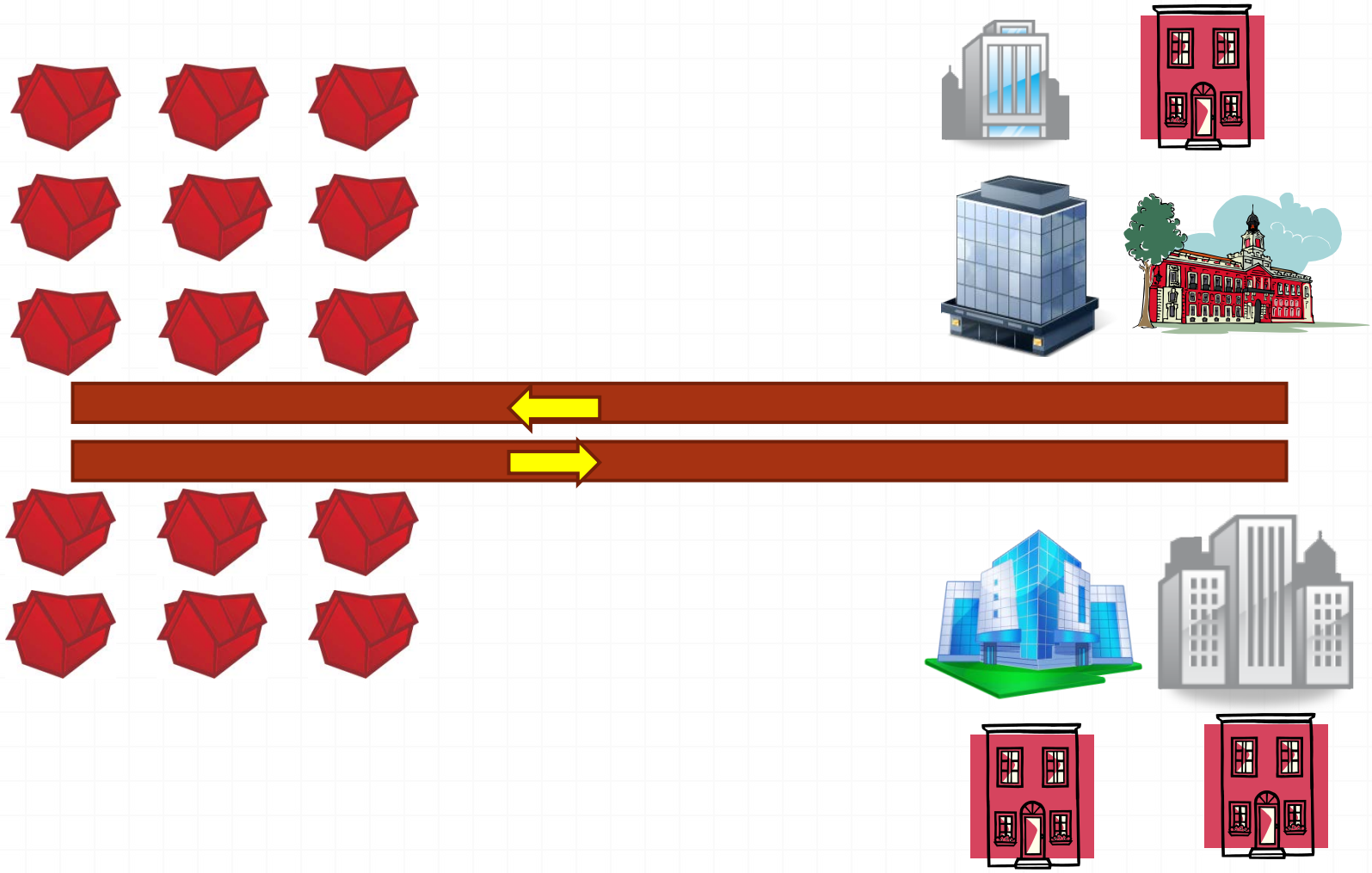
Trip Attractor



Basic Travel Model

Trip Generator = 8,000 Trips/Day

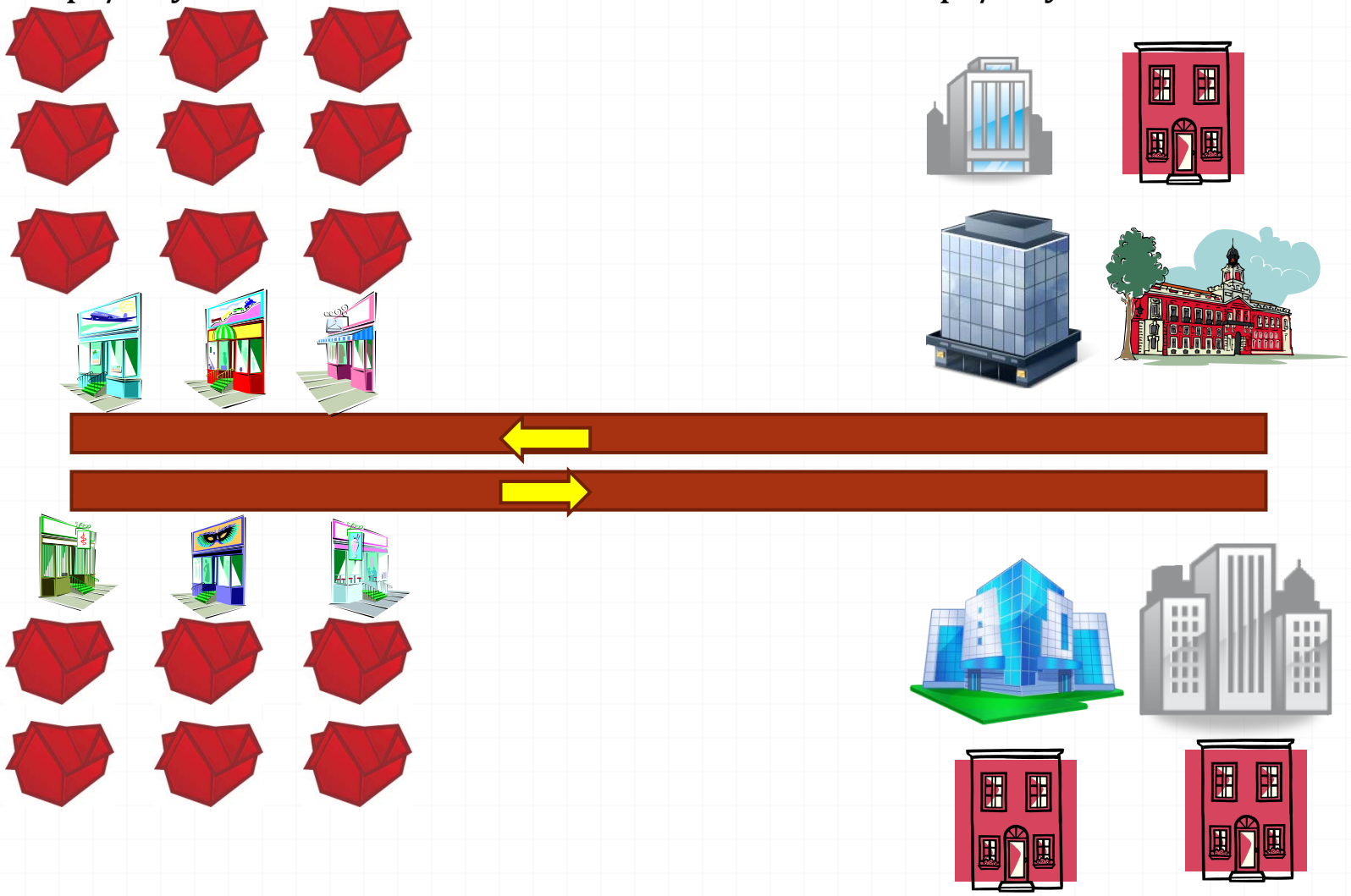
Trip Attractor + Households



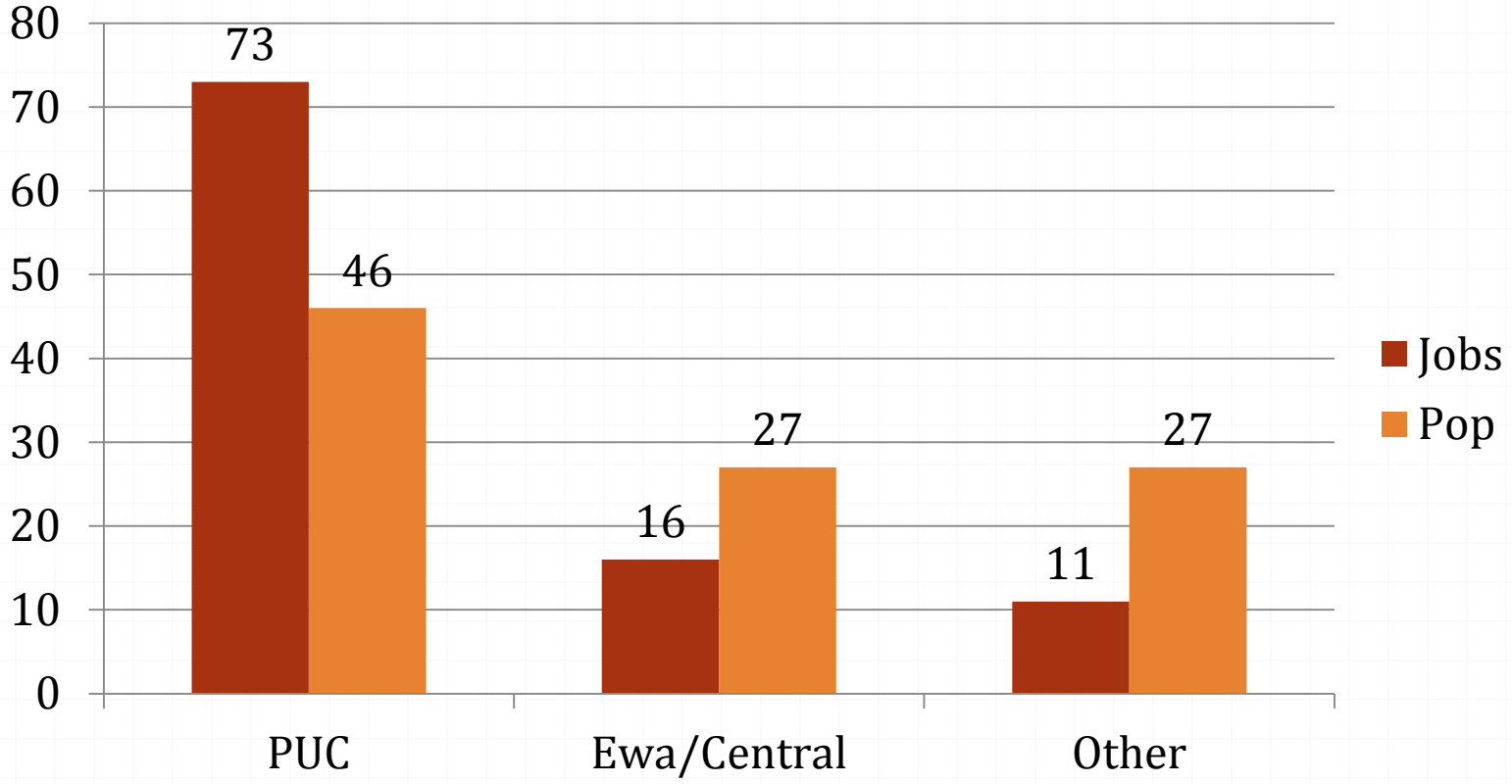
Basic Travel Model

