PATHWAYS TO 100% RENEWABLE ENERGY

SUSTAINABLE MADISON COMMITTEE

APRIL 23, 2018

CITY OF MADISON WISCONSIN

Sustainable Engineering Group LLC

NAVIGANT

AGENDA

- Recap & Approach for City Operations
- Scenarios/Options for City Operations
- Questions - Discussion
- Next Steps

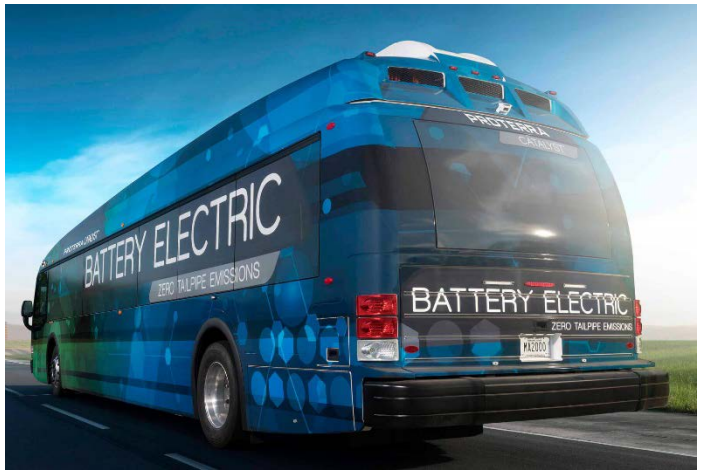

Image: Electric Bus

Photo: Proterra

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RECAP AND APPROACH – CITY OPERATIONS

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MADISON IS ALL IN FOR RENEWABLE ENERGY

WE ARE STILL IN

MAYORS NATIONAL CLIMATE ACTION AGENDA

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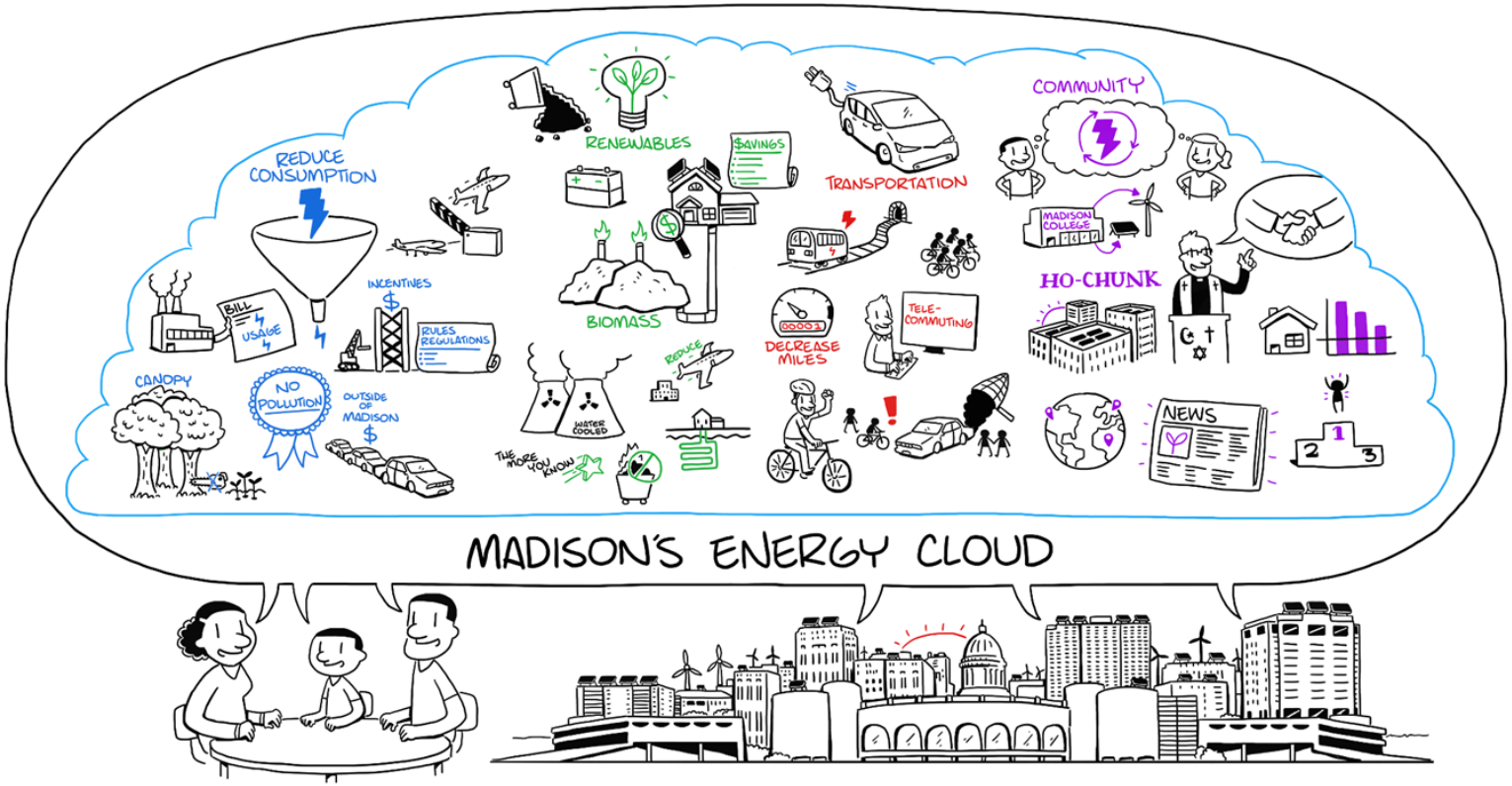
MADISON'S ENERGY TRANSFORMATION IS HAPPENING NOW



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BACKGROUND ABOUT CITY FACILITIES

