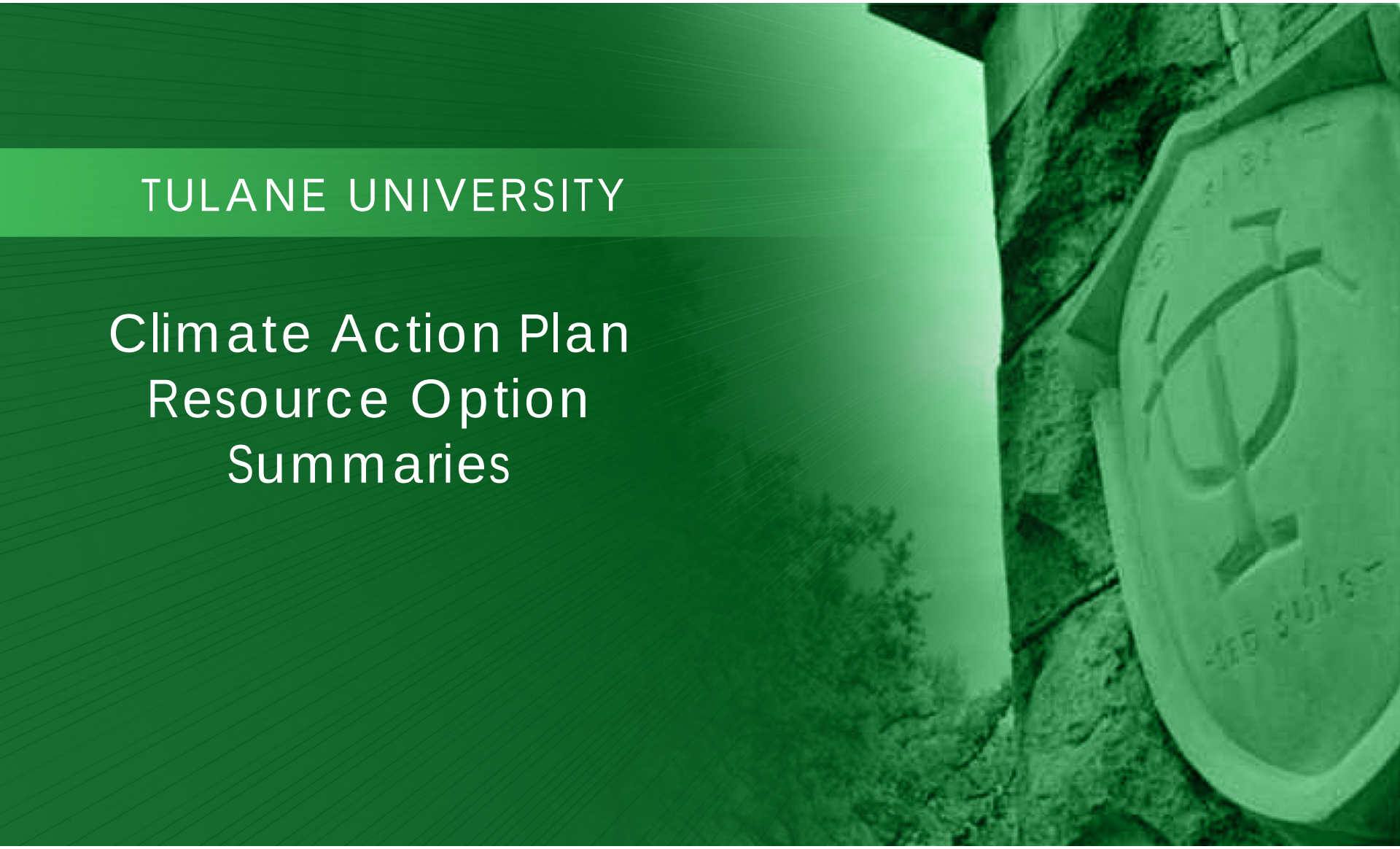
TULANE UNIVERSITY

Climate Action Plan Resource Option Summaries



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VHB

December 3, 2014

ECMs – Near Term

ECMs with a combined simple payback of less than 7 years.

