Tompkins County Energy Roadmap

Fall 2015

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For Tompkins County Planning Department

Presentation Outline

Overview

Potential

Scenarios

Next Steps

Motivation for Energy Roadmap

Overview

Motivation for Energy Roadmap

Overview

Isn’t Climate Change a Global Problem?

Overview

What difference will it make to achieve climate goals here in Tompkins County?

- If everyone says that, then no one will move the dial
- Keeps money spent on energy in the local economy instead of in multi-national corporations’ pockets
- Creates local jobs – can’t outsource insulating a house
- Reduces pollutants and improves health
- Makes buildings more comfortable to live in
- Increases our resilience in the face of a changing climate

Tompkins County 2015 Comprehensive Plan

Overview

Principle

Tompkins County should be a place where the energy system meets community needs without contributing additional greenhouse gases to the atmosphere

Policy

Reduce greenhouse gas emissions to reach a minimum 80% reduction from 2008 levels by 2050 and reduce reliance on fossil fuels across all sectors.

What is the Energy Roadmap?

Overview

1. Assesses potential of local renewable energy sources

2. Assesses potential for energy efficiency and demand management to reduce energy demand

3. Identifies scenarios for how both energy demand and greenhouse gas emissions goals can be met in 2050

A framework to guide activities and energy-related decision making to achieve long-term energy demand and climate goals

What the Energy Roadmap is NOT

Overview

- Concrete action steps to achieve goals (wait for the Updated Energy Strategy in 2016)
- An evaluation of all technologies available today – limited to those most pertinent to community
- A guide for solving all of the grid-level issues the nation needs to address to incorporate high amounts of renewables –
  - Utility rate structure, interconnection, energy storage, peak demand, balancing renewable generation, infrastructure limitations, etc.
- A crystal ball that predicts energy pricing and new innovations in technologies and policy developments

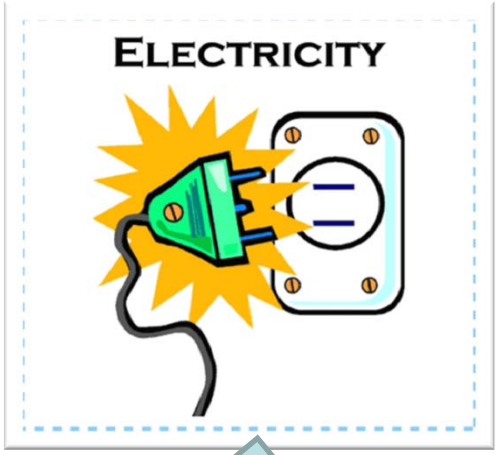
Energy Roadmap Steering Committee

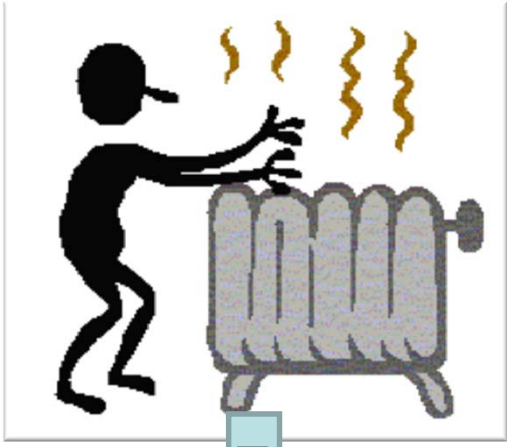
Overview

Martha Armstrong, TC Area Development	Tony Ingraffea, Cornell Civil & Enviro Eng
Peter Bardaglio, Black Oak Wind, TCCPI	Tim Mount, Cornell Applied Econ & Mgmt
Scott Bochenek, Iberdrola USA	Gay Nicholson, Sustainable Tompkins
Carol Chock, TC Legislature	Bob Pass, NYSEG
Linda Copman, Cornell Climate Action Plan	Leslie Schill, Cornell Facilities Services
Brian Eden, EMC Energy Committee	Ken Schlather, Cooperative Ext. Tompkins
Nick Goldsmith, City/Town Ithaca	Ian Shapiro, Taitem Engineering
Jerry Goodenough, Cayuga Power Station	(Lew Durland, Ithaca College)

What Creates GHG Emissions

Overview





Grid- Nat Gas, Coal

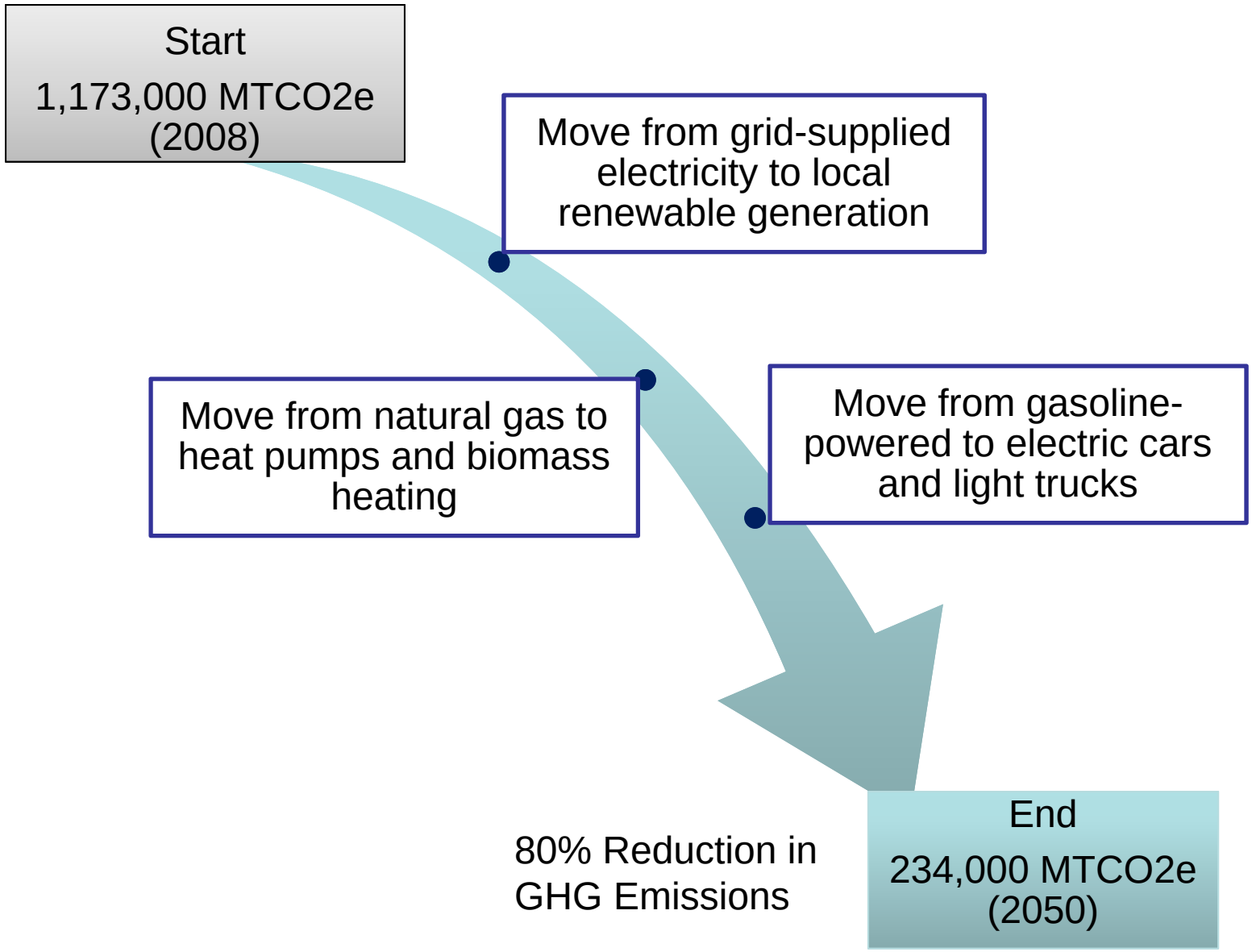
Nat Gas, Oil, Propane

Gasoline, Diesel

GHG Emissions

Achieving 80% Reduction – Trade-offs

Overview



Bottom Line – What We Learned

Overview

Low-Hanging Fruit

- Retrofit existing buildings and build new energy efficient ones – often the lowest cost way to get to goals
- Install a lot of solar PV for electricity
- Transition away from natural gas to heat pumps and biomass for heating – can't achieve goals and still use same amount of gas
- Reduce vehicle miles traveled by building housing in population centers, encouraging carpooling, etc.
- Transition away from gasoline to electric vehicles