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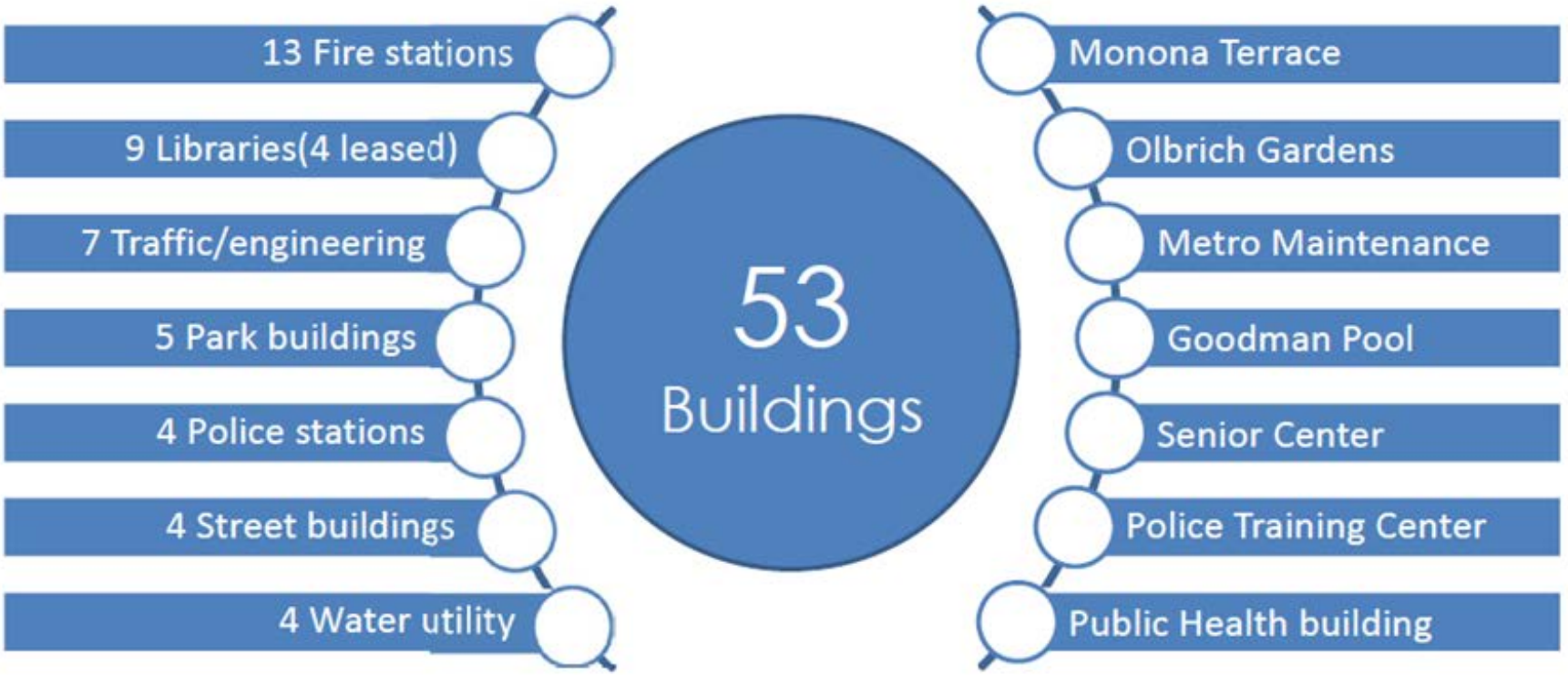
FACILITIES BACKGROUND



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CARBON FOOTPRINT AND OPTIONS

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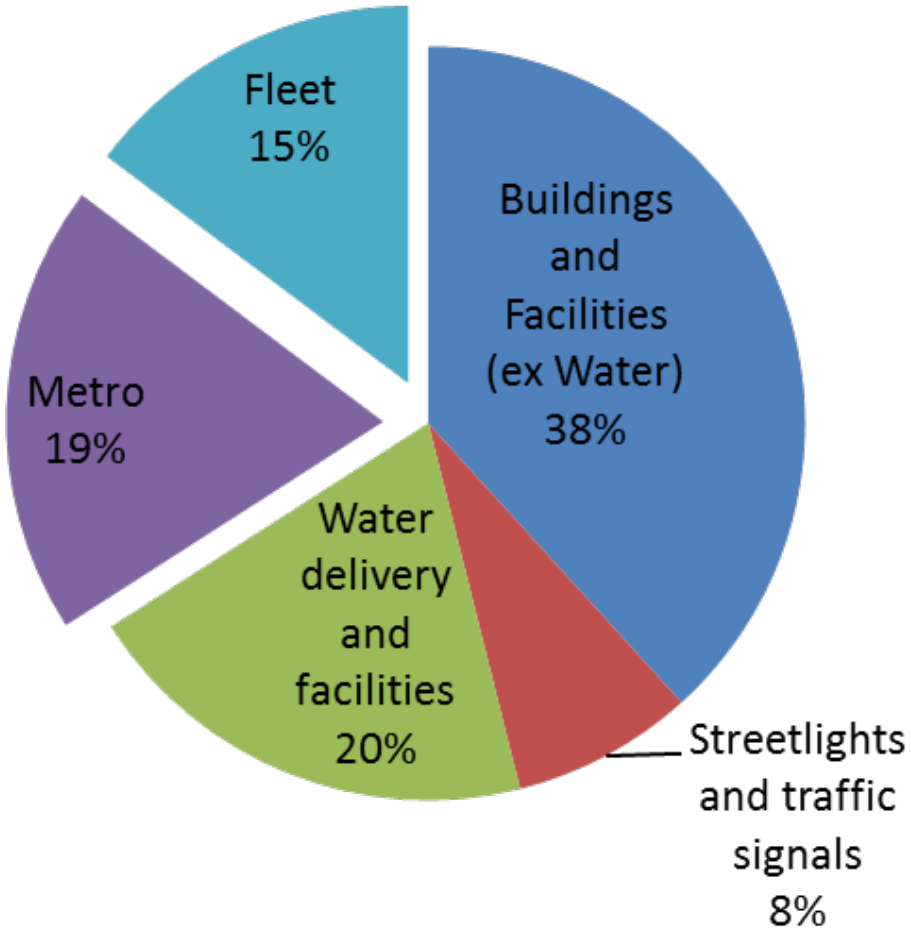
MADISON'S CARBON FOOTPRINT INCLUDES CITY BUILDINGS, STREETLIGHTS AND TRAFFIC, FLEET, METRO AND WATER



