

Community Energy Master Planning

Arlington County (VA) & City of Holland (MI)

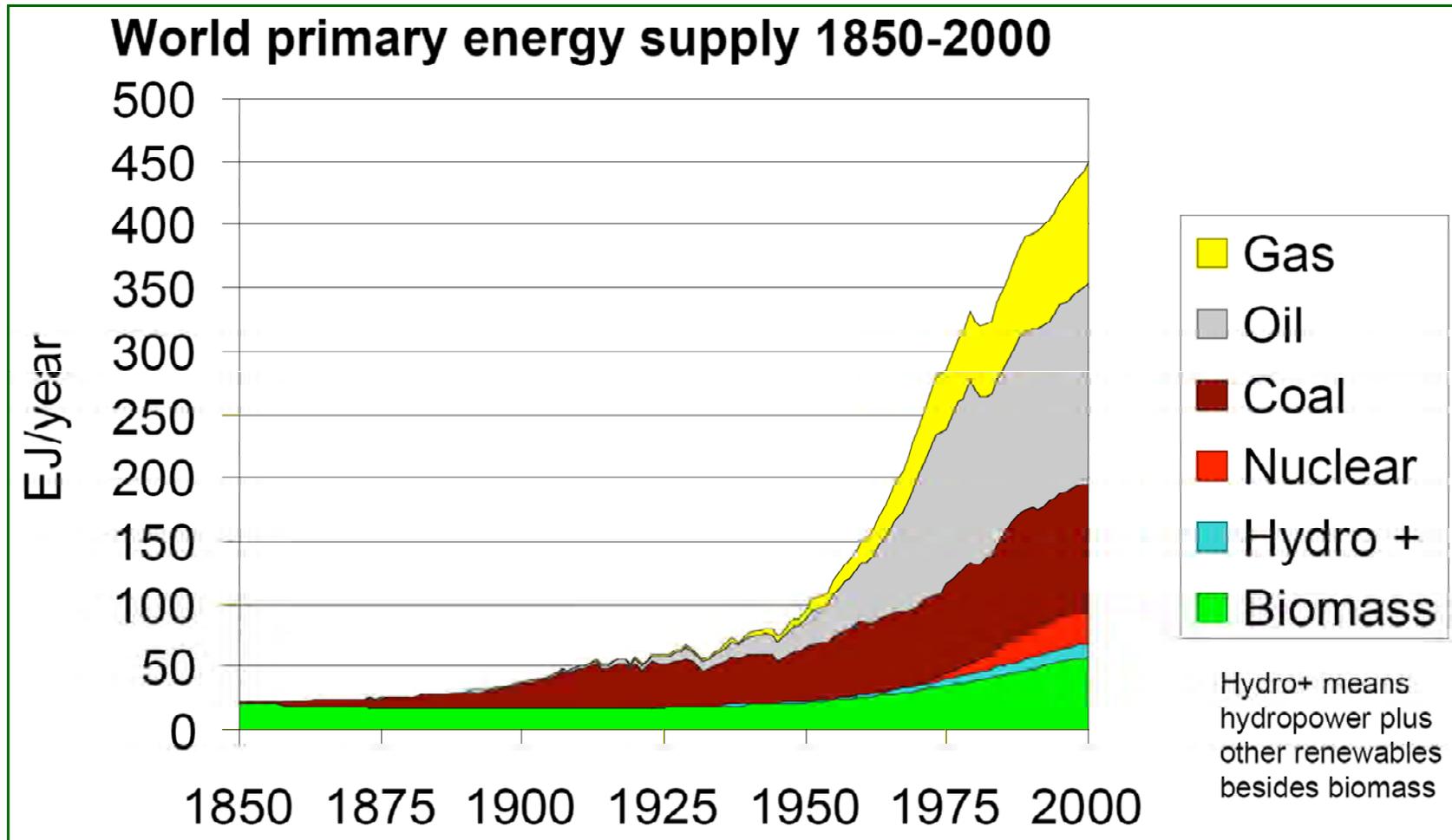


Creating Globally Competitive Communities

Army Net Zero Conference
18-20th January 2012, Chicago, Illinois

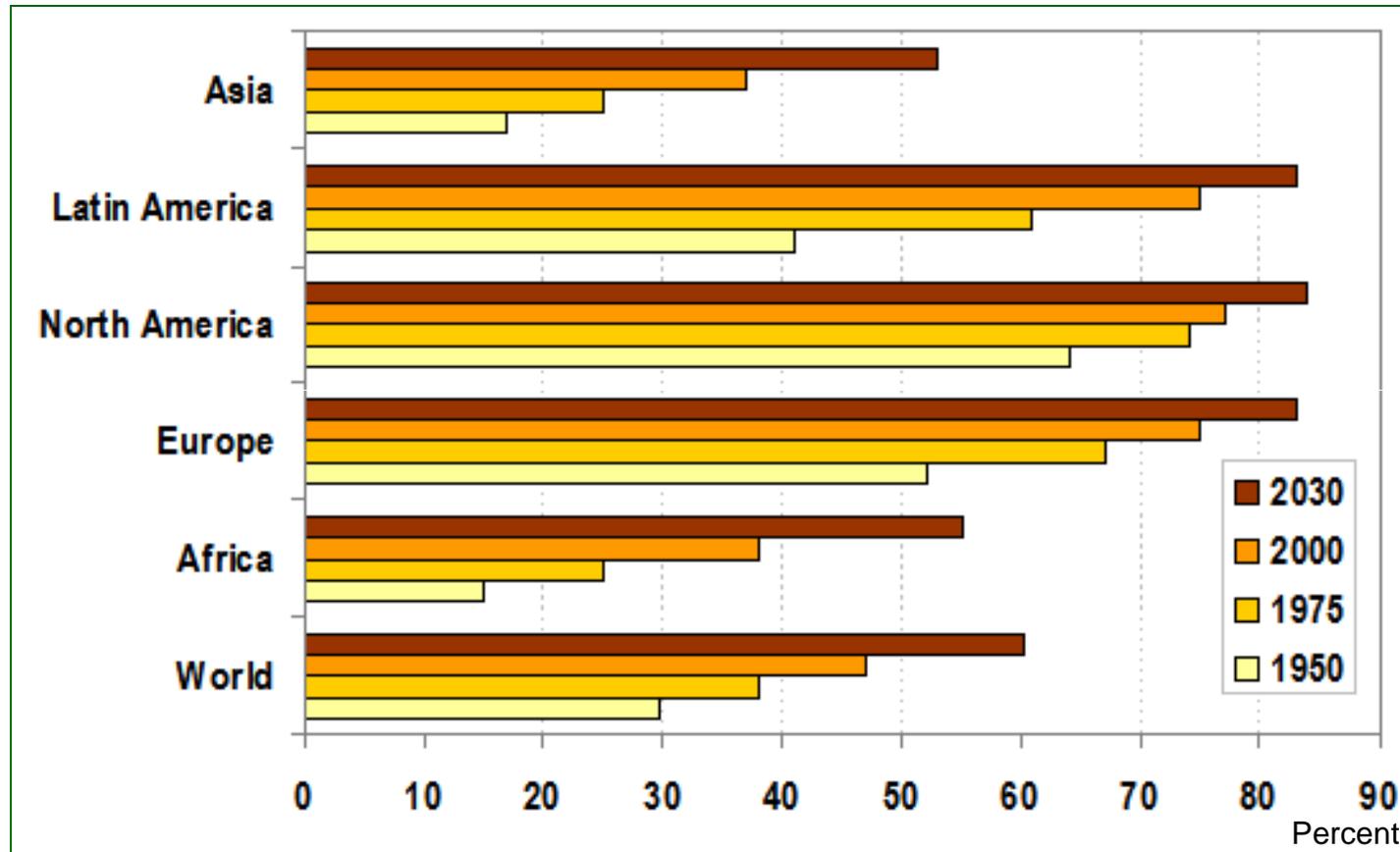