Federal, State and Local Governments, Agencies, Non-profits, Businesses and Consumers have critical roles to play

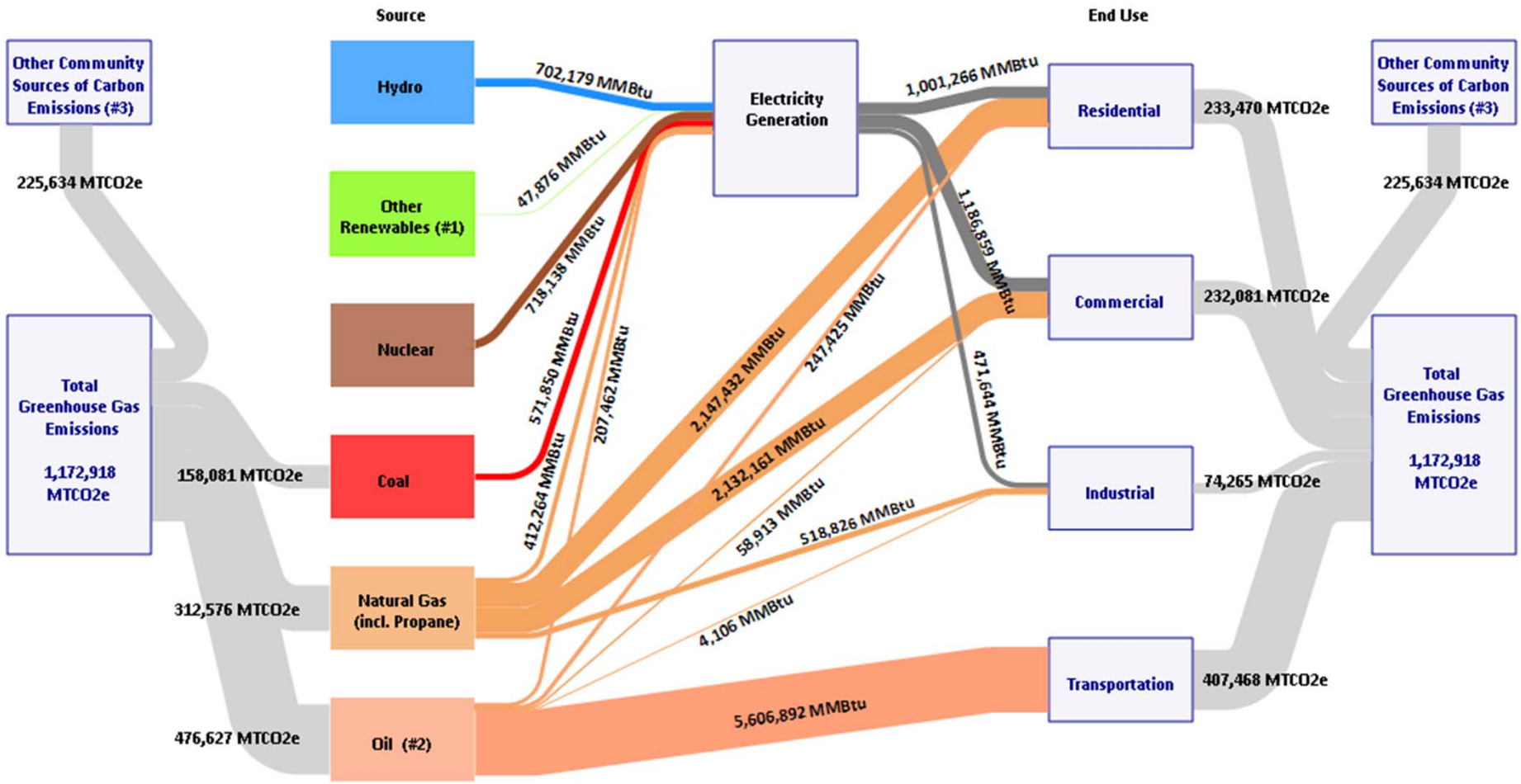
Diving Into the Numbers: Terms

Overview

MTCO2e, or Metric tons of carbon dioxide equivalent – a measure of the combined ability of all emitted greenhouse gases to trap heat over a given lifetime in the atmosphere, relative to the effects of the same mass of carbon dioxide released over the same time period.

MMBtu, or Million British thermal units – a measure of the energy content in fuel.

2008 Tompkins County Energy Flow and Greenhouse Gas Emissions



Data Sources:
Energy use by sectors and greenhouse gas emissions sources from Tompkins County 2008 GHG Emissions Inventory, developed using the 2009 version of ICLEI's Clean Air Climate Protection (CACP) software. Electricity fuel sources used for Tompkins County 2008 GHG Emissions Inventory is EPA eGRID Profiler, Year 2005 eGRID Subregion Resrouce Mix, NPCC Upstate NY: Nuclear 27%, Hydro 26.4%, Coal 21.5%, Natural Gas 15.5%, Oil 7.8%, Biomass 1.2%, Other Fossil Fuel 0.4%, and Wind 0.1%.

Notes:
#1. Other Renewables include solar, wind, biomass, and geothermal energy sources.
#2. Oil includes heating fuel, diesel, gasoline, motorcycle gasoline, and transit bus diesel.
#3. Other Community Sources of Carbon Emissions include Waste (41,792 MTCO2e), Agriculture (43,996 MTCO2e), Cornell Power Generation (139,833 MTCO2e), and Groton Electricity Use (13 MTCO2e).

e!Sankey software

Presentation Outline

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Potential

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Quantifying Renewable Energy Potential

Potential

Topics Evaluated

- Solar
- Wind
- Micro-hydro
- Biomass
- Demand-Side Management (incl Efficiency and Heat Pumps)
- District Energy Systems and Combined Heat and Power
- Deep Geothermal
- Transportation

Approach to Quantifying Potential

Potential

- Used only technologies that are commercially available today
- Tried to be conservative in our assumptions about feasibility
- Used sound methodology and defensible numbers
- Thorough review by Steering Committee

All detailed topic chapters are available online at tompkinscountyny.gov/planning/energy-climate

Solar - Electricity

Potential

Category		Annual Electricity Output (GWh)
Residential	Urban*	16
	Rural	109
Nonresid#	Commercial	132
	Industrial	21
	Community and public services	81
PV Farms		2,093
Total		**2,452**

Total electricity demand in 2008 was 779 GWh/yr

315% of Total Demand

*Urban areas are defined in this chapter as the City of Ithaca and the 6 Villages

Wind - Electricity

Potential

Scale			Annual Energy Output (GWh)
Small-scale			40
Medium-scale			650
Large-scale			302
Total			**992**

Total electricity demand in 2008 was 779 GWh/yr

127% of Total Demand

- *Small-scale*: turbine rated capacity 1-25 kW. Likely used by individual homes.
- *Medium-scale*: turbine rated capacity 25-500 kW. Likely used for small businesses, especially agriculture, or for community shared turbines.
- *Large-scale*: turbine rated capacity >500 kW. Likely used as wind farms with the electricity sold to utilities or through power purchase agreement.