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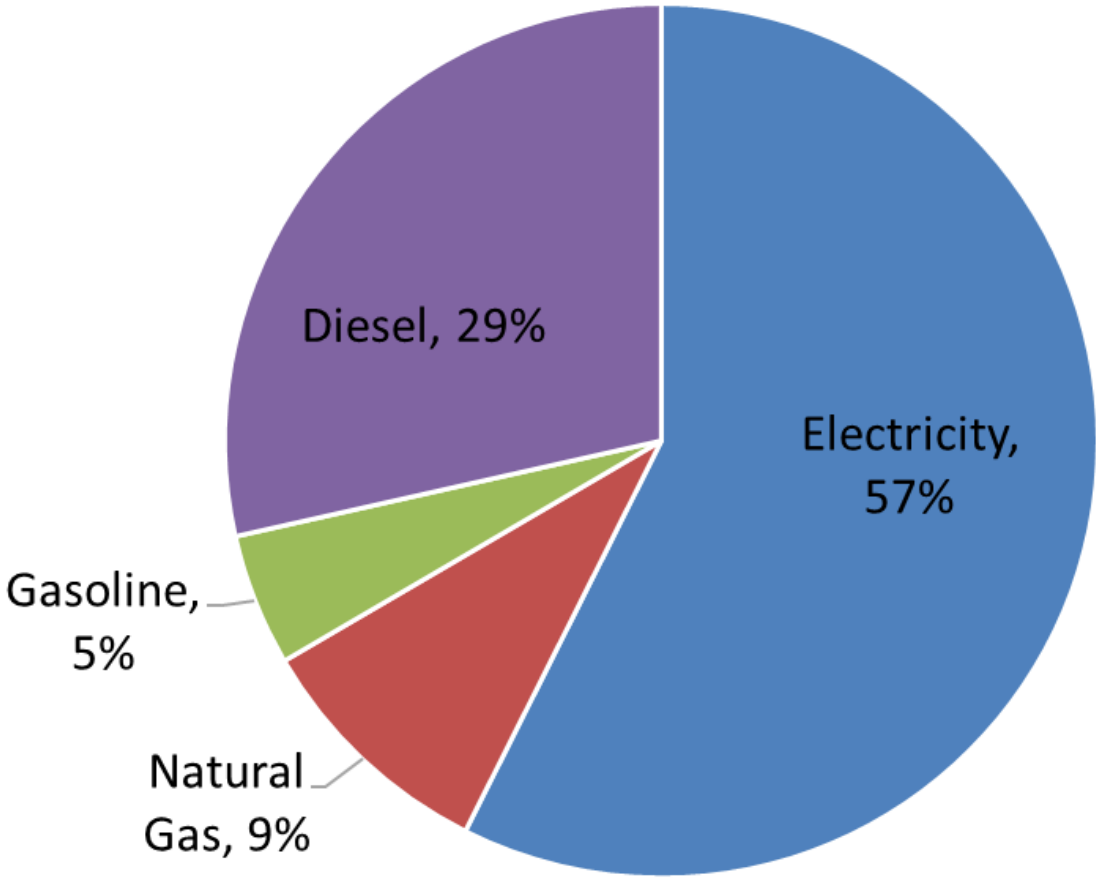
CITY EMISSIONS BY FUEL



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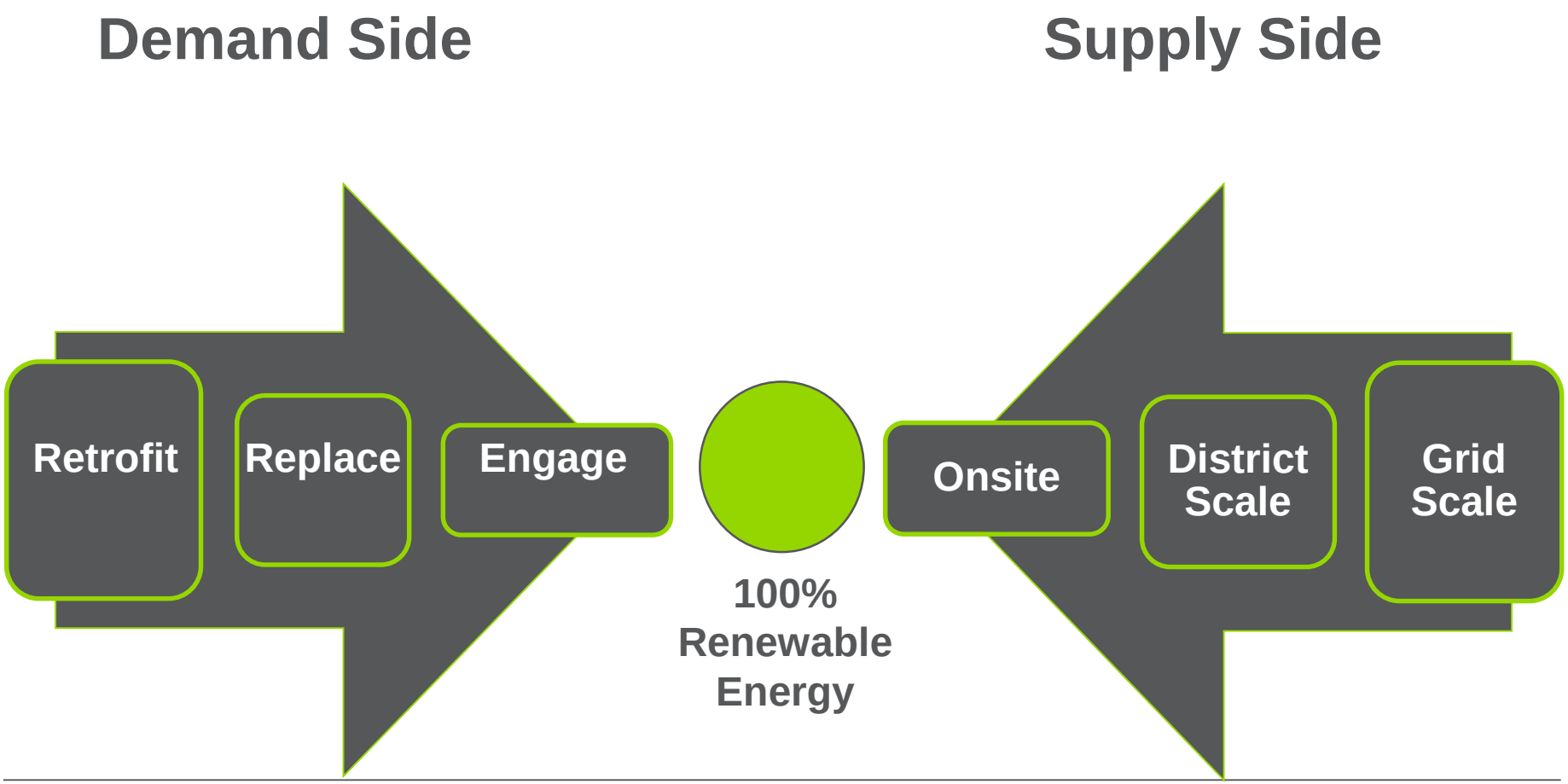
ACHIEVING 100% RENEWABLE ENERGY – NET ZERO CARBON