Trip Generator = 6,500 Trips/Day

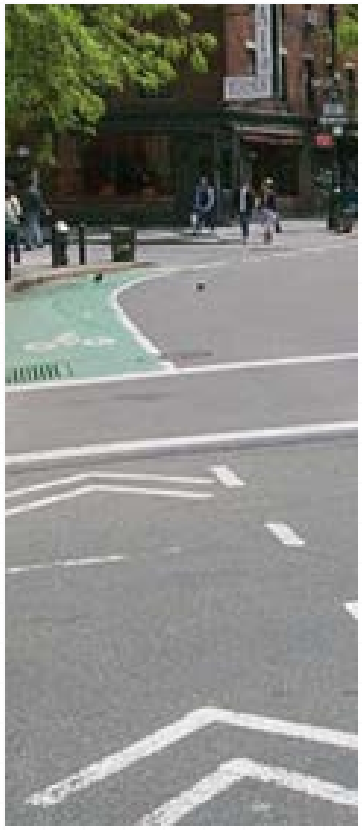
Trip Generator = 750 Trips/Day



Oahu Jobs/Household Mismatch



Complete Streets



Coordinated Land-Use & Transportation Decision-Making

- Shorter driving distances @ lower speeds
- Densities are important and mixed uses
- Walking, biking, and transit are more viable options
- Build it and they will come?
- People who think beyond themselves
- Do we retrofit or apply just to new construction?
  - How best to adapt?