Micro-Hydro - Electricity

Potential

Potential Sites			Annual Energy Output
			726 GWh

- Generation potential at individual sites varies from 100 kW - 2,950 kW
- Most sites could generate between 100kW - 600kW

Total electricity demand in 2008 was 779 GWh/yr

93% of Total Demand, but less certainty in numbers

Biomass – Heating

Potential

Land Type	Acres†	MMBtus/yr§
Wood - Forests	69,775	1,345,751
Energy Crops - Inactive Ag, Brush, Grass Land	29,668	2,373,440
Ag Waste - Active Agricultural Land		798,846
Total		**4,518,037**

Total heating demand in 2008 was 5,208,990 MMBtus/yr

87% of Total Demand

Energy Efficiency

Potential

			Potential Energy Savings
Commercial Retrofits			2,319,177 MMBtus
Residential Retrofits			2,286,693 MMBtus
Total			**4,605,870 MMBtus**
Amount for heating alone (69% of avg. building total)			***3,178,050***

Total heating demand in 2008 was 5,208,990 MMBtus/yr

61% of Total Heating Demand

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Major Assumptions Applied to All Scenarios

Scenarios

GENERAL

- Only account for direct emissions, not life cycle
- No change in weather patterns included
- Analysis is for a static point in time, 2050, not points along the way, and not how quickly to achieve emissions reductions
- Emissions from waste and agriculture remain constant
- Do not include emissions from air or rail travel
- Costs of actions to achieve scenarios are not factored into scenarios, but are identified in challenges in each topic chapter
- Electricity, Heat and Transportation use projected growth rates of 33-34% (2008-2050) based on Census and EIA estimates

Scenarios

Scenarios

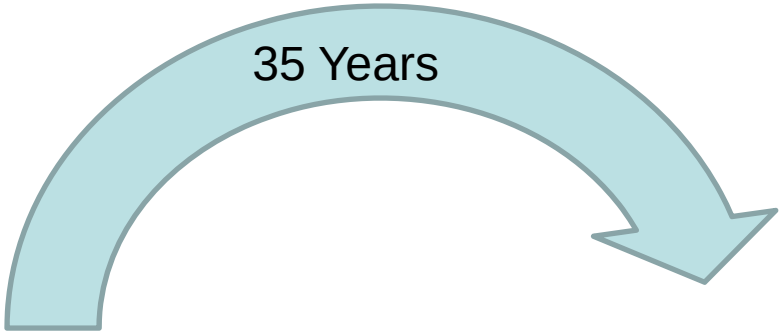
- ***Scenario A – Business as Usual***
- Scenario B – Mixed
- Scenario C – All Electric
- Scenario D – Maintaining Half of 2008 Natural Gas Use

All Except for “A” meet goal of 80% reduction from 2008 levels by 2050

Scenario A
“Business as Usual”

Timeframe for This Analysis

Scenarios



Baby Tyler in 2015

Tyler in 2050

Scenario A: Business As Usual

Scenarios

In 2015, Tyler's family is likely to:

- Live in a house heated by natural gas
- Get electricity from a grid powered by nuclear, hydro, natural gas and coal
- Live in the suburbs or country and drive to work in Ithaca
- Drive a vehicle that gets about 20 miles per gallon of gasoline

In 2050, Tyler's family is likely to:

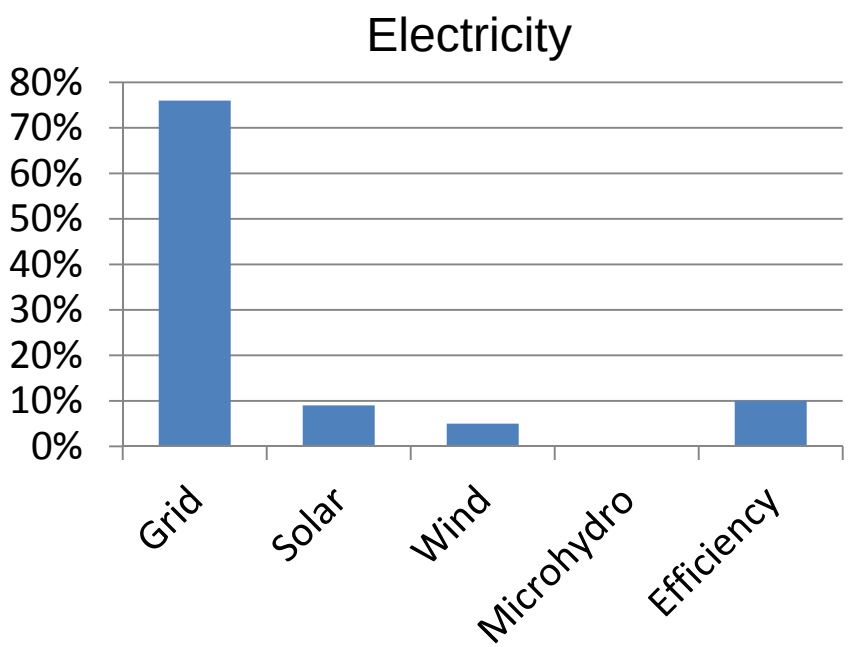
- Live in a house heated by natural gas
- Get electricity from a grid powered by more renewables than in 2015
- Live in the suburbs or country and drive to work in Ithaca
- Drive a vehicle that gets about 55 miles per gallon of gasoline