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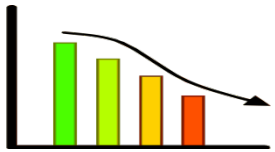
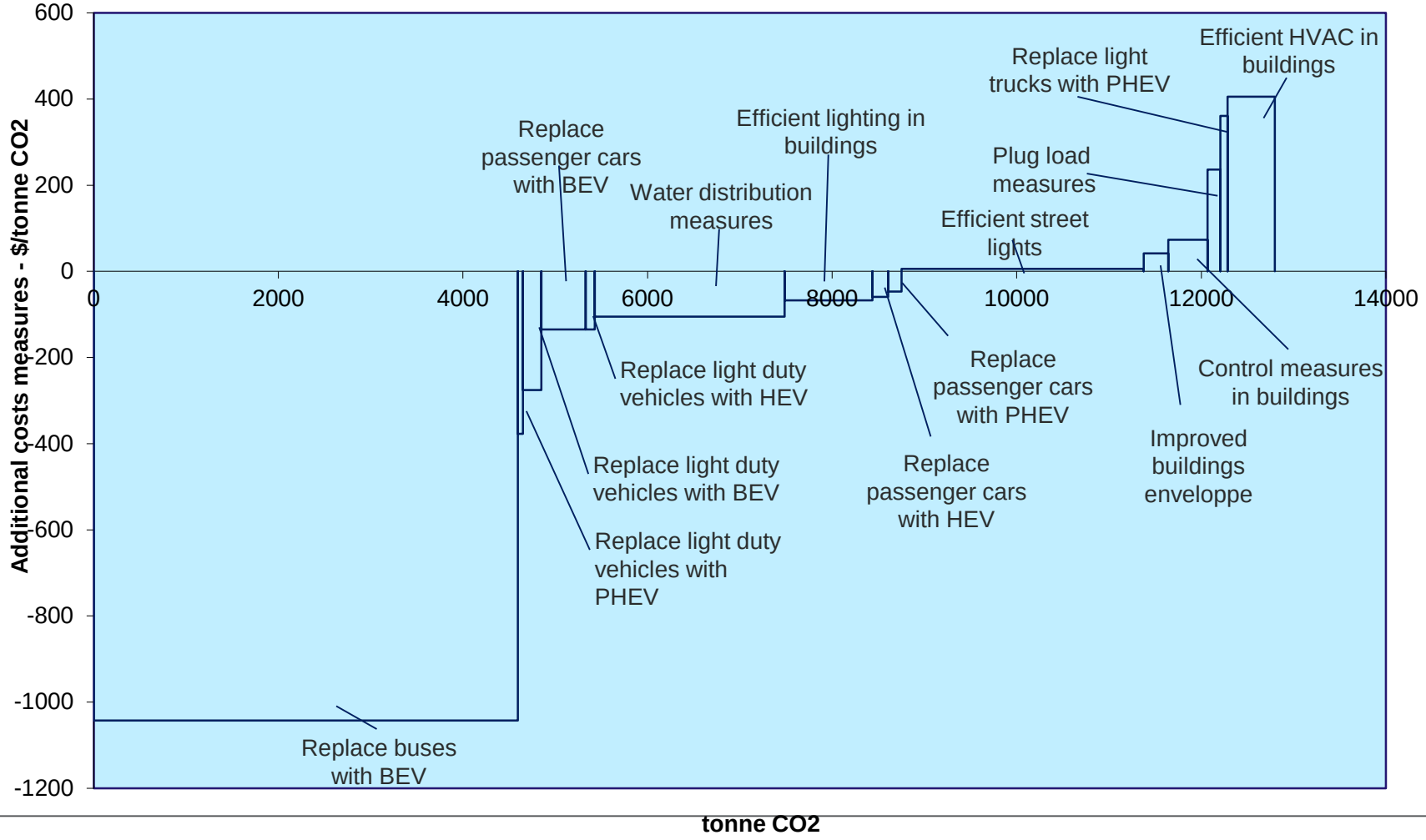
DEMAND SIDE STRATEGIES

Public reporting of COM building performance	
Detailed retro-commissioning of all city facilities	
Implement high payback retrofit opportunities	
Maintain high performance green building standards for new construction. Energy Star certification for all existing buildings.	ENERGY STAR U.S. GREEN BUILDING COUNCIL LEED CERTIFIED USGBC

COST OF CO2 REDUCTION – DEMAND MEASURES



SUPPLY SIDE OPTIONS

Behind the Meter Solar	
Off-Site Solar	
Renewable Energy Credits	

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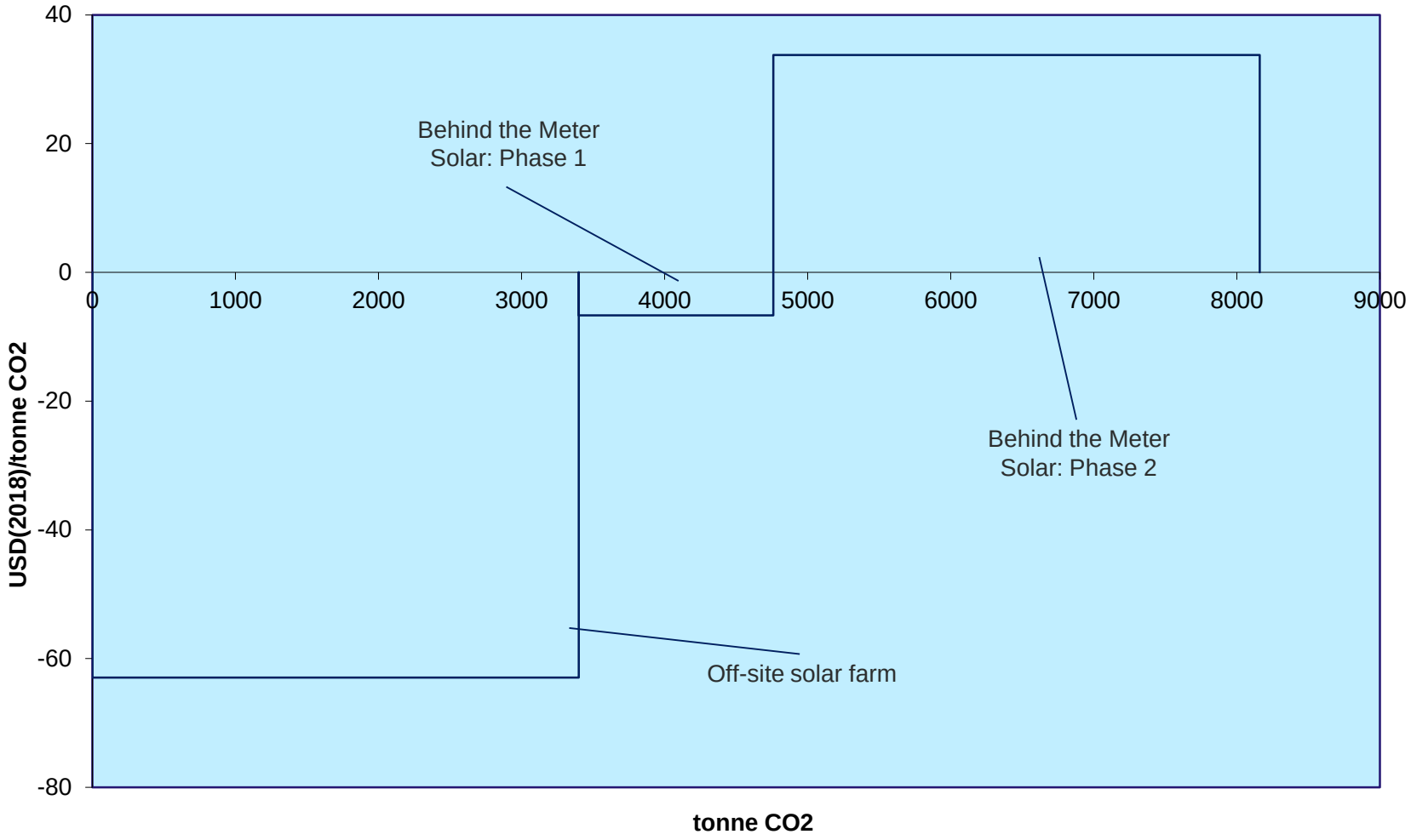
COST OF CO2 REDUCTION – SUPPLY MEASURES



OPTIONS TO FILL THE GAP BETWEEN SUPPLY AND DEMAND

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OPTIONS TO FILL THE GAP

Options	Pros	Cons
Deep retrofit EE	EE/Green building benefits	Operational, cost
Behind the meter solar	Relatively quick and controllable	Limited spaces available due to regulatory constraints
Utility scale solar	Costs coming down; city influence; regulatory environment RER option	Out of city's control, although still able to influence
Programs	Work with Focus on Energy or other groups to design and/or deliver programs	Regulatory, time to deliver savings, evaluation
Investments	Enable renewable energy projects (additionality)	City doesn't control what/when/where of projects; proximity

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PROGRAMS TO PROMOTE GOALS

Envisioning 100% Renewable Energy

MadiSUN

SOLAR ENERGY PROGRAM

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WHY GREEN ENERGY SOURCING

Paris Agreement

1

Limiting global warming to 2° is the target.