Insatiable Global Appetite for Energy

About 70% in Urban Areas



Forecast to nearly double by 2030

Most of us live in Urban Setting *70% of all Energy Use*



Urban Population passed 50% in 2008

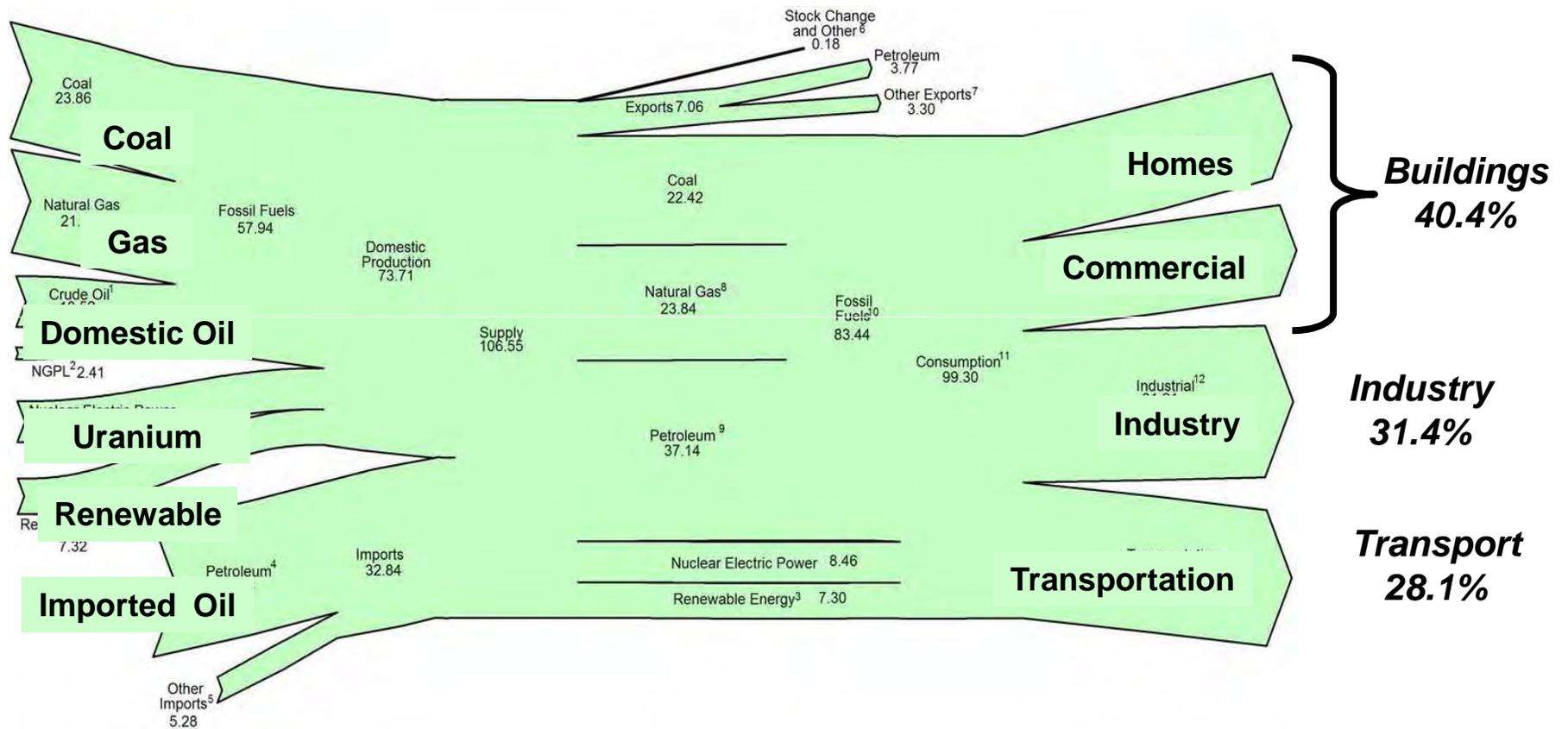
Why Communities Care *New Energy Realities...*