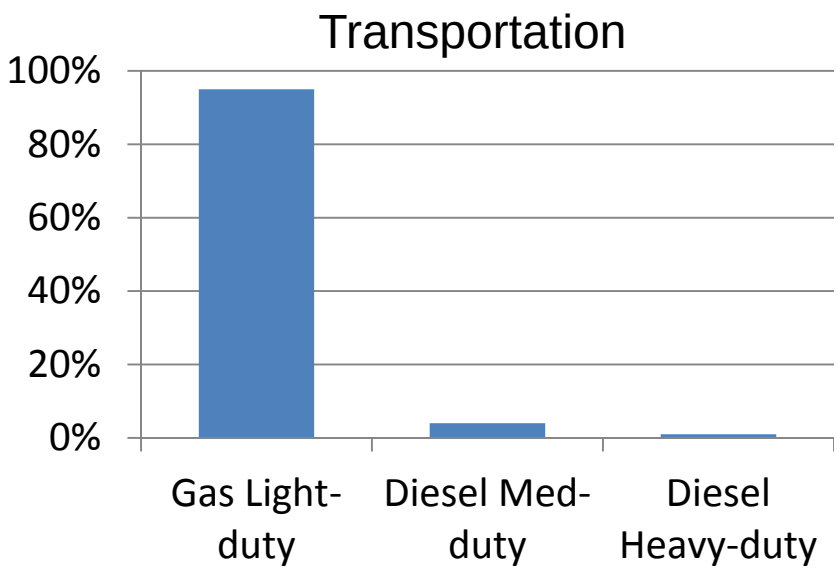
. . . but they may not be smiling

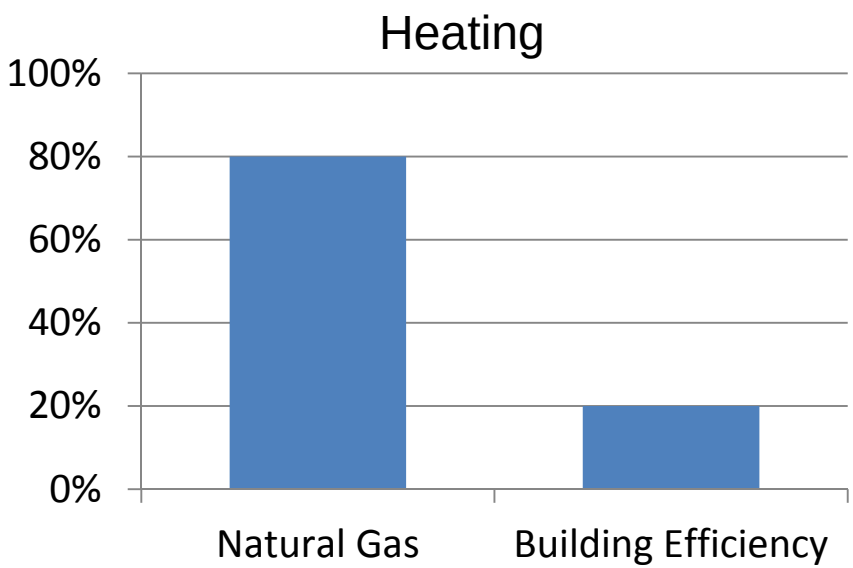
Scenarios

Scenario A (BAU)
Percent of Energy Demand Met by Source in 2050

Mostly:
- Electricity from Grid
- Cars fueled by Gasoline
- Heating from Nat Gas





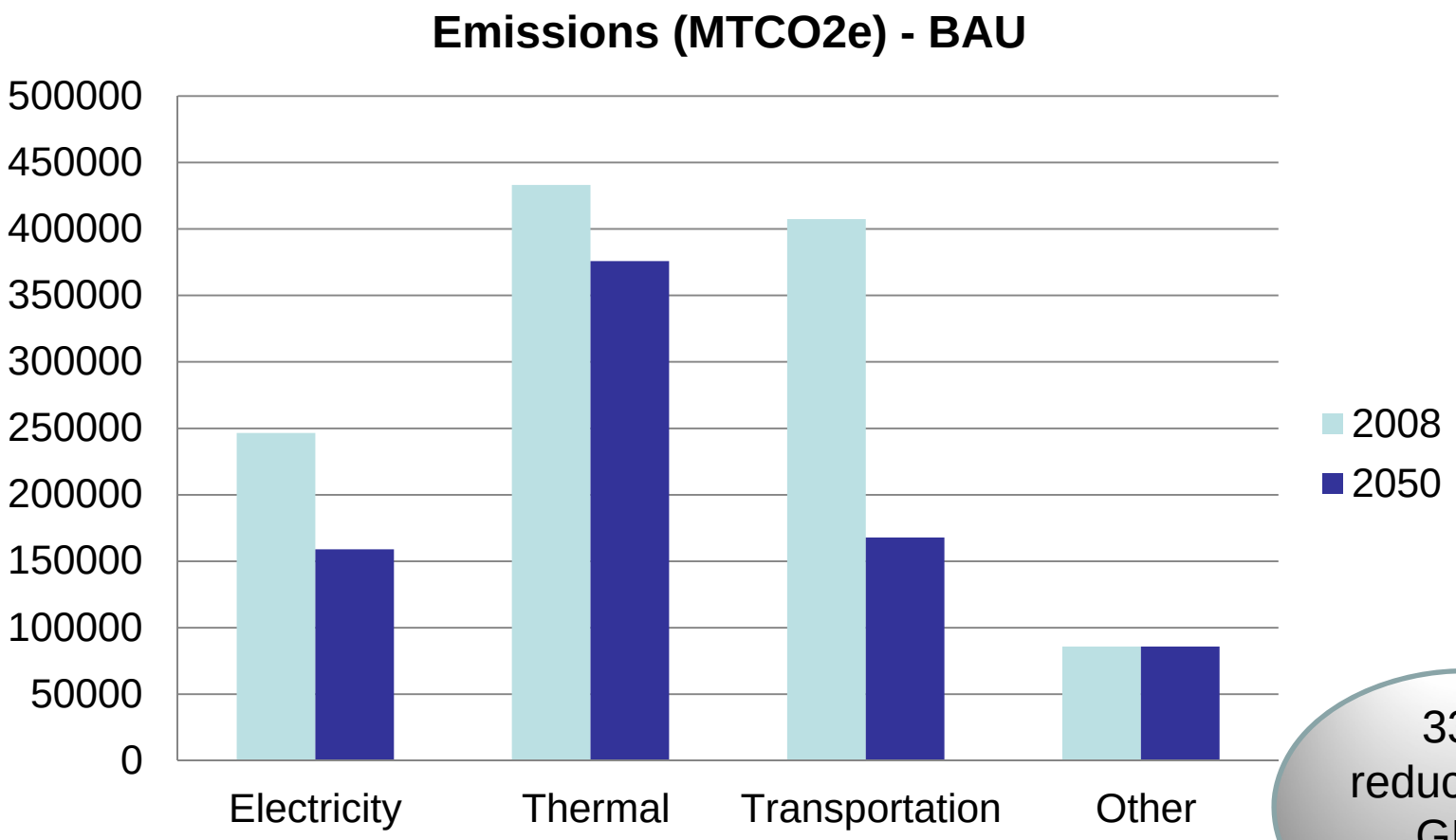


Scenario A – Business as Usual 2008-2050

Scenarios

2008 Emissions
1,173,000 MTCO2e

2050 Scenario A
790,000 MTCO2e



33% reduction in GHG Emissions

Scenario A (BAU) - Summary

Scenarios

2008

Emissions

1.2 million MTCO2e

Thermal Energy

6.7 million MMBtus

Electricity

800 million kWh

Vehicle Miles Traveled

690 million miles

2050

Emissions

0.8 million MTCO2e

Thermal Energy

7.1 million MMBtus

Electricity

940 million kWh

Vehicle Miles Traveled

920 million miles

Scenarios

Scenarios

- *Scenario A – Business as Usual*
- **Scenario B – Mixed**
- **Scenario C – All Electric**
- **Scenario D – Maintaining Half of 2008 Natural Gas**

All Except for “A” meet goal of 80% reduction from 2008 levels by 2050

Developing Scenarios

Scenarios

Guiding Principles and Assumptions

- Achieve goal of 80% reduction from 2008 levels by 2050
- Utilize local resources given reasonable assumptions
  - 53% solar potential
  - 53% wind potential
  - 20% micro-hydro potential
  - 80% of lighting and appliance efficiency potential
  - 50% building energy efficiency potential
  - 25% reduction in VMT from projected levels (increase growth in population centers, reduce the number of in-commuters, increase carpooling, etc.)
- Balance needs of environment, economy and equitable society
- Use only currently available technology

Scenario B
“Mixed”

Scenario B (Mixed) - Compared to BAU

Scenarios

In 2050 BAU, Tyler's family is likely to:

- Live in a house heated by natural gas
- Get electricity from a grid powered by more renewables than in 2015
- Live in the suburbs or country and drive to work in Ithaca
- Drive a vehicle that gets about 55 miles per gallon of gasoline

In 2050 Mixed, Tyler's family is likely to:

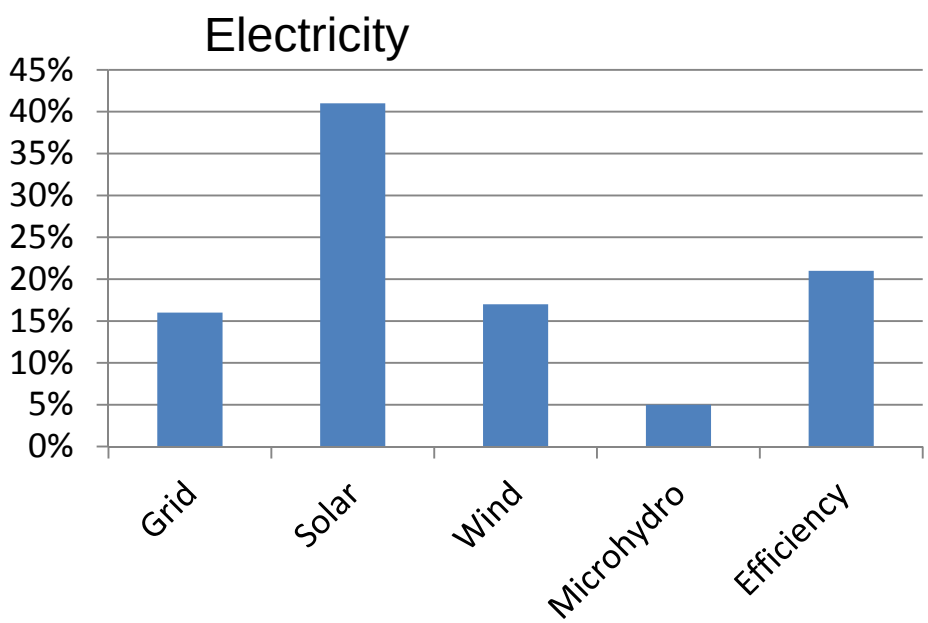
- Live in a house heated by heat pumps or biomass
- Get electricity from locally produced solar or wind
- Live in one of the villages or the City of Ithaca
- Have a 50% chance of driving an electric vehicle or walk, bike or take the bus