Madison Commitment

2

City Council unanimously passed resolution

Cost effectiveness

3

Benefits for people, planet and prosperity while costs continue to decrease

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WWF-CORPORATE RENEWABLE ENERGY PRINCIPLES ‘TRANSFORMATIONAL RENEWABLE ELECTRICITY’

Principle 1:
Sourced sustainably

Principle 2:
Additionality

Wind, solar, geothermal, hydropower and biomass

new generation capacity

Source: [WWF]

Fewer impacts

Greater impacts

Conventional

Standard Renewable

Progressive Renewable

Transformational Renewable

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FLEET/METRO

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OPTIONS TO REDUCE CARBON EMISSIONS BY FLEET VEHICLE SEGMENTS

Segment	Example	Number of Vehicles	Greening Options
Heavy-duty truck	Freightliner M2	168	CNG, Biofuels, Anti-Idling, Operator Training, GPS
Mid-duty truck	Ford F450 Ambulance	47	CNG, Biofuels, Anti-Idling, Operator Training, GPS, Right-Size
Light truck	Ford F250	85	CNG, Biofuels, Anti-Idling, Operator Training, GPS Right-Size
Light-duty vehicle	Ford Escape	121	Operator Training, GPS, hybrid or electric, Right-Size
Passenger car	Chevy Malibu	162	Operator Training, GPS, hybrid or electric, Right-Size
Other equipment	Forklift, Lawnmower	491	Operator Training, Electrification

HEAVY DUTY VEHICLES

photo: Josh Arnold

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HEAVY DUTY VEHICLES - LANDFILL CNG COLLABORATION WITH DANE COUNTY

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PRIVATE SECTOR CNG FUELING – MID-SIZE VEHICLES

Barnes vehicle powered by CNG
source: barnesinc.net/sustainability

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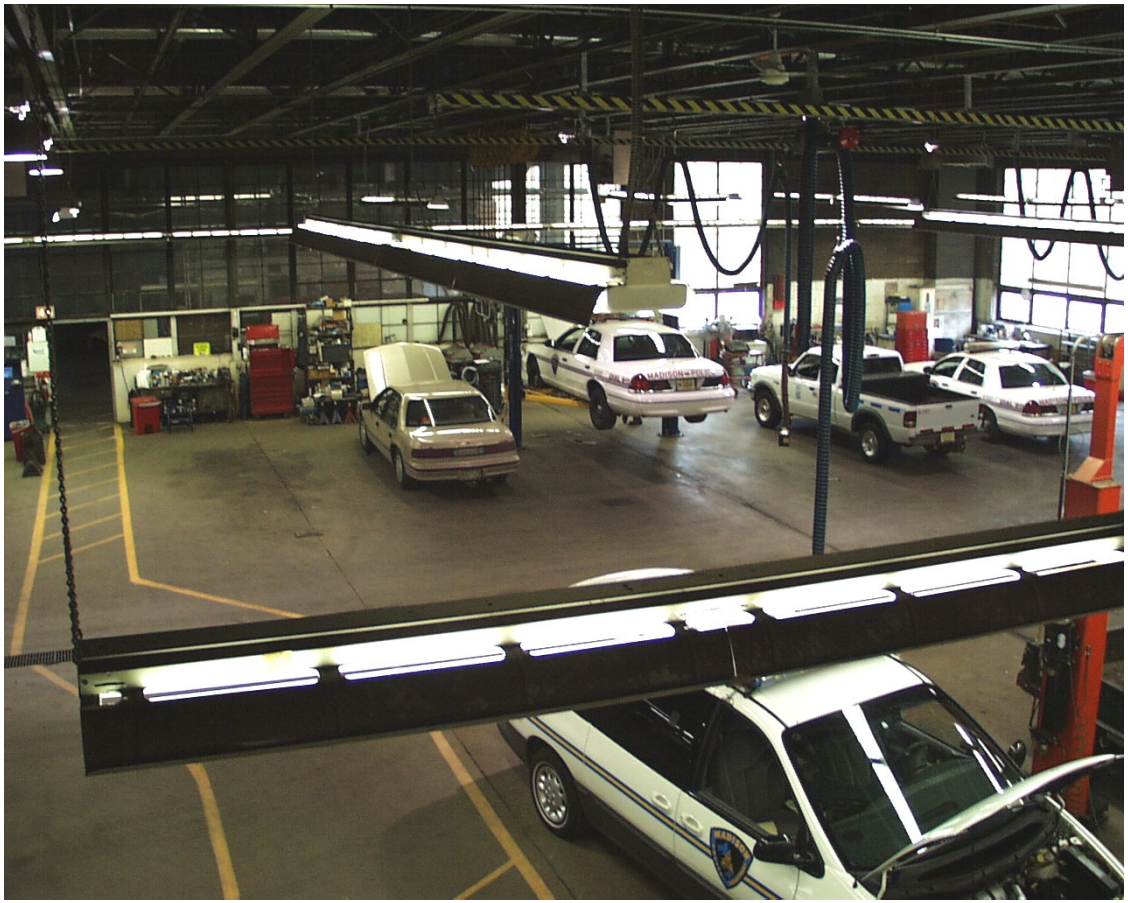
COST SAVINGS FROM OPERATIONS AND MAINTENANCE



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SMALL TRUCKS, SUVS AND PASSENGER VEHICLES

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OTHER EQUIPMENT INCLUDES SWEEPERS, UTILITY CARTS

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SCENARIO VEHICLES

Compact SUVs

Make	Model	Powertrain
TOYOTA	RAV4	HEV
KIA	SOUL	BEV
MITSUBISHI	OUTLANDER	PHEV
FORD	ESCAPE	ICE