- Community Values and Image
- Investment and Green Jobs
- Unpredictable energy prices
- Supply quality and security
- Environmental legislation
- Global shifts in energy market
- Weather events
- Nuclear and coal uncertainties...

Fundamentally Different From Past

Total US Energy Use ~ \$1.5 Trillion

Most in Urban Environment



Largest User is Least Efficient

Benchmark Efficiencies by Sector

USA / EU Energy Example

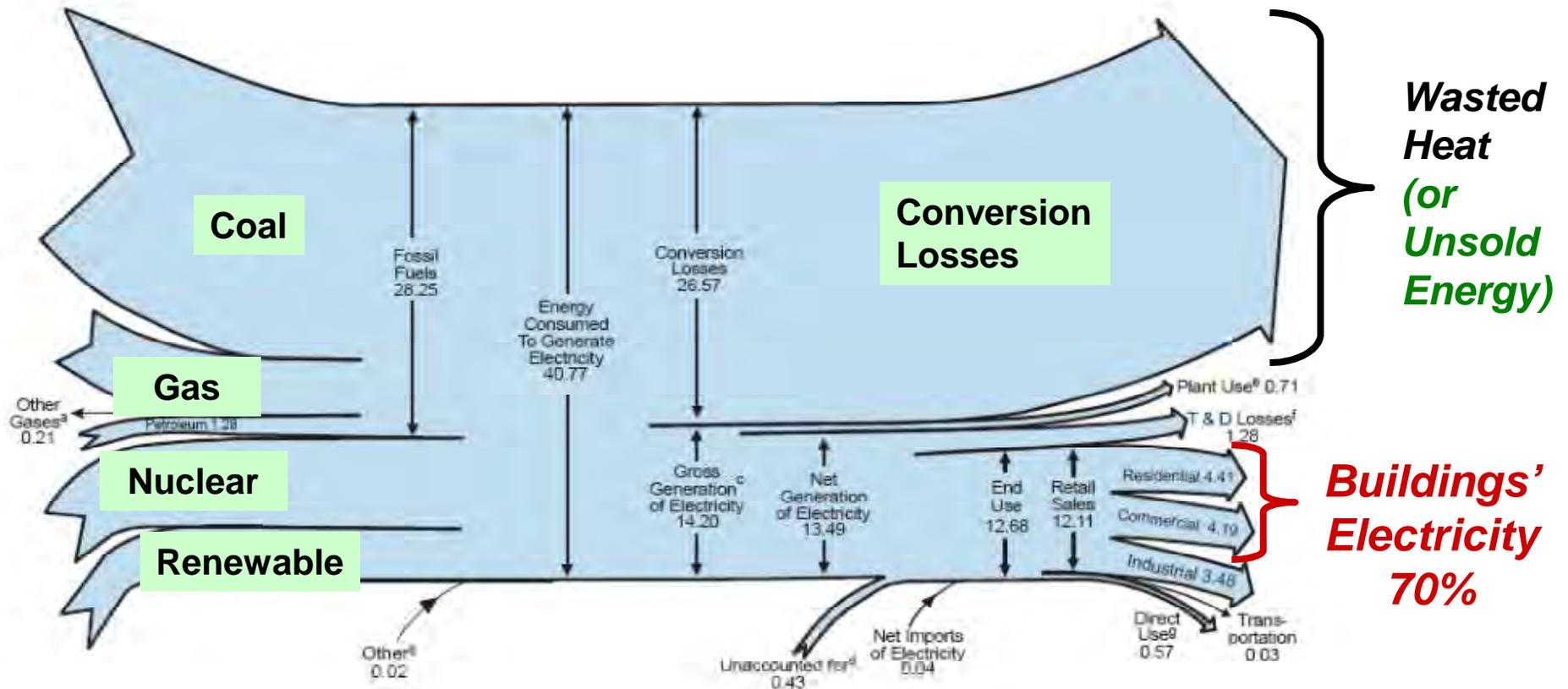
Sector	Share	Index USA/EU
Industry	32%	1.2 : 1
Homes & Buildings	40%	1.8 to 2.5 : 1
Transportation	29%	1.4 : 1

- Building efficiency potential often underestimated
- Industrial efficiency potential often overestimated

High potential for productivity gains!