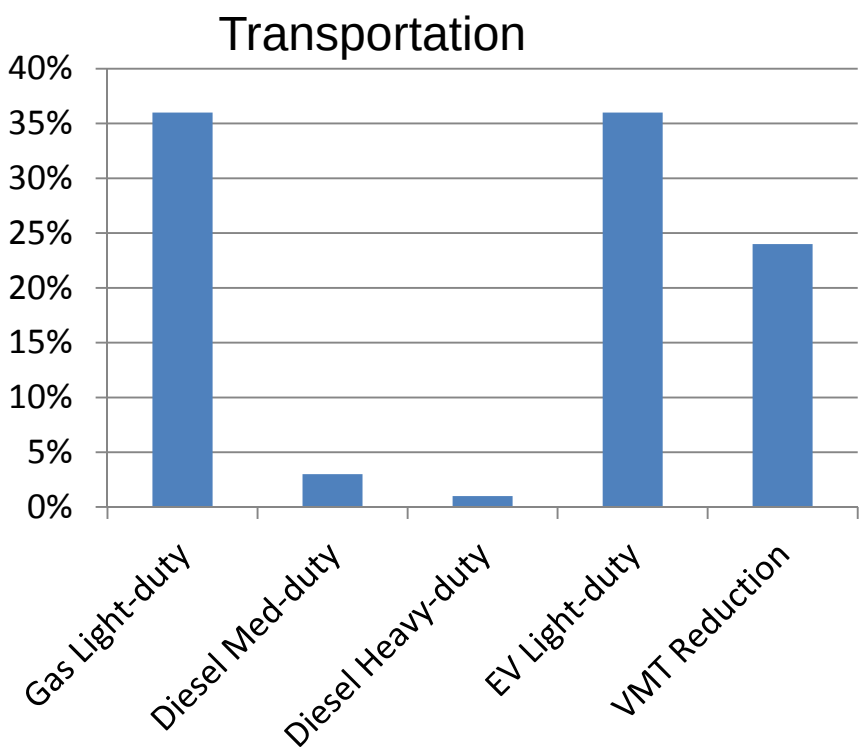
Scenarios

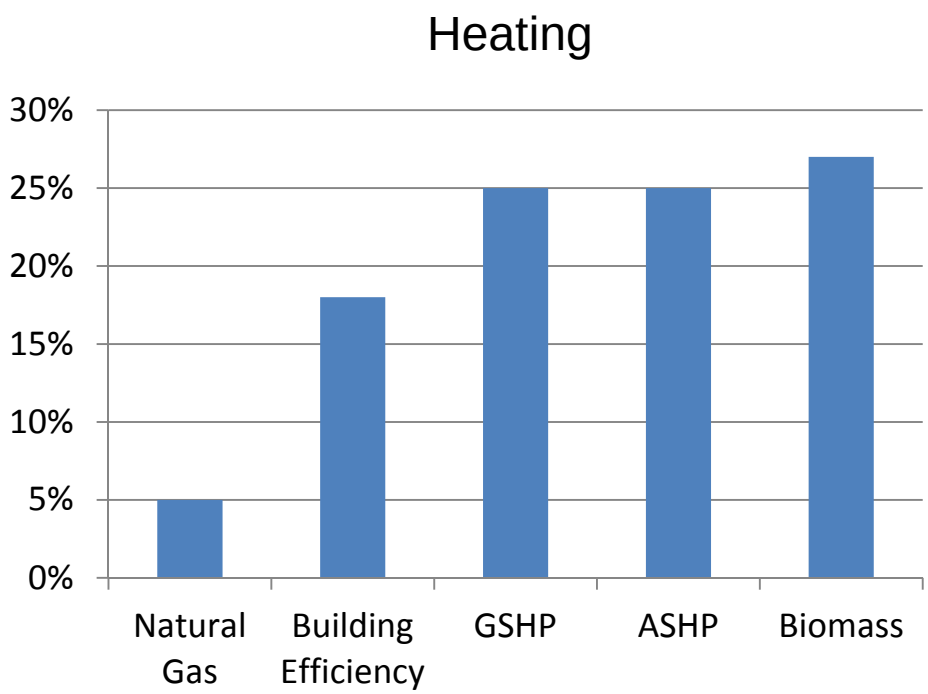
Scenario B (Mixed)
Percent of Energy Demand Met by Source in 2050

Mostly:

- Electricity from local Solar
- Cars fueled by EV and Gasoline
- Heating from Heat Pumps and Biomass





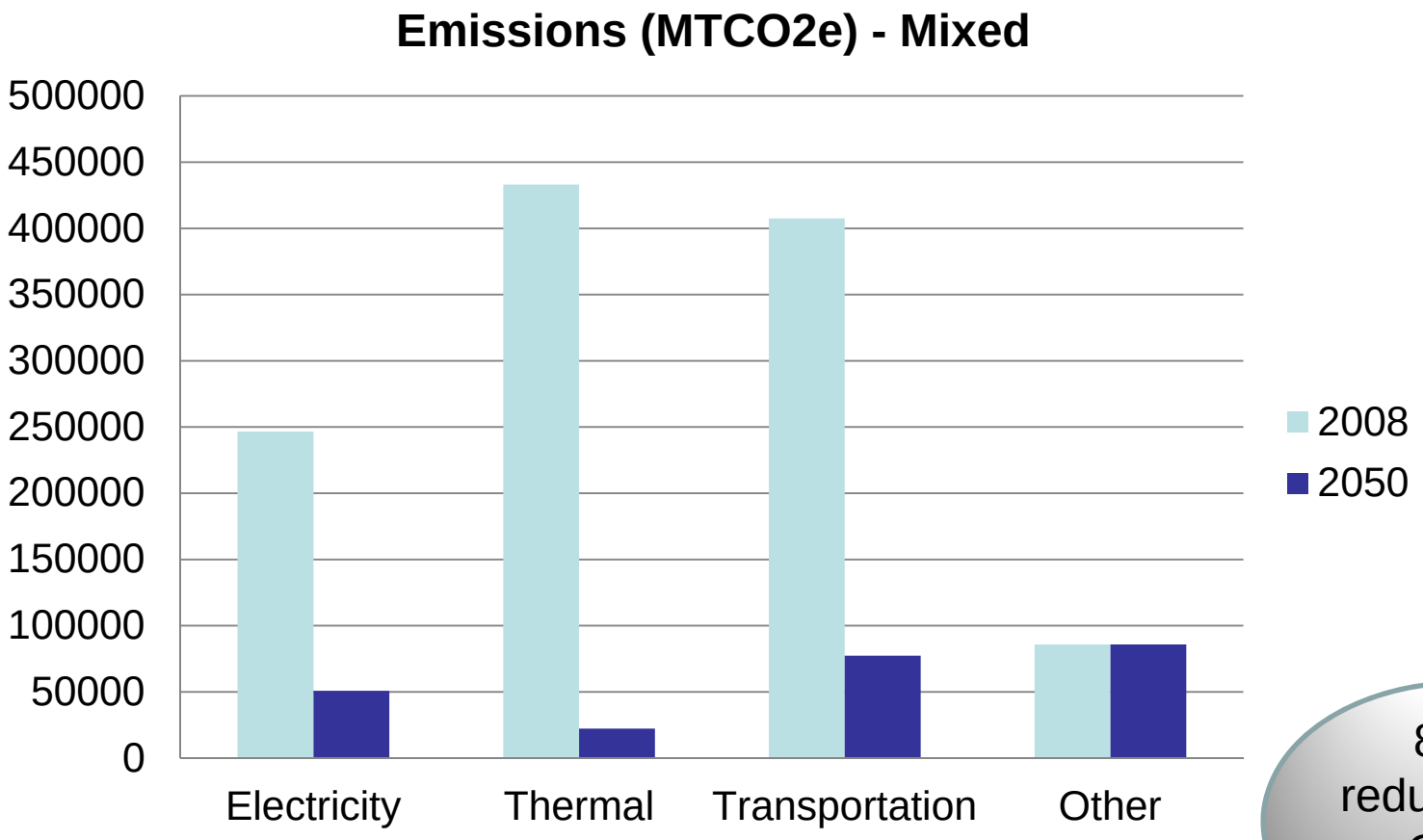


Scenario B – Mixed 2008-2050

Scenarios

2008 Emissions
1,173,000 MTCO2e

2050 Scenario A
236,000 MTCO2e



80% reduction in GHG Emissions

Scenario C
“All Electric”