Mid-Size Passenger Cars

Make	Model	Powertrain
TOYOTA	PRIUS	HEV
HYUNDAI	IONIQ	BEV
TOYOTA	PRIUS	PHEV
CHEVROLET	MALIBU	ICE






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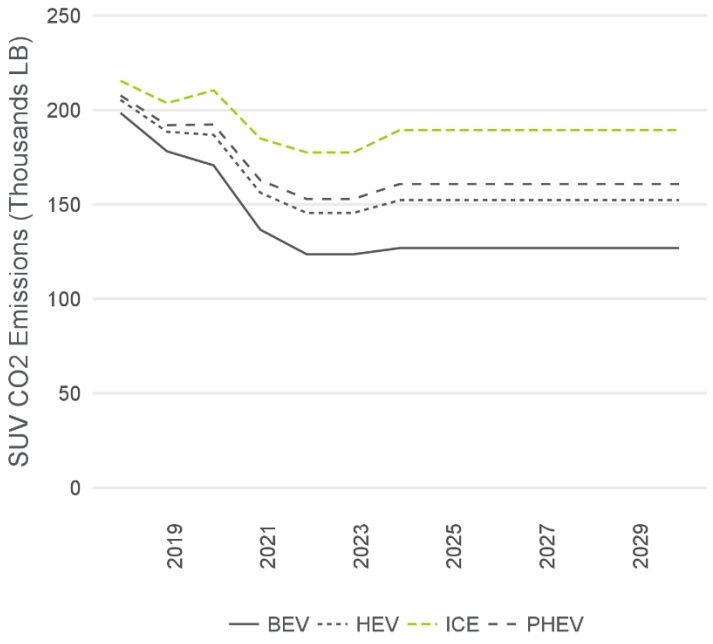
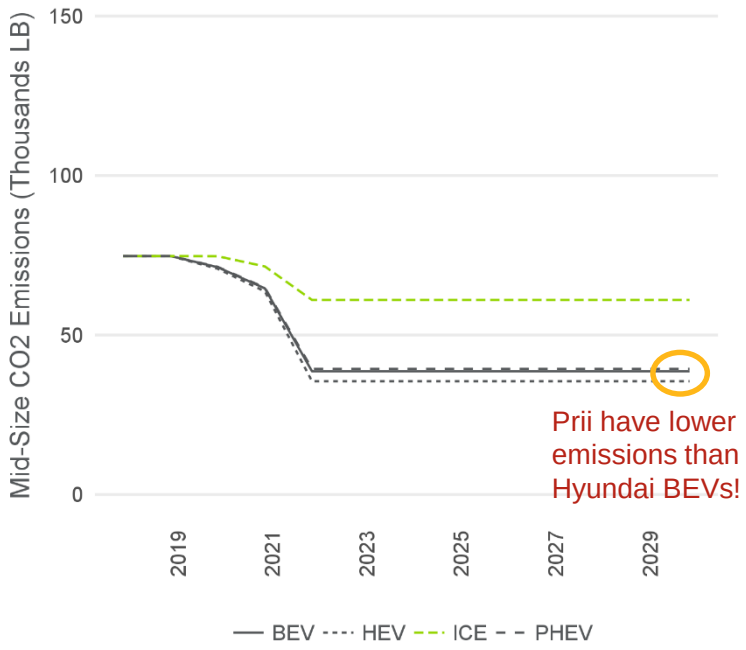
SEGMENT CO2 EMISSIONS IMPACTS





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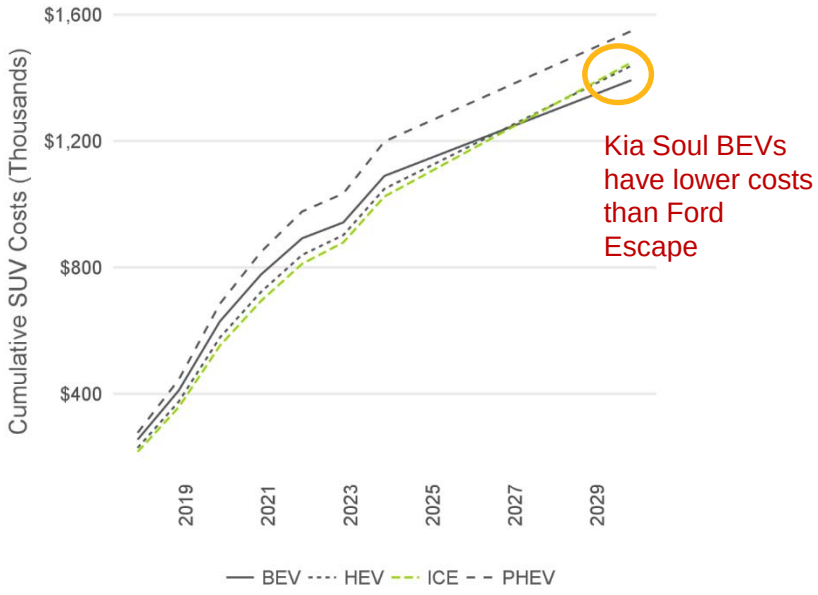
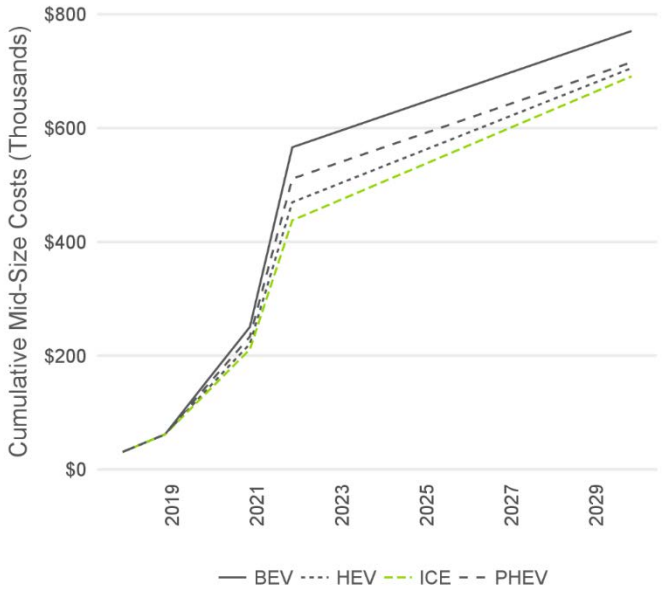
SEGMENT ECONOMIC IMPACTS