Electricity in USA

Most used in Homes and Buildings

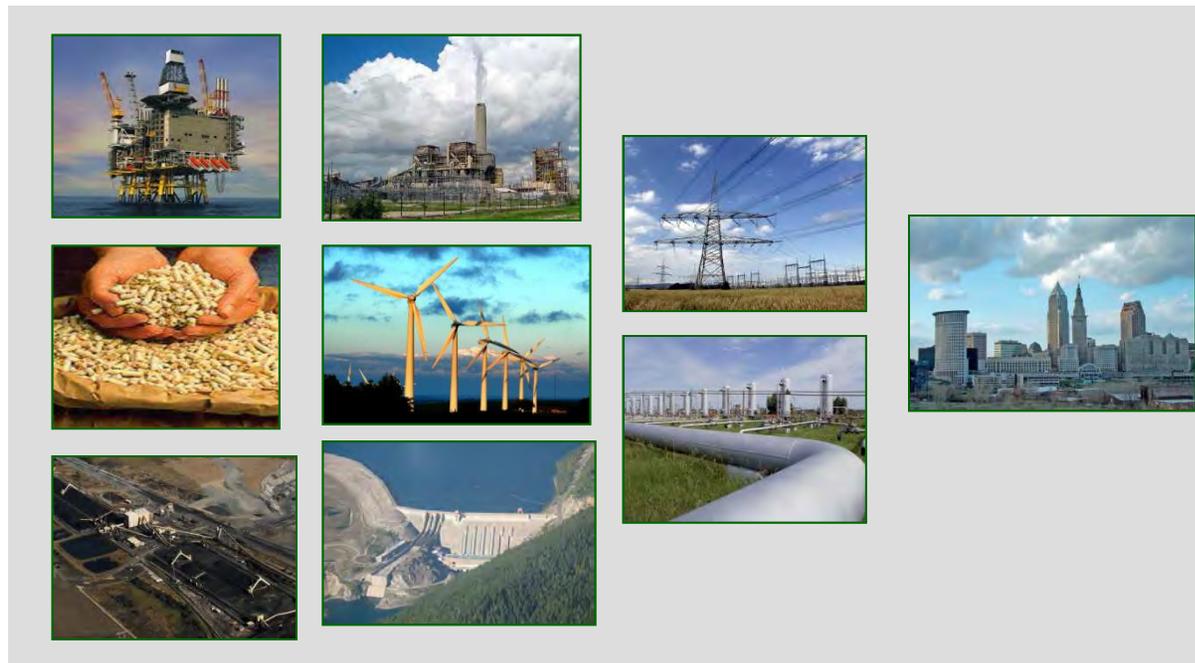


Largest Cause of Greenhouse Gas

Dysfunctional Energy Supply Chain

From fuel to service

Uses 70% of all energy



25%



5%



- High-cost low returns
- High risk
- High greenhouse gas

Pay 100 for fuel - Get less than 10 in services

Performance Benchmarking *Greenhouse Gas per Capita*



USA - Total
USA - "Municipal"

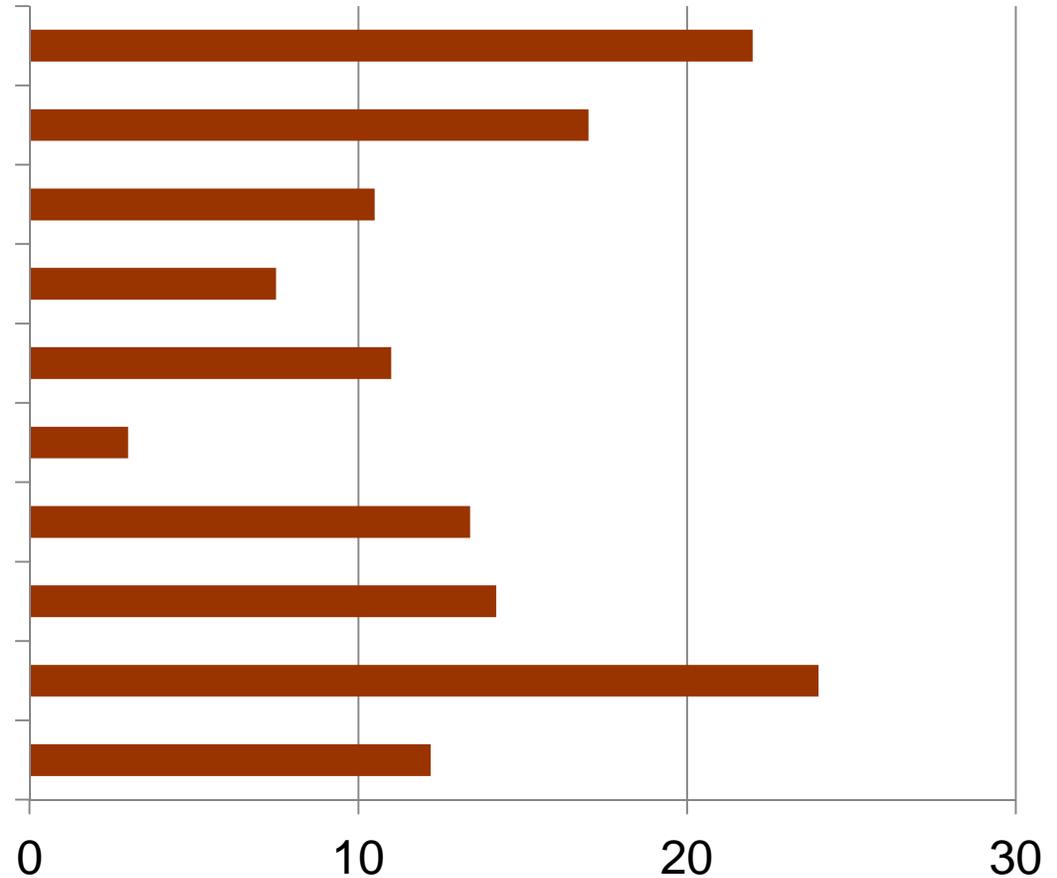


EU - Total
EU - "Municipal"