Scenario C (All Electric)

Scenarios

Key Differences Between All Electric and Mixed

- No natural gas use, compared to 10% of 2008 levels in Mixed
- No gasoline use, compared to 50% in Mixed
- Electric heat pumps and electric cars dramatically increase electricity demand
- Amount of electricity needed is more than may be generated locally at 53% of resource potential, so 2.5 times more grid power required than Mixed
- No direct burning of fuels could improve health

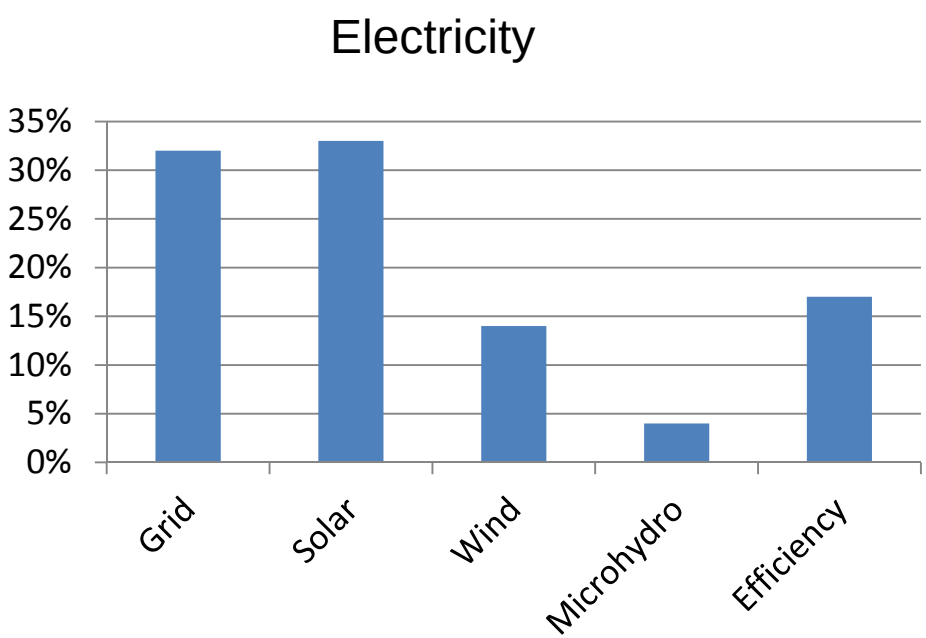
Scenarios

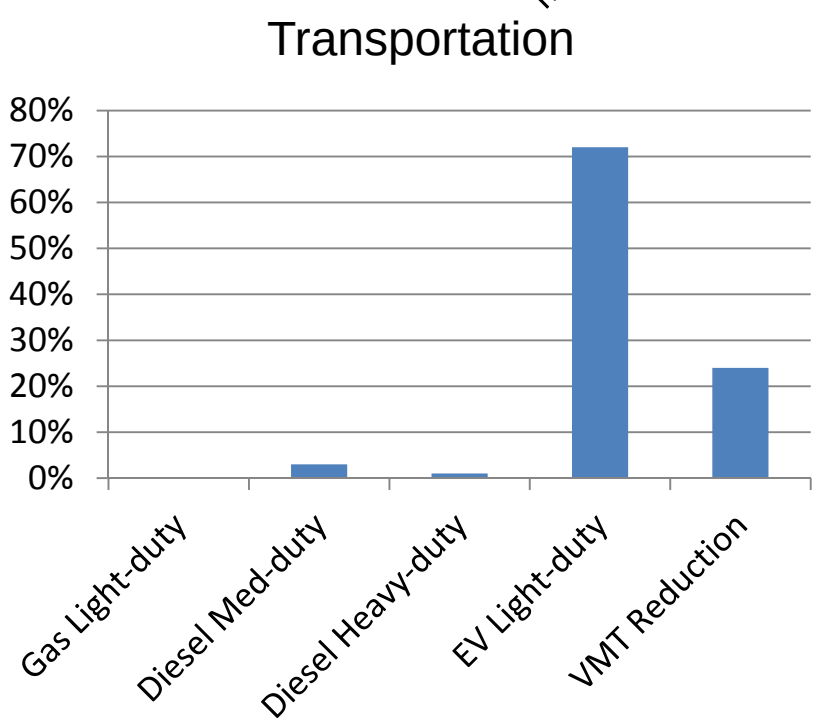
Scenario C (All Electric)

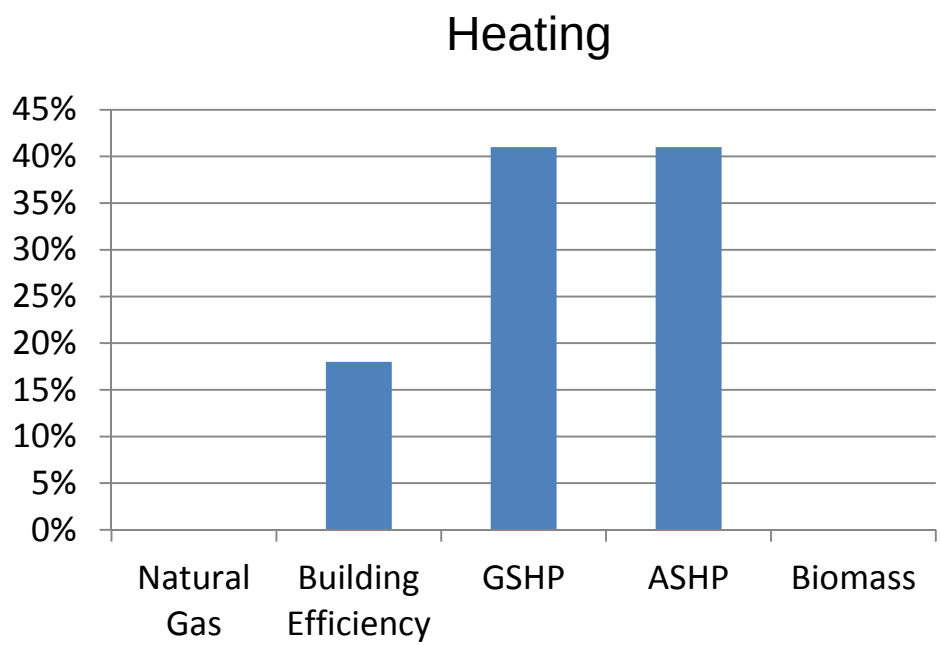
Percent of Energy Demand Met by Source in 2050

Mostly:

- Electricity from Grid/Local Solar
- Cars fueled by electricity
- Heating from Heat Pumps