Kia Soul BEVs have lower costs than Ford Escape



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PER VEHICLE IMPACTS

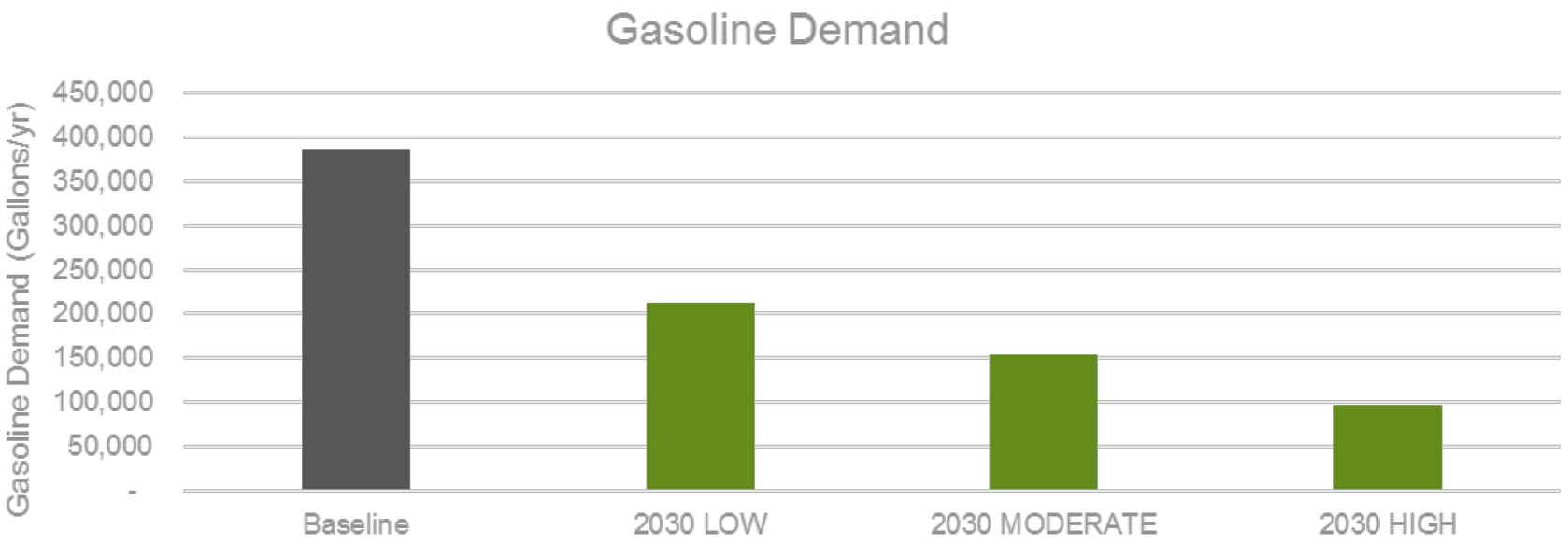
Cost Impacts Relative to ICEV

Powertrain	Mid-Size Sedan	Compact SUV
BEV	-$6,121.13	$2,547.78
HEV	-$1,103.48	$465.08
PHEV	-$1,899.84	-$4,530.27

Emissions Impacts Relative to ICEV (LB CO2)

Powertrain	Mid-Size Sedan	Compact SUV
BEV	-16,279	-30,698
HEV	-18,539	-18,241
PHEV	-15,717	-14,032

THE CITY OF MADISON CAN REDUCE GASOLINE DEMAND BY 75% BY 2030



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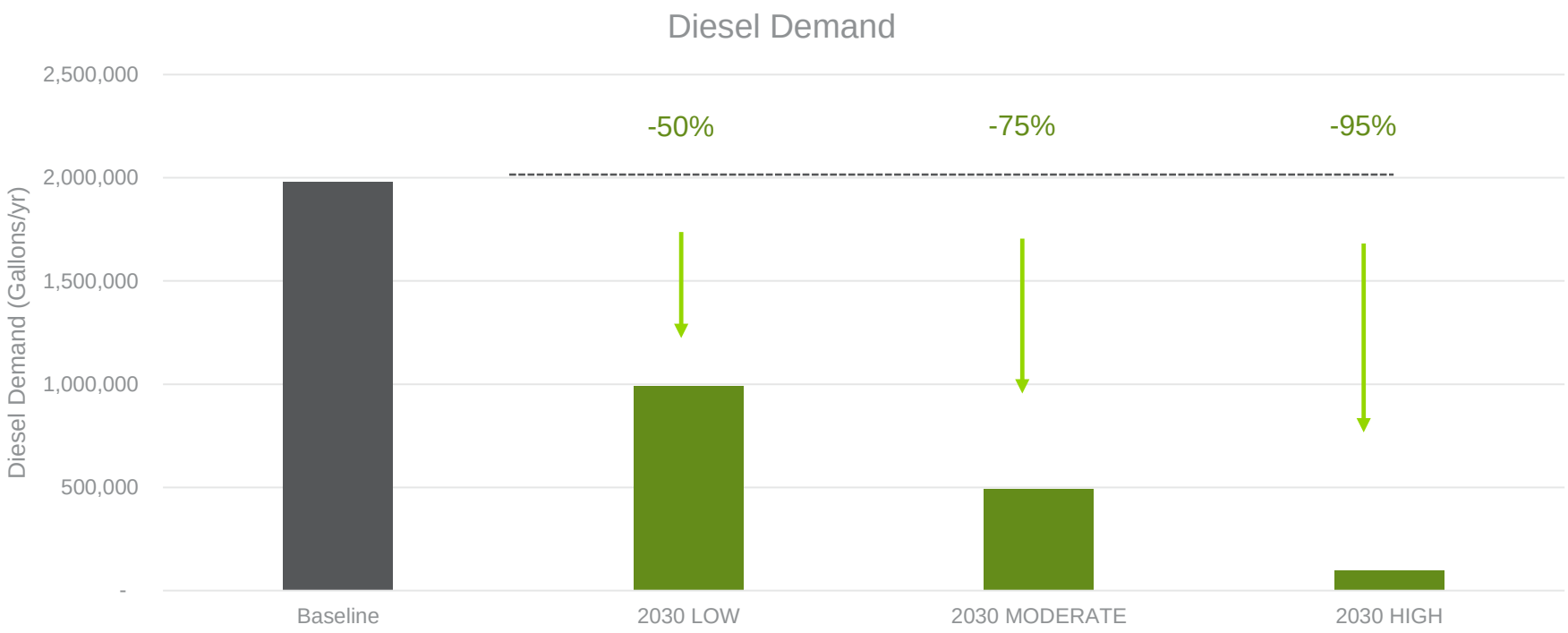
EFFECT OF MEASURES ON ENERGY DEMAND
DIESEL