Mannheim, Germany
Copenhagen, Denmark

Arlington, VA
Loudoun, VA

Holland, MI
Guelph, Ontario



Global View Encourages Open Dialog

Typical Range of Community Responses

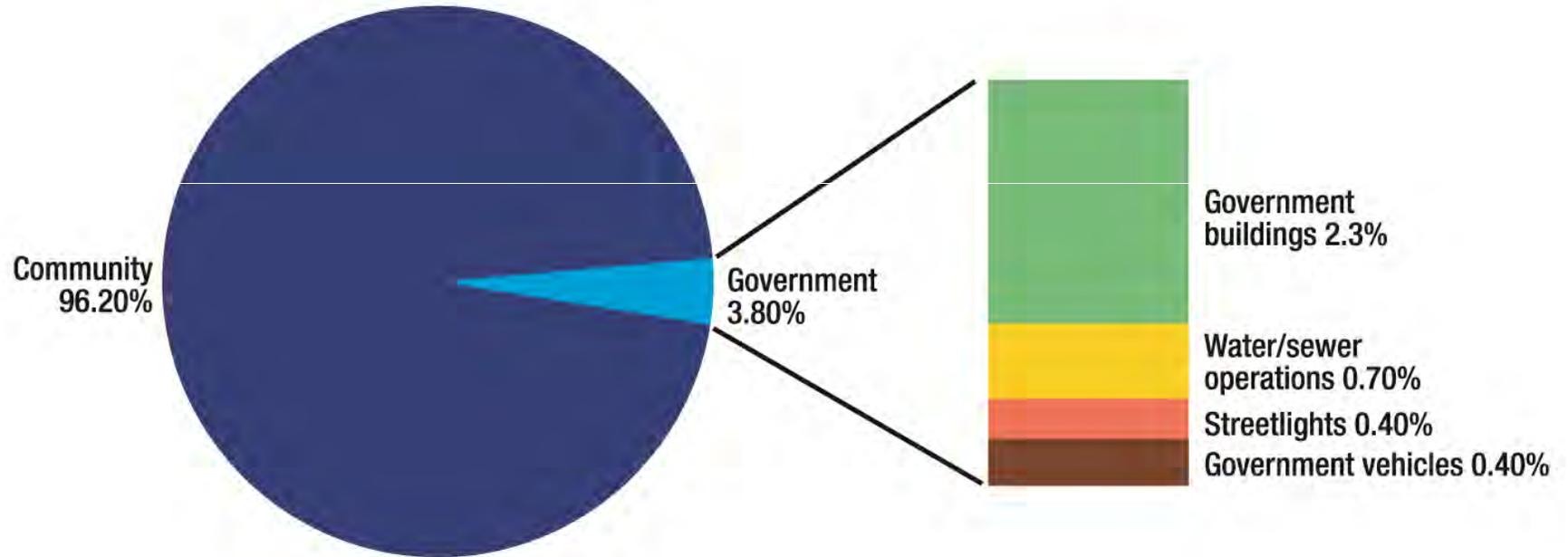
- **Community Commitments**
 - *Cool Climate Initiatives*
 - *US Mayors Climate Protection Agreement*
- **Directional Plans**
 - *Climate / Sustainability Action Plans.....*
 - *Energy part of Land Use and Master Planning*
- **Clean and Efficient Initiatives**
 - *Education and outreach*
 - *Community owned assets as examples*
 - *Voluntary private sector engagement*
 - *Demonstration projects*
 - *Selected policy changes or guidelines*
 - *Local incentives...*

Generally Fail to Achieve Scale

Community Owned Impact is Small

Example from Arlington

Total Arlington County Greenhouse Gas Emissions by Sector, 2000



Source: Morrill 2007.

Important Examples – Not the Game!

Benchmarking Goals Example

Greenhouse Gas per Capita



USA - Total
USA - "Municipal"



EU - Total
EU - "Municipal"