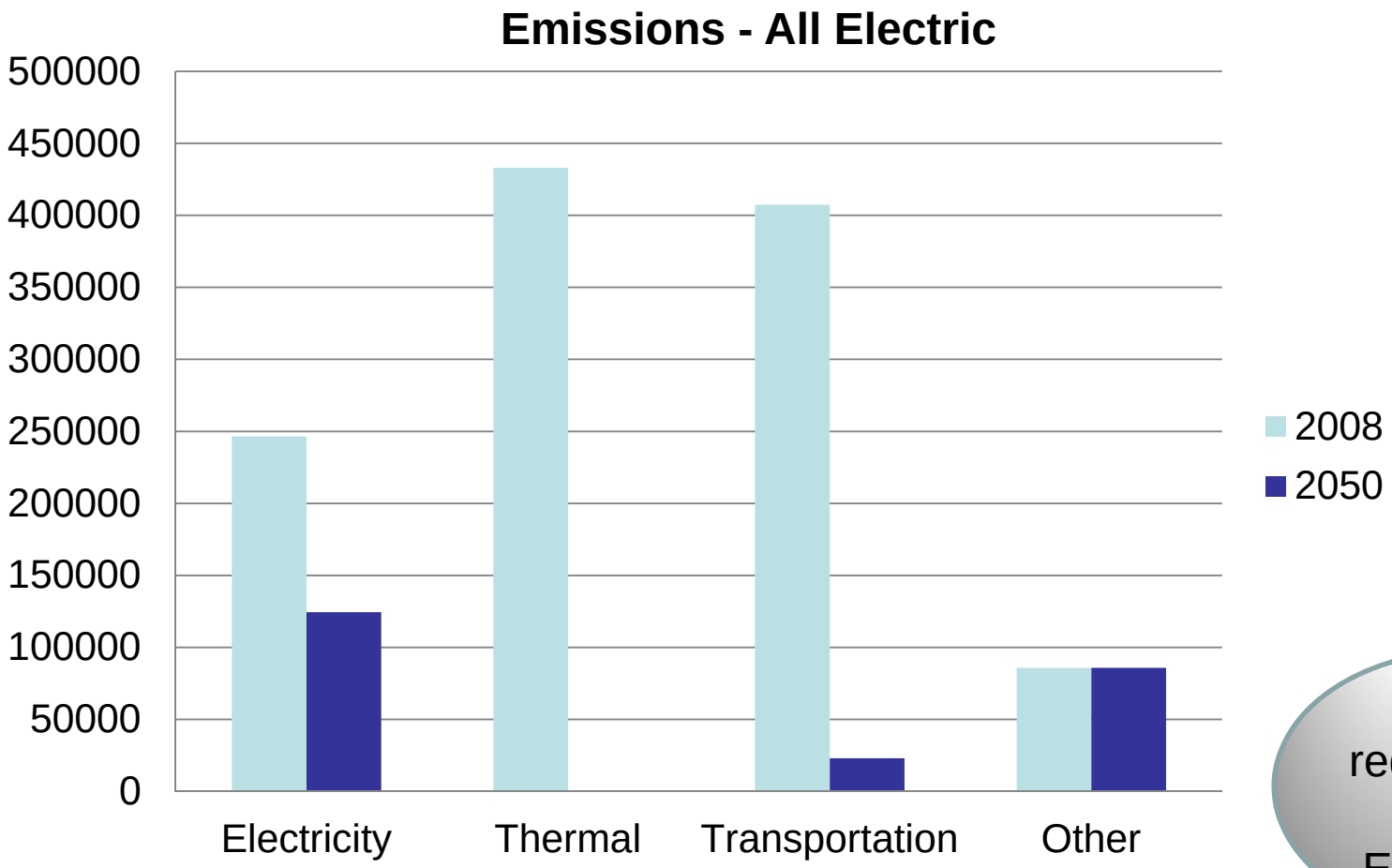


Scenario C – All Electric 2008-2050

Scenarios

2008 Emissions
1,173,000 MTCO2e

2050 Scenario A
233,000 MTCO2e



80% reduction in GHG Emissions

Scenario D
“Maintain Half 2008 Natural Gas Use”

Scenario D (Half Nat Gas)

Scenarios

Key Differences Between Half Natural Gas and Mixed

- Continued use of infrastructure and heating qualities of natural gas, 50% compared to 10% in Mixed
- Using this much of a high-emitting resource will require us to do more in other areas, especially for heating:
  - Ramp up retrofits and building efficiency to achieve significantly more of potential than other scenarios
  - Decrease use of electricity-using heat pumps
- All light-duty vehicles will need to be electric
- Almost all electricity must be from local renewables and efficiency because of emissions associated with grid
- Requires we solve methane emissions leaks from transmission and distribution system

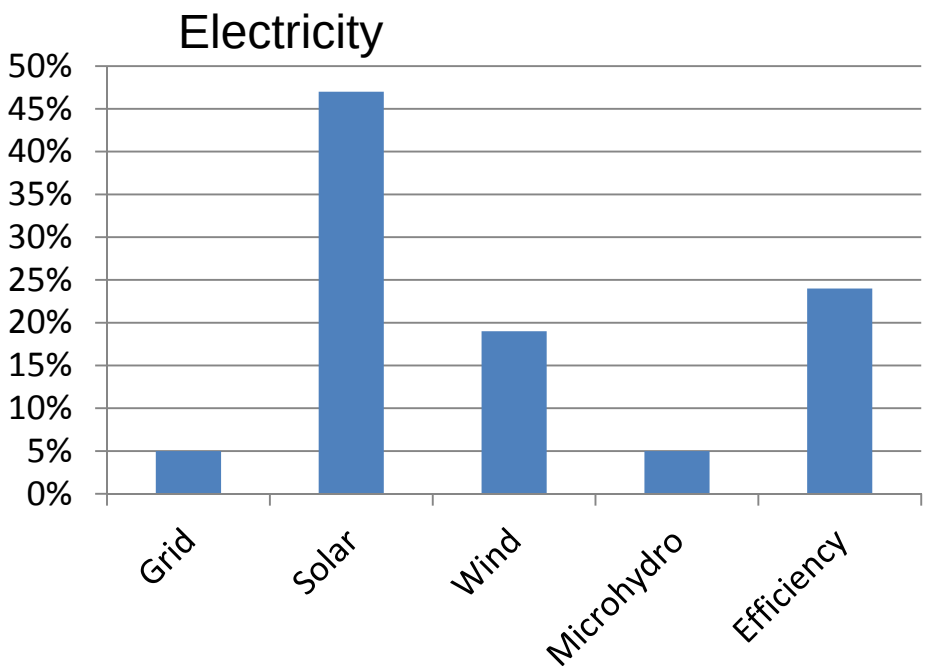
Scenarios

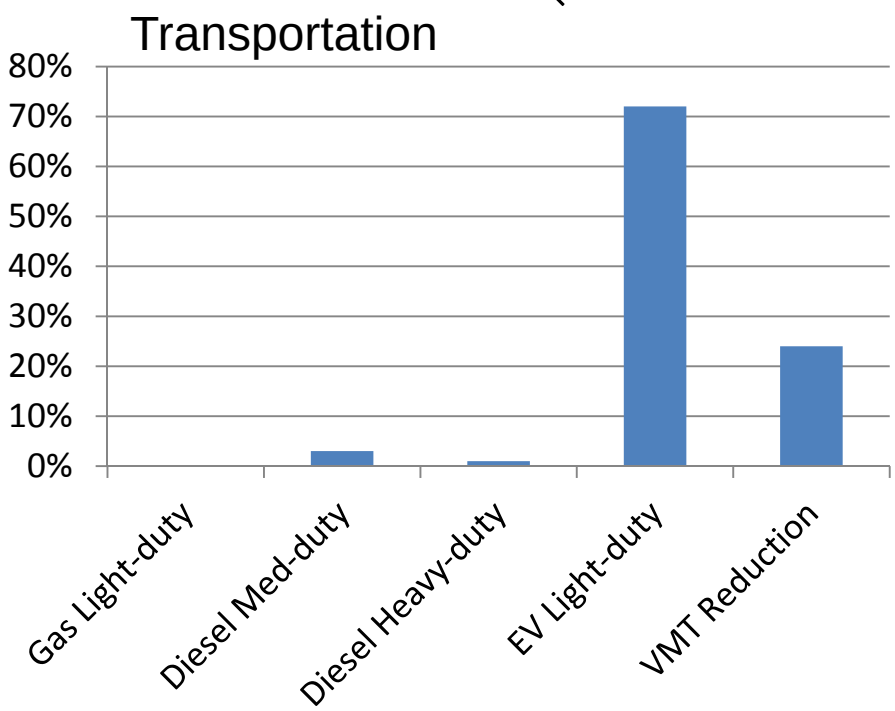
Scenario D (Half Nat Gas)