Downtown ECMs (10 buildings):
- Variable Speed Drive Pumps
- Demand Control Ventilation
- Temperature Setbacks
- Equipment Scheduling
- Building Metering
- Retro-Commissioning
- Demand Management
- Lighting Upgrade

Uptown ECMs (41 buildings):
- Variable Speed Drive Pumps
- Demand Control Ventilation
- Fume hood Decommissioning
- Temperature Setbacks
- Building Metering
- Equipment Scheduling
- Retro-Commissioning
- Demand Management
- Lighting Upgrade

Capital (2014$)
- $2.0M (DT), $4.0M (UT)

Annual O&M (2014$)
- $300,000 (DT), $600,000 (UT)

Change in Demand
- Reduce purchased fuels
- Reduce purchased electricity

Change in Supply
- None

Impact on GHG Emissions
- Reduction in scope 1 & 2

Start Date
- 2015

Useful Life
- 40 years

Average Annual Savings (2014$)
- $611,000 (DT), $990,000 (UT)

Simple Payback
- 5 years (DT), 6 years (UT)

Building Energy Literacy Campaign

Integrated activities that bring greater University focus to climate change. This is intended to stimulate behavioral change to reduce University GHG emissions in part by linking the issue between classroom and other aspects of the university experience.

Phase 1 – Integrate building energy information into student and staff community through social media, curricula, incentive programs and educational guides

Phase 2 – Set targets for each class and hold contests

Phase 3 – Tulane to establish itself as national expert

(Note: O&M charge appears as part of ECMs)

Capital (2014$)

- None

Annual O&M (2014$)

- $270,000 (cost included as demand management ECM)

Change in Demand

- Reduce purchased fuels
- Reduce purchased electricity

Change in Supply

- None

Impact on GHG Emissions

- Reduction in scope 1 & 2

Start Date

- 2015

Useful Life

- 40 years

Average Annual Savings (2014$)

- $335k

Simple Payback

- Not applicable

Combined Heat and Power with Steam Driven Chiller

Baseload the current Combined Heat and Power (CHP) system year-round and add a 2000 ton steam driven chiller to utilize waste steam, when available, from the CHP system to produce chilled water.

Additional Information:

Incremental Capital:

- Steam Driven Chiller = $1.8M
- CHP = 150,000

Incremental O&M

- Steam Driven Chiller = $70,900
- CHP = None

Source: York Estimate

Mutually exclusive with other CHP options

Capital (2014$)

- $1.95 M

O&M (2014$)

- $70,900/yr

Change in Demand

- None

Change in Supply

- Reduce purchased electricity
- Reduce purchased fuels

Impact on GHG Emissions

- Net combined reduction in Scope 1 & 2

Start Date

- 2015

Useful Life

- 25 years

Average Annual Savings (2014$)

- $508,000

Simple Payback

- 5 years

Production and Distribution Efficiency

This resource option increases the plant production and distribution efficiency by 1) adding a condensing economizer on the existing boilers, 2) conducting chilled water retro-commissioning activities and 3) decreasing steam distribution losses from 15% to 10%.

Additional Information:

- Example chilled water retro- commissioning projects include control valve replacement or updates and variable speed drive pumping

Capital (2014$)

- $5.9 M

O&M (2014 $)

- $50,000

Change in Demand

- None

Change in Supply

- Reduce purchased fuels
- Reduce purchased electricity

Impact on GHG Emissions

- Reduction in Scope 1 and 2

Start Date

- 2015

Useful Life

- 40 years

Average Annual Savings (2014$)

- $400,000

Simple Payback

- 18 years

Energy Aspect of Construction Standards

This resource option increases building energy standards for new construction to 31% savings above ASHRAE 90.1 2007 (10% above ASHRAE 90.1 2013).

Additional Information:

- $9/SF increase in construction costs for new buildings

Capital (2014$)

- $2.0 M

Annual O&M (2014$)

- None

Change in Demand

- Reduce purchased fuels
- Reduce purchased electricity

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope 1 and 2

Start Date

- 2015

Useful Life

- 40 years

Average Annual Savings (2014$)

- $32,000

Simple Payback

- Approximately (assumed to be) 40 years

Fleet – Fuel Standards

Establish fuel purchase standards for fleet vehicles to achieve reductions in fuel use. Program pays ~$2,000 premium for higher than average efficiency vehicle (for 10 veh per year).