Mannheim, Germany

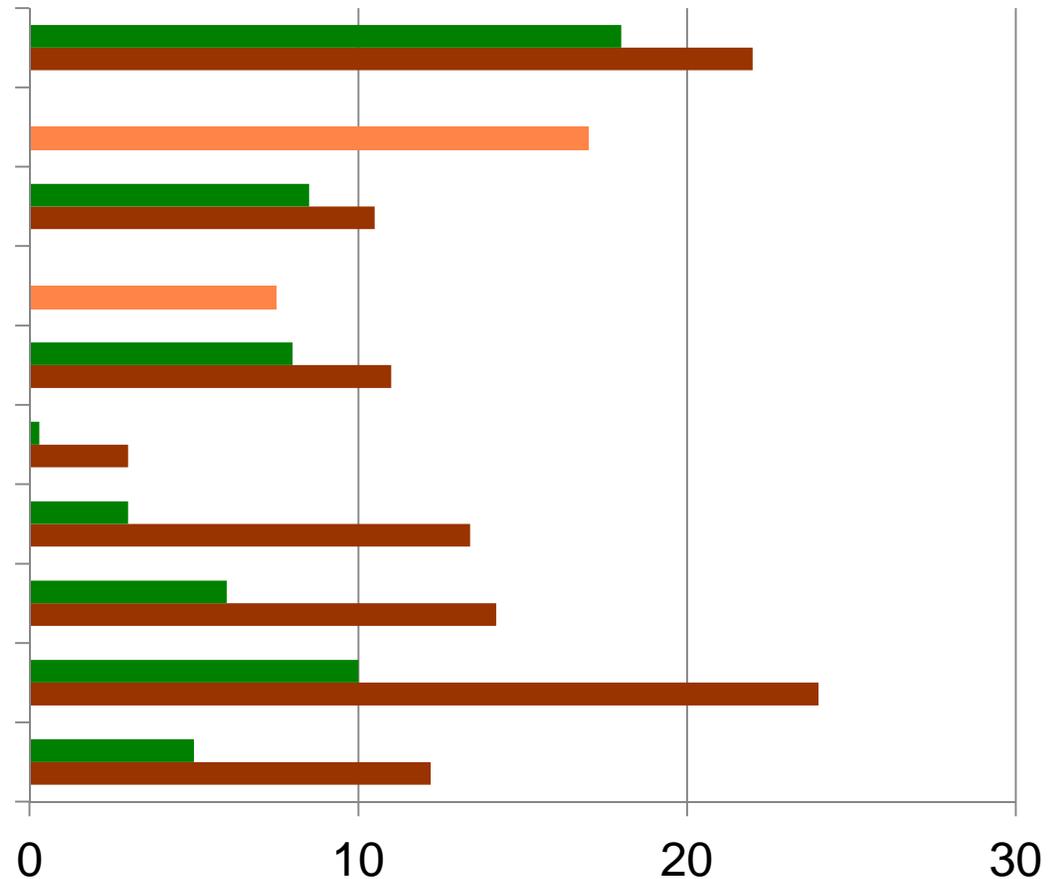
Copenhagen, Denmark

Arlington, VA

Loudoun, VA

Holland, MI

Guelph, Ontario



Transparency of Community Challenge

Evaluate Global and Local Benchmarks

Example of Copenhagen



- Triggered by 70's energy crisis
- 3.0 tons / capita GHG
- Efficiency
 - *World leading building efficiency*
 - *Energy Performance Validation*
- District Energy
 - *Widespread across city*
- Fuel flexibility
 - *Multi-fuel cogeneration*
 - *Coal, oil, gas, biomass, waste-to-energy*
 - *Wind and solar generation*
- Transport
 - *Urban design for bike/walking*
 - *Efficient trams/trains*
 - *City-wide EV plans*
- High Value Employment

2009 – Voted “Second Most Livable City”

Learning from Global Benchmarks

Loading Order Discipline

- Energy efficiency – ***If you don't need it don't use it***
 - *Efficient buildings , vehicles and industry*
 - *Urban design for transport efficiency*
 - *Local employment for commuting efficiency*
- Heat Recovery – ***It it's already there – use it***
 - *Combined heat and power*
 - *Use existing “waste” heat*
 - *Structure neighborhoods to share heat*
 - *Integrated industrial sites*
- Renewable energy – ***If it makes sense, go carbon free***
 - *Renewable electricity – Photovoltaic, Wind,*
 - *Renewable heat - Solar thermal, Biomass, biogas, geothermal*
 - *Renewable heat and power – waste-to-energy, biomass*
 - *Renewable transport fuels – ethanol, biodiesel, electricity*
- Energy distribution – ***Invest where it makes sense***
 - *Flexible distribution – electricity, gas, district energy...*
 - *Multiple fuels and conversion technologies*
 - *Optimize local / regional investments*

Prioritized – Sustained - Holistic

Arlington Community Energy and Sustainability Plan *Competitive Community of the Future*



CES Task Force (29 members)

- **Businesses (8)**
 - *JBG*
 - *Little Diversified Architectural Consulting*
 - *Lockheed Martin*
 - *Marriott International*
 - *SRA International*
 - *Turner Construction*
 - *VA Hospital Center*
 - *Vornado*
- **Citizens (4)**
 - *Arlington Civic Federation*
 - *Commissions*
- **Educational Institutions (2)**
 - *Arlington Public Schools*
 - *Virginia Tech*
- **Energy & Energy Tech Industry (3)**
 - *Dominion Virginia Power*
 - *United Solar Ovonic (Uni-Solar)*
 - *Washington Gas*
- **Local, State and Federal Gov'ts (5)**
 - *The Pentagon*
 - *US EPA*
 - *Commonwealth of Virginia Senate*
- **Nonprofits/Associations (5)**
 - *Apartment and Office Building Association*
 - *Arlington Chamber of Commerce*
 - *Arlington Partnership for Affordable Housing*
 - *Arlingtonians for a Clean Environment*
 - *Pew Center on Global Climate*
- **Regional Transportation Authorities (2)**
 - *Metro Washington Airports Authority*
 - *Metro Washington Area Transit Authority*