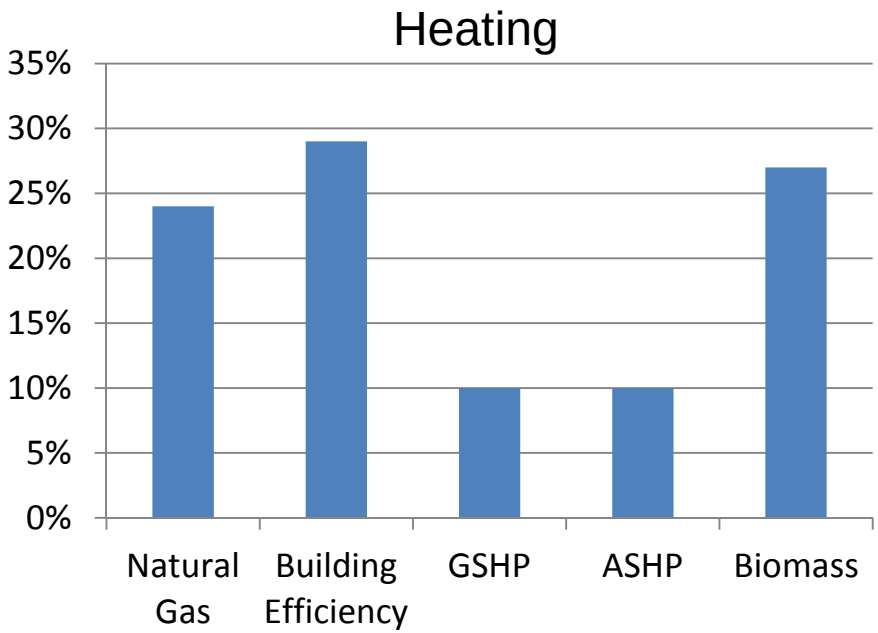
Percent of Energy Demand Met by Source in 2050

Mostly:

- Electricity from Solar
- Cars fueled by electricity
- Heating from Natural Gas and Biomass





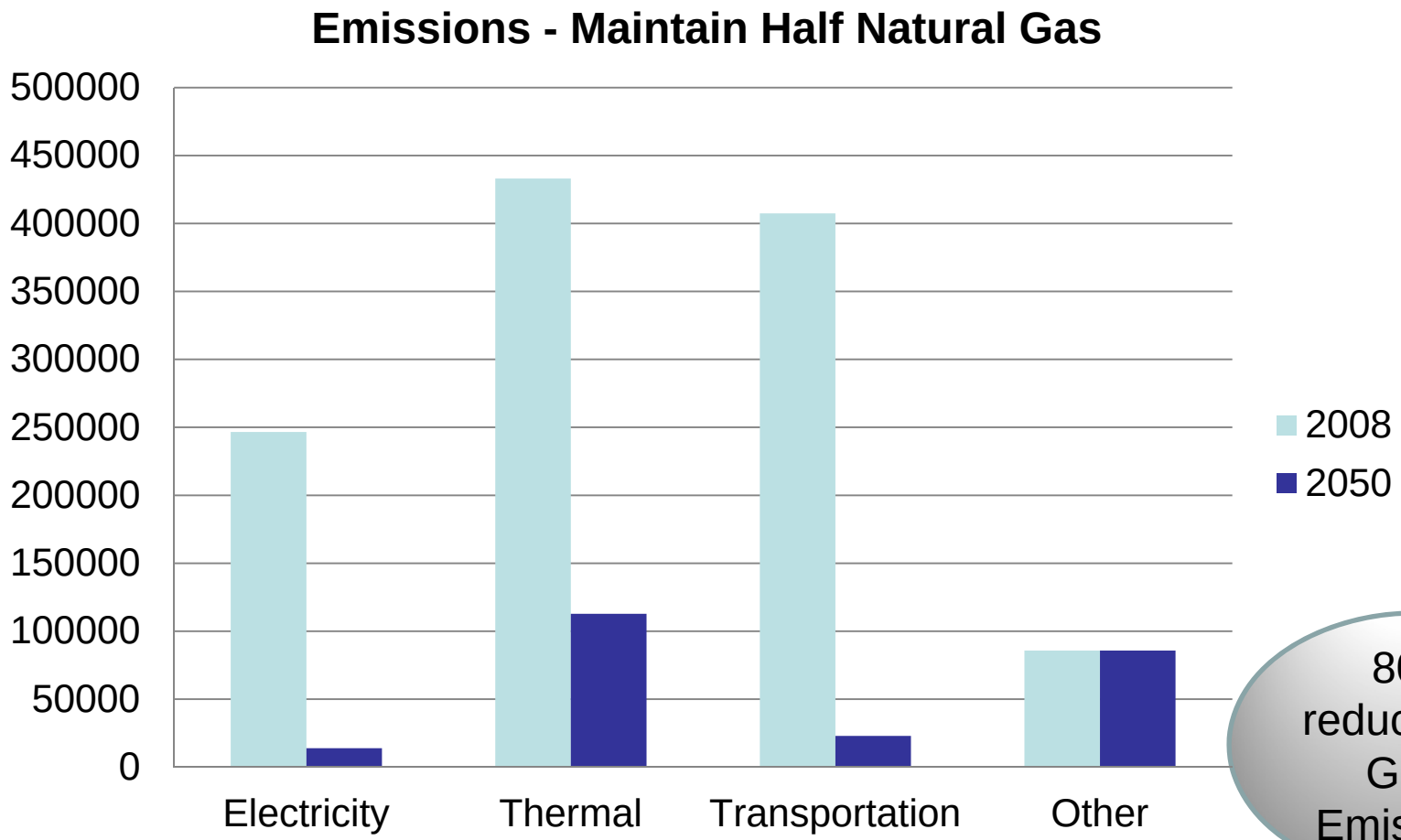


Scenario D – Maintain Half Nat Gas 2008-2050

Scenarios

2008 Emissions
1,173,000 MTCO2e

2050 Scenario A
235,000 MTCO2e



80% reduction in GHG Emissions

Presentation Outline

Overview

Potential

Scenarios

Next Steps

Major Challenges

- Cost
- Energy storage
- Competing land uses
- Infrastructure limitations
- Balancing renewable generation
- Acceptance of new technologies

Generational Change

Next Steps

How has our world changed in the past 35 years?

Baby Tyler in 2015

35 Years

Generational Change

Next Steps

Take Home Message

Next Steps

The problem is real . . . But the **solution** is also real

It won't be easy, but it is **possible** to achieve the needed greenhouse gas emissions reduction goals.

1961 Kennedy set goal of man on moon - achieved 1969

Local Priorities

Next Steps

All viable scenarios indicate that local actions should:

- Emphasize energy efficiency
- Promote and make it easier to develop renewable energy
- Make community EV friendly
- Support development in population centers to reduce VMT

Energy Roadmap Timeline

Next Steps

Sept/Nov	Public outreach – scenarios
	Public Open House October 21, 5:30-8:00PM
	Tompkins County Library
Nov/Dec	Steering Committee develop recommendations for Energy Strategy
2016	Update Energy Strategy based on recommendations

Feedback?

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