Land Use & Planning GHG-E Benefits

- Where 60-90% of all new growth is compact, walkable neighborhoods, GHG-E would decrease 1.2-3.9%
- Comprehensive urban bike and pedestrian improvements = 0.2-0.6% GHG-E reduction
- Transit expansion and promotion (2.4 – 4.6% annual increase) = 0.3-0.8% GHG-E reduction
- Cumulative effects = 2 – 5% reduction

Source: Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, USDOT, 2010

Incentives to Ride the Bus

	Number	%
More frequent service	48	12.0%
More convenient stops	40	10.0%
Other	112	25.4%
Nothing	**210**	**52.4%**

Source: Strategies for Energy Efficiency in Transportation, 2010

Travel Reduction

- Tele-commuting (double current levels) = 0.5-0.6% reduction
- Compressed work weeks (double current levels) = 0.1-0.3% reduction
- Flexible schedules (not analyzed)
- Ridematching, carpooling, vanpooling = 0-0.2% reduction

Source: Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, USDOT, 2010

Strategies to Reduce Transportation GHG Emissions

- ~~Reduce VMT (MPO can impact)~~
  - ~~Improve transportation system efficiency~~
  - ~~Reduce travel activity~~
- **Technology** (MPO has no impact)
  - Alternative Fuels
  - Increase vehicle fuel economy
- Economic
  - Carbon pricing strategies

Technology

- Hybrid Electric Vehicles reduce GHG-E (per vehicle) by 26 – 54%
- Plug-In Electric Vehicles reduce GHG-E (per vehicle) by 46 – 75%
- Hydrogen Fuel Cell Vehicles <u>could</u> reduce GHG-E by up to 80% if technically successful
- What are the life cycle costs?
- How quickly can these vehicle penetrate the market?

Source: Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, USDOT, 2010

Hawaii Clean Energy Initiative Market Penetration Scenarios – 2030

	Business As Usual	Cautiously Optimistic	Wildly Optimistic
CAFE	Standard MPG	80%	100%
Hybrid	3%	13%	43%
Plug-In HEV	Minimal	4%	13%
BEV	Minimal	0.6%	5%
FFV	Minimal	9%	19%

On average, vehicle life in Hawaii is about 9 years

Current CAFE standard is 25mpg (35.5mpg by 2016)
Hawaii vehicle fleet average mpg is estimated at 19.4 mpg

Technology

- Alternative Fuels
  - Hydrogen
    - 2030 - 18% market penetration = 2.4-3.4% GHG-E reduction
    - 2050 - 60% market penetration = 18-22% GHG-E reduction
  - Ethanol & biodiesel not analyzed
- Electricity
  - 2030 - 5% market penetration = 2.2-2.5% GHG-E reduction
  - 2050 - 56% market penetration = 26-30% GHG-E reduction

Source: Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, USDOT, 2010

Likelihood of Buying or Leasing Hybrid Vehicle?

	Number	%
Very Likely	52	33.1%
Somewhat Likely	53	33.8%
Not Likely at all	**47**	**29.9%**
Don't Know	5	3.2%

Source: Strategies for Energy Efficiency in Transportation, 2010

Price of Gasoline as Motivation for Purchase of Fuel-Efficient Vehicle

	Number	%
$3.00/gal	23	14.6%
$3.50/gal	5	3.2%
$4.00/gal	30	19.1%
$4.50/gal	7	4.5%
$5.00/gal	25	15.9%
$6.00/gal or more	15	9.6%
None	**44**	**28%**
Refused	8	5.1%

Source: Strategies for Energy Efficiency in Transportation, 2010

Technology

- Where does the electricity come from?
  - Burning fossil fuels to produce more electricity doesn't help much
- Are we trading in one finite resource for another?
  - Gold, platinum, cadmium

Strategies to Reduce Transportation GHG Emissions

- ~~Reduce VMT (MPO can impact)~~
  - ~~Improve transportation system efficiency~~
  - ~~Reduce travel activity~~
- ~~Technology (MPO has no impact)~~
  - ~~Low carbon fuels~~
  - ~~Increase vehicle fuel economy~~
- **Economic**
  - Carbon pricing strategies

Pricing Strategies

- Parking management
  - $5 per day for everyone = 0.2% GHG-E reduction
- VMT Fees
  - 2 – 5 cents/mile = 0.8 – 2.3% GHG-E reduction
- Pay-as-you-drive insurance
  - 1.1 – 3.5% GHG-E reduction
- Congestion pricing
  - 65 cents/mile for 30% of urban roads = 0.4 – 1.6% GHG-E reduction

Source: Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, USDOT, 2010

Pricing Strategies

- Cap-and-trade carbon tax ($30-$50/ton) = 2.6 – 8.5% GHG-E reduction
- Motor fuel taxes ($2.40/gal) = 23% GHG-E reduction

Source: Transportation's Role in Reducing U.S. Greenhouse Gas Emissions, USDOT, 2010

Conclusions

- Adapting to and mitigating the impacts of climate change will be challenging in the transportation sector
- There is no “one thing” that will solve the problem
  - But dogpiling a lot of different strategies could have a big impact
    - Technology
    - Pricing
    - Planning
  - Some solutions are easier to implement than others
- Adaptation efforts need to begin now
  - Change will take time and a lot of effort