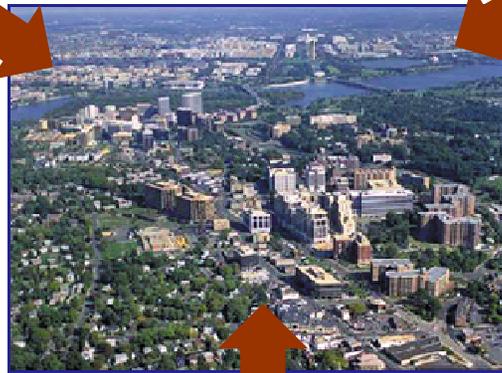
Senior Level Bi-Monthly Meetings

CEP Takes a Comprehensive View

Three Groups of Benefits

Competitiveness

1. Energy cost
2. Employment
3. Investment



Security

4. Supply security
5. Supply quality
6. Flexibility

Environment

7. Greenhouse Gas Reduction

Goals informed by Global Benchmarks



Community Energy Plan *2011 to 2050 Goals*

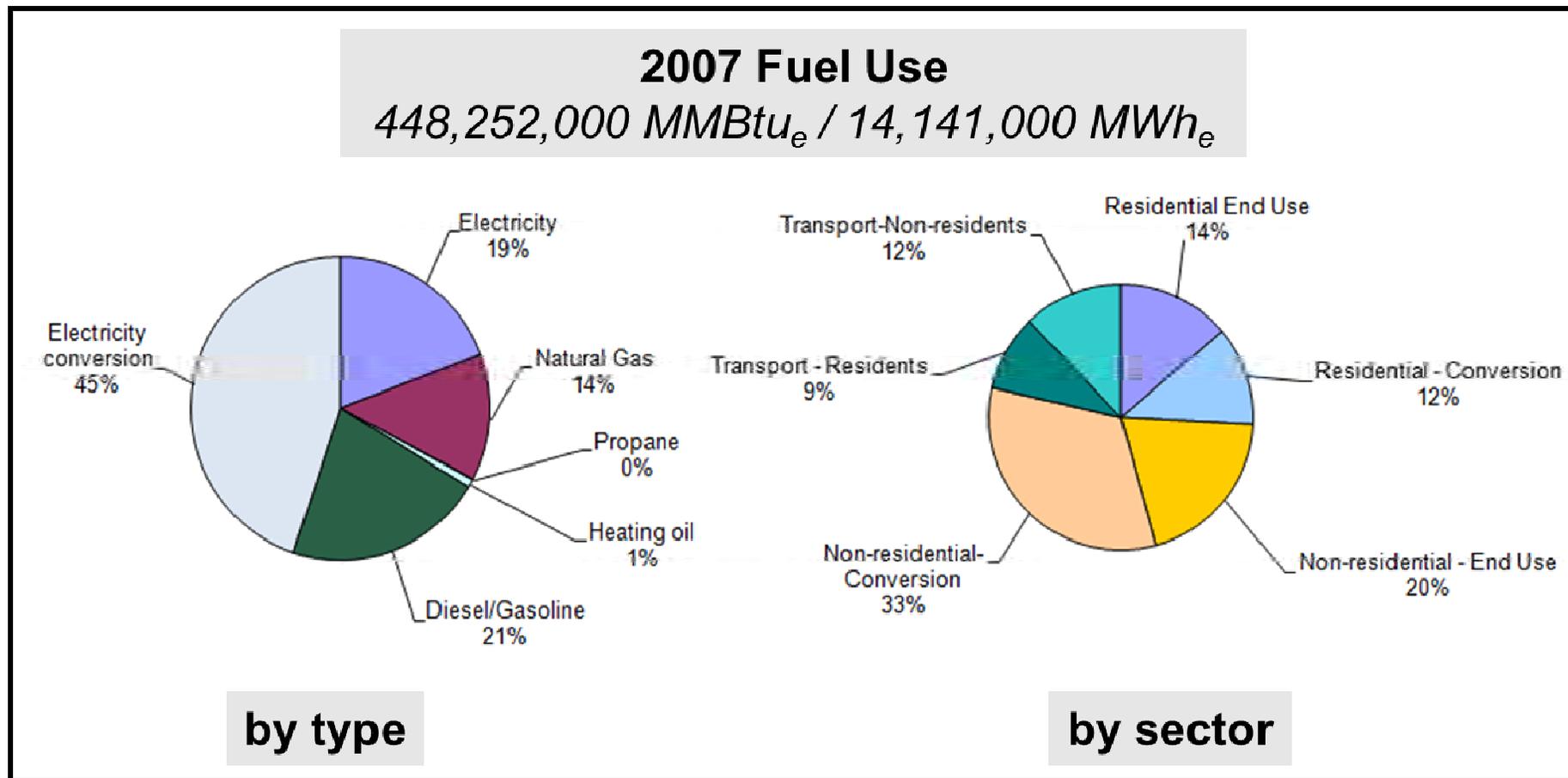
- Affordable, reliable energy supplies
- Flexible to meet changing technologies, legislation and market conditions
- Meet investor, employer and resident needs
- Meet Arlington's "Cool County" commitment

Headline Measurement

Reduce Arlington's annual GHG emissions to 3.0 mt CO₂e per capita by 2050. If an effective regional energy plan is put in place, achieve 2.2 mt CO₂e per capita per year.

Arlington Community Energy Use

These totals do not include Federal sites or DCA airport.



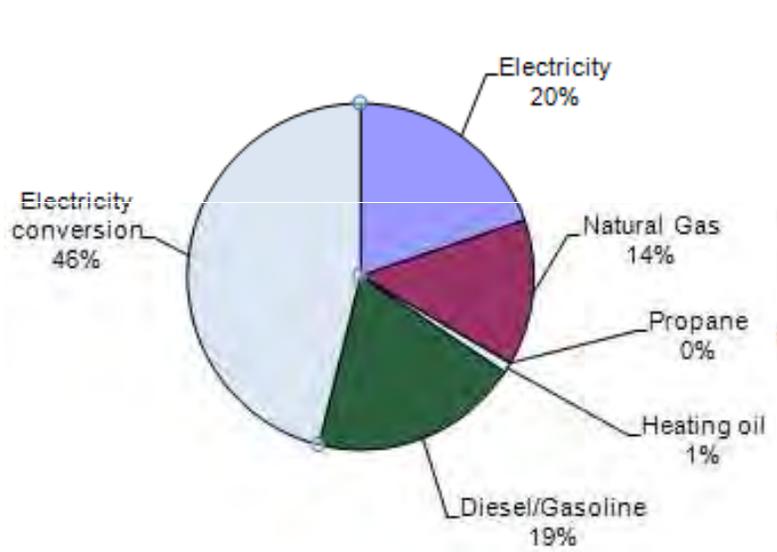
Homes and buildings use 75% of all energy



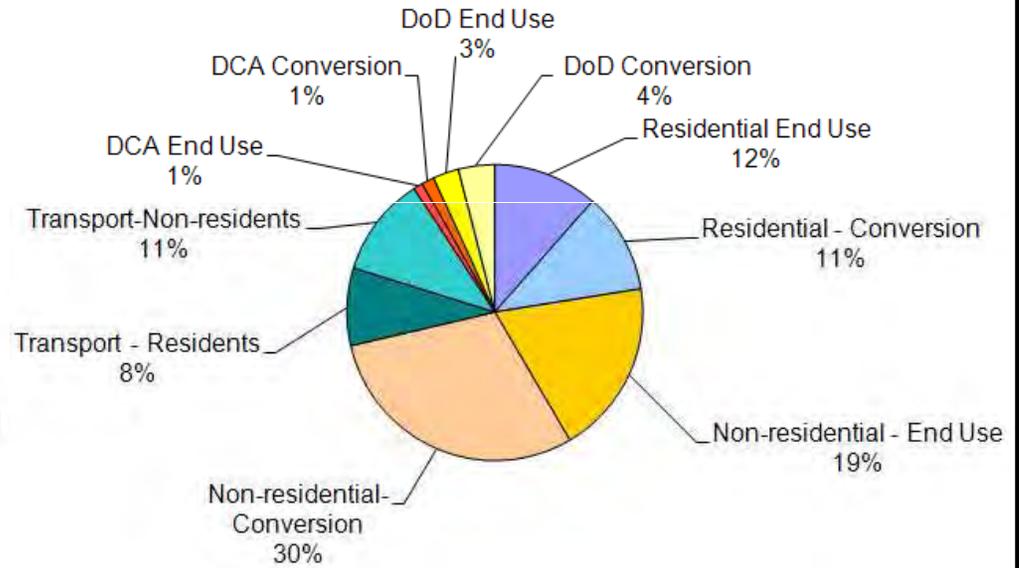
Arlington's Energy Use

Pentagon and National Airport ~ 7%

2007 Fuel Use
 53,140,000 MMBtu_e / 15,575,000 MWh_e



by type



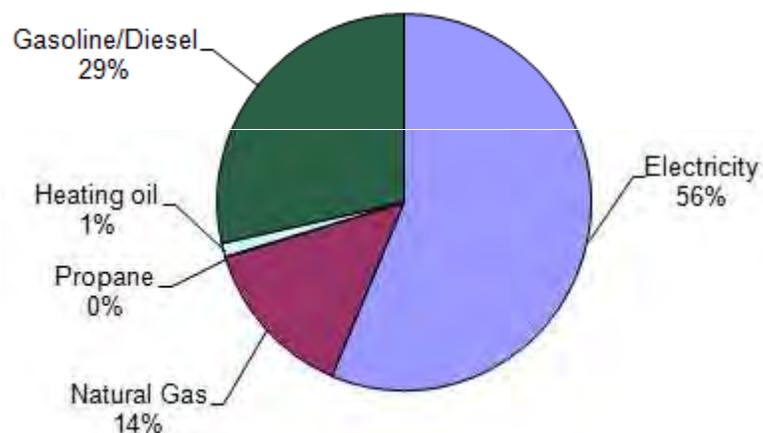
by sector

260 MMBtu_e / 76 MWh_e for each Resident

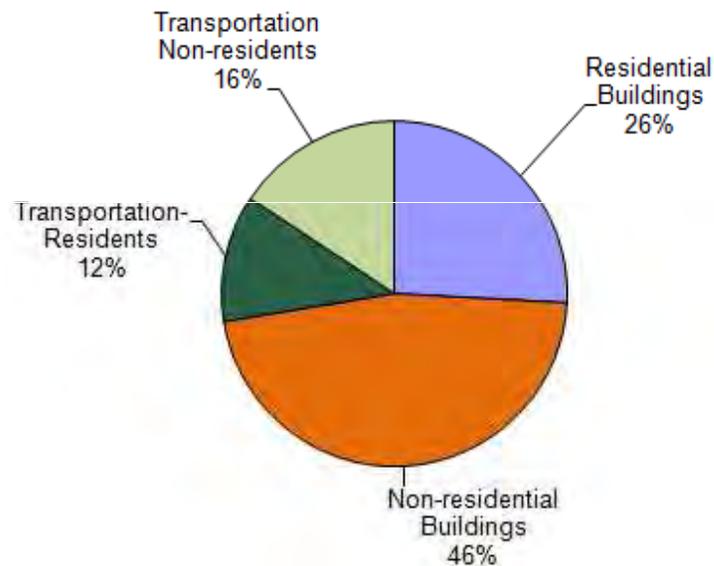
Arlington Community Carbon Footprint

These totals do not include Federal sites or DCA airport.

2007 Greenhouse Gas Emissions 2,730,000 metric tons / 6,020,000,000 lbs CO_{2e}



by type



by sector

13.4 metric tons for each Resident

CEP Framework

Followed benchmark examples

- *Energy efficiency – If you don't need it - don't use it*
- *Heat Recovery – If it's already there – use it*
- *Renewable energy – If it makes sense, go carbon free*
- *Energy distribution – Invest where it makes sense*

Integrated Solution – Tailored for County!

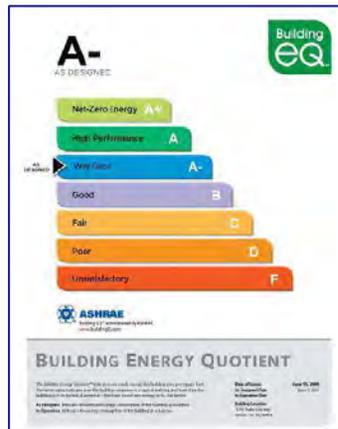
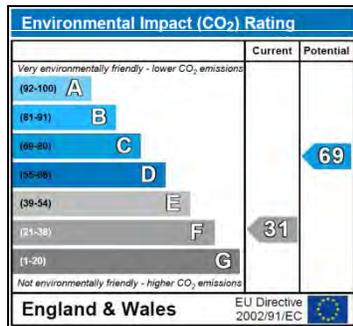