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MADISON METRO STRATEGIES

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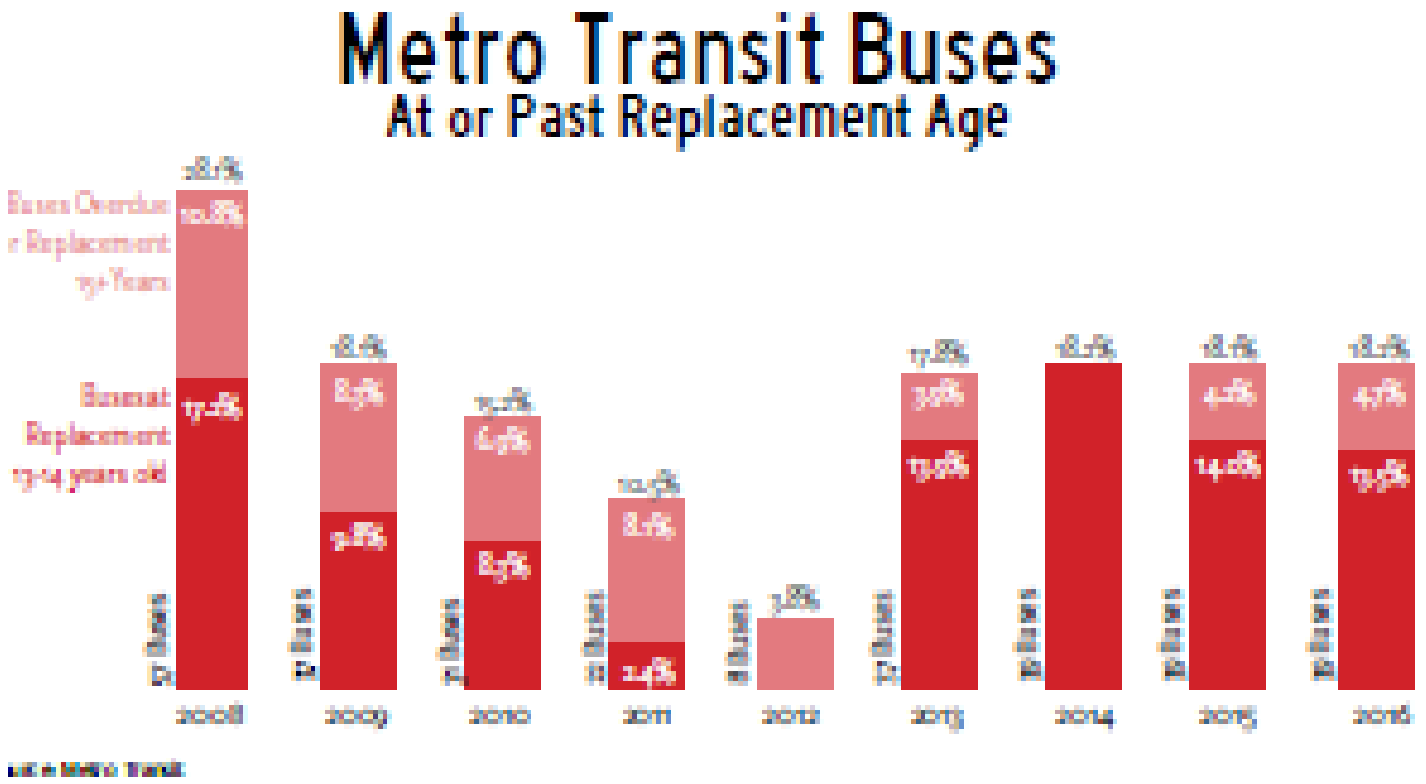
MADISON METRO BUSES REPLACEMENT AGE



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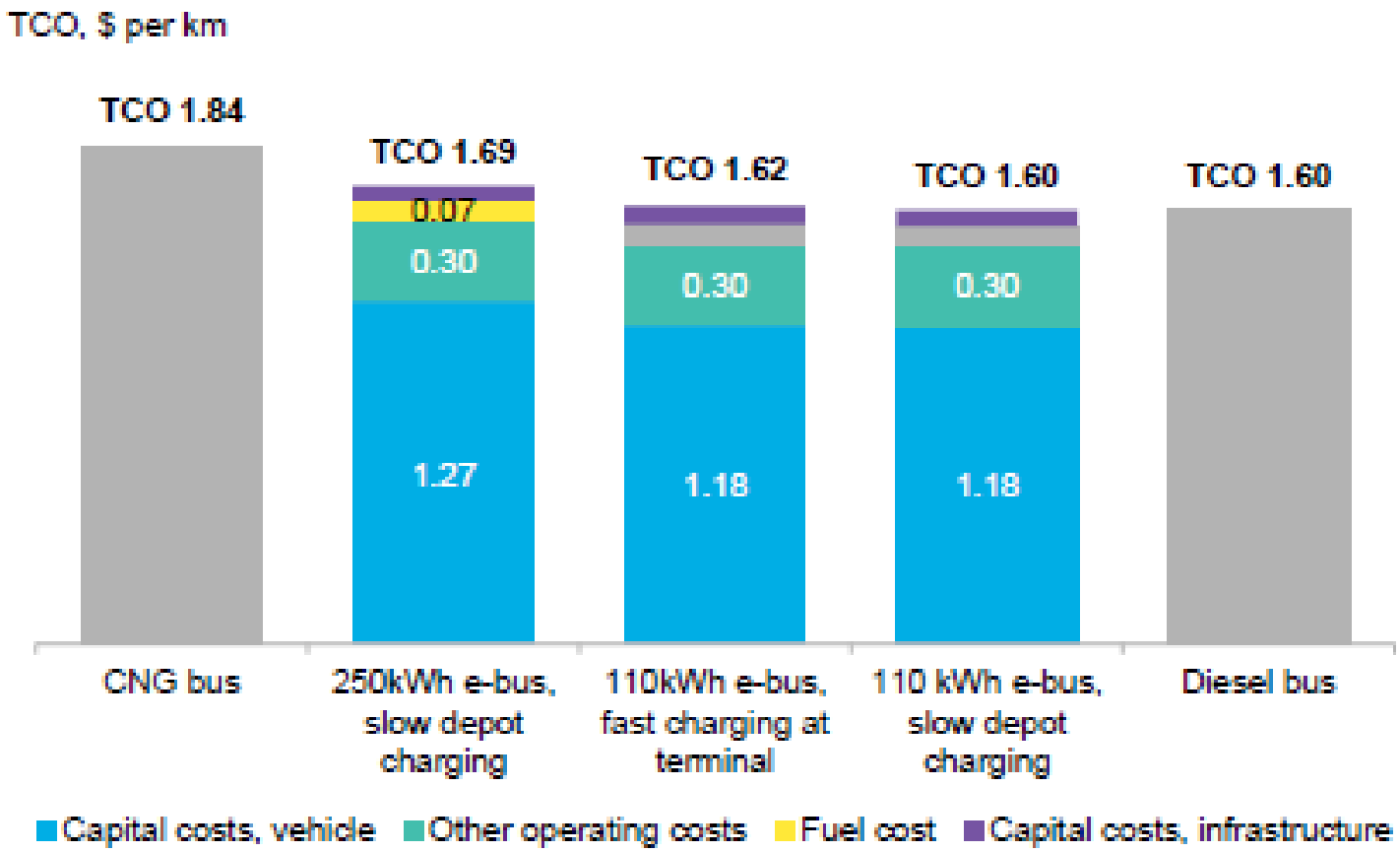
C40 ELECTRIC BUS V. CNG TOTAL COST OF OWNERSHIP

Figure 21: TCO comparison for the most likely e-bus configurations in a small city



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FINANCE OPTIONS FOR ELECTRIC BUSES

Lower upfront costs		Lower upfront costs Add flexibility	
Pay for the bus, lease the battery	Joining forces / joint purchasing	Lease (operating lease or capital lease)	F

Source: Bloomberg New Energy Finance

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THANK YOU – QUESTIONS?

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