Mutually exclusive with other fleet options

Capital (2014$)

- $20,000/yr

O&M (2014$)

- Savings grow to over $45,000/y in 2050

Change in Demand

- Grow to 43% reduction of gasoline (2050)
- Grow to 20% reduction of diesel (2050)

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope 1

Start Date

- 2015

Useful Life

- Indefinite

Average Annual Savings (2014$)

- $24,000

Simple Payback

- Approximately (assumed to be) 40 years

Air Travel

Promote more efficient air travel by prioritizing air carriers with lower emissions per passenger-mile. This could result in an agreement of a preferred airline, for example. Develop programs to support increased electronic communication including distribution of webcams, etc

Capital (2014$)

- $40,000/yr in 2015 decreasing to $25,000/y in 2024

O&M (2014$)

- $20,000

Change in Demand

- ½% reduction in air travel emissions from improved carrier efficiency
- ½%/year reduction in travel miles

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope 3

Start Date

- 2015

Useful Life

- l40 years

Average Annual Savings (2014$)

- $300,000

Simple Payback

- Approximately (assumed to be) 40 years

ECMs – Mid Term

ECMs with a combined simple payback of less than 12 years.

Downtown Campus ECMs (2 buildings):

- Lighting Controls

Uptown Campus ECMs (22 buildings):

- Lighting Controls

Capital (2014$)

- $150,000 (DT), $1.3 M (UT)

Annual O&M (2014$)

- $4,000 (DT), $40,000 (UT)

Change in Demand

- Reduce purchased fuels
- Reduce purchased electricity

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope 1 and 2

Start Date

- 2020

Useful Life

- 40 years

Average Annual Savings (2014$)

- $17,700 (DT), $154,000 (UT)

Simple Payback

- 10 years (DT and UT)

Commuter – High Investment (Live/Work)

Invest in commuter incentives to reduce single occupant vehicle (SOV) commuting. Additional investments and programs to promote students and employees living close to campus.

- Transit incentive
- Additional shuttle service
- Commuter incentives & marketing,
- Staff support (0.5->1.5FTE)
- Housing program: loan, capital, staff support (up to 1.5 FTE)
- Additional bike infrastructure (grows to $150,000 in 2050)
- Shuttle fleet fuel efficiency program/standards

Mutually exclusive with other commuter options

Capital (2014$)

- $110,000/y grow to $340,000/y (shuttle and bikes)

O&M (2014$)

- $400,000/y grow to $1M/y

Change in Demand

- Reduction grow to SOV 50%

Change in Supply

- Not applicable

Impact on GHG Emissions

- Net reduction in combined Scope 1 and 3

Start Date

- 2020

Useful Life

- 40 years

Average Annual Costs (2014$)

- $800,000

Simple Payback

- No payback

GHG Offsets

This option purchases offsets for all natural gas in order to reduce, avoid, or destroy the equivalent of a ton of emissions. Offsets generally represent direct emission reductions or sequestration.

It prices GHG offsets at $/MTCO2e.

Capital (2014$)

- None

Annual O&M (2014$)

- $10/MTC02e

Change in Demand

- None

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope 1 and/or 2

Start Date

- 2025

Useful Life

- 40 years

Average Annual Costs (2014$)

- $540,000

Simple Payback

- Not applicable

Green Power Purchases

Purchase green power from the electric utility company. Green Power Purchases allow consumers to purchase renewable energy certificates (RECs).

Two options:

- Option A: $20/MWH
- Option B: $7/MWH

Capital (2014$)

- None

Annual O&M (2014$)

- $20/MWH
- $7/MWH

Change in Demand

- None

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope 2

Start Date

- 2025

Useful Life

- 40 years

Average Annual Costs (2014$)

- Option A: $3 M ($20/MWH)
- Option B: $1.1M ($7/MWH)

Simple Payback

- Not Applicable

Solar 5MW Power Purchase Agreement

Contract with a third party for equivalent of a 5MW solar installation.

Additional Information:

- PV Watts- solar resource
- Entergy Electricity Rates from Wendell
- EIA electricity forecasts

Capital (2014$)

- None

Annual O&M (2014$)

- $113/MWh and escalates each year

Change in Demand

- None

Change in Supply

- Reduce purchased electricity

Impact on GHG Emissions

- Reduction in Scope 2

Start Date

- 2025

Useful Life

- 25 years

Average Annual Costs (2014$)

- $474,000

Simple Payback

- Not Applicable

ECMs – Long Term

ECMs with a combined simple payback more than 30 years.

Downtown ECMs (10 buildings):

- Constant Volume to Variable Air Volume
- Exhaust Air Heat Recovery
- Fume Hood VAV
- Plug Load Management
- Window Replacement
- Solar Thermal

Uptown ECMs (41 buildings):

- Constant Volume to Variable Air Volume
- Dedicated Outside Air Systems
- Fume Hood VAV
- Plug Load Management
- Window Replacement
- Solar Thermal

Capital (2014$)

- $16 M (DT), $38 M (UT)

Annual O&M (2014$)

- 375,000 (DT), $500,000 (UT),

Change in Demand

- Reduce purchased fuels
- Reduce purchased electricity

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope1 and 2

Start Date

- 2025

Useful Life

- 40 years

Average Annual Savings (2014$)

- $250,000 (DT), $676,000 (UT)

Simple Payback

- Approximately (assumed to be) 40 years

Solar Domestic Hot Water

Solar thermal flat plate collectors to serve as a pre-heat for domestic hot water.

Downtown: 17 buildings per "Solar Hot Water Strategies for Tulane University – Feasibility Analysis," 2013

Uptown: Deming Pavilion and JBJ

Additional Information:

- Solar resource model - RETScreen

(Note: charge appears as part of ECMs- Near Term)

Capital (2014$)

- $12.8M (appears as ECM budget item)

Annual O&M (2014$)

- $200,000 (appears as ECM budget item)

Change in Demand

- Reduce purchased fuels
- Reduce purchased electricity

Change in Supply

- None

Impact on GHG Emissions

- Reduction in Scope 1 and 2

Start Date

- 2025

Useful Life

- 25 years

Average Annual Savings (2014$)

- $500,000

Simple Payback

- 26 years

Horizontal Geo-exchange

A horizontal geoexchange installed on 5 acres of Uptown Campus open space. This resource option provides 97 tons of capacity.

Capital (2014$)

- $660,000 (half payment in two consecutive years)

Annual O&M (2014$)

- $7,250

Change in Demand

- None

Change in Supply

- Reduce purchased fuels

Impact on GHG Emissions

- Net reduction in Scope 1 and 2

Start Date

- 2025

Useful Life

- 40 years

Average Annual Savings (2014$)

- $30,000

Simple Payback

- 26 years

Building Integrated PV

Install a 1MW building integrated solar photovoltaic (BIPV) system.

Additional Information:

- PV Watts-solar resource

Capital (2014$)

- $3.8M

Annual O&M (2014$)

- $19,000

Change in Demand

- None

Change in Supply

- Reduce purchased electricity

Impact on GHG Emissions

- Reduction in Scope 2

Start Date

- 2025

Useful Life

- 25 years

Average Annual Savings (2014$)

- $80,600

Simple Payback

- Approximately (assumed to be) 40 years

Resource Options in the Abatement Diagram, but not Included in the Recommended Portfolio

Fleet – Fuel Standards + EV

Establish fuel purchase standards for fleet vehicles to achieve reductions in fuel use. Additionally, aim to have 15% of all fleet mileage on electric vehicles by 2050.

- Program pays ~$2,000 premium for higher than average efficiency vehicle (for 8 vehicles per year).
- Program pays ~$10,000 premium for electric vehicles; shrinks to $5,000 by 2025 (for 2 vehicles per year)

Mutually exclusive with other fleet options

Capital (2014$)
- $36,000/yr in 2015 decreasing to $26,000/y in 2025

O&M (2014$)
- Fuel savings grow to $65,000/y in 2050
- Electricity costs depend on generation

Change in Demand
- 43% reduction of gasoline by 2050
- 20% reduction of diesel by 2050
- Additional 125kWh of electricity demand in 2050

Change in Supply
- None

Impact on GHG Emissions
- Decrease Scope 1
- Potential increase in Scope 2
- Net reduction of fuel GHG (relative to BAU) of 39%
- At current EGRID rates, net impact is ~ same as low investment scenario

Start Date
- 2015

Useful Life
- Indefinite

Average Annual Savings (2014 $)
- $27,000

Simple Payback
- More than 36 years

Commuter – Low Investment

Invest in commuter incentives to reduce single occupant vehicle (SOV) commuting:

- Transit incentive (paid passes/rides)
- Additional shuttle service
- Commuter incentives & marketing,
- Staff support (0.5->1FTE)
- Additional bike infrastructure (grows to $50,000 in 2050)

Mutually exclusive with other commuter options

Capital (2014 $)

- None

O&M (2014$)

- $545,000/y in 2015 growing to $990,000/y in 2050 ($595,000/y over BAU)
- Savings in reduced downtown parking of $110,000 in 2050
- Net of $485,000/y in 2050 (over BAU)

Change in Demand

- Reduction of SOV by 10-15%

Change in Supply

- Increase programs, shuttle service

Impact on GHG Emissions

- Reduce Scope 3
- Increase Scope 1
- Net reduction (relative to BAU) of 18%

Start Date

- 2020

Useful Life

- Indefinite

Average Annual Costs (2014 $)

- $373,000

Simple Payback

- Not Applicable

Commuter – Medium Investment (Live/Work)

Invest in commuter incentives to reduce single occupant vehicle (SOV) commuting. Additional investments and programs to promote students and employees living close to campus.

- Transit incentive
- Additional shuttle service
- Commuter incentives & marketing,
- Staff support (0.5->1.25FTE)
- Housing program: loan, capital, staff support (up to 1 FTE)
- Additional bike infrastructure

Mutually exclusive with other commuter options

Capital (2014 $)

- None

O&M (2014$)

- $625,000/y in 2015 growing to $1.6M/y in 2050 ($1.2M/y over BAU)
- Savings in reduced downtown parking of $240,000 in 2050
- Net of $960,000/y in 2050 (over BAU)

Change in Demand

- Reduction of SOV by 15-25%

Change in Supply

- Increase programs, shuttle service

Impact on GHG Emissions

- Reduce Scope 3
- Increase Scope 1
- Net reduction (relative to BAU) of 36%

Start Date

- 2020

Useful Life

- Indefinite

Average Annual Costs (2014 $)

- $680,000

Simple Payback

- Not Applicable

Combined Heat and Power with Steam Turbine Generator

Baseload the current Combined Heat and Power (CHP) system year-round and add a 545 kW steam turbine generator to utilize waste steam, when available, from the CHP system to produce electricity.

Additional Information:

Incremental Capital

- Steam Turbine Generator = $3.3M
- CHP= $150,000

Incremental O&M

- Steam Turbine Generator = $30,000
- CHP = None

Source: Dresser- Rand/AEI

Mutually exclusive with other CHP options

Capital (2014 $)

- $3.45M

O&M (2014 $)

- $30,000

Change in Demand

- None

Change in Supply

- Reduce purchased electricity
- Reduce purchased fuels

Impact on GHG Emissions

- Reduce scope 1 & 2

Start Date

- 2015

Useful Life

- 25 years

Average Annual Savings (2014 $)

- $485,000

Simple Payback

- 9 years

Uptown Hot Water Conversion

Convert Uptown Campus steam distribution system to hot water.

Additional Information:

- Capital cost assumes steam to hot water building conversion: $20/sf x 4 M GSF. Hot water condensing boiler + piping upgrades + other plant conversion costs: $10 million.

Capital (2014 $)

- $90 M

Annual O&M (2014 $)

- No incremental

Change in Demand

- None

Change in Supply

- Reduce purchased fuels

Impact on GHG Emissions

- Reduce scope 2
- Increase scope 1

Start Date

- 2025

Useful Life

- 40 years

Average Annual Savings (2014 $)

- $156,000

Simple Payback

- more than 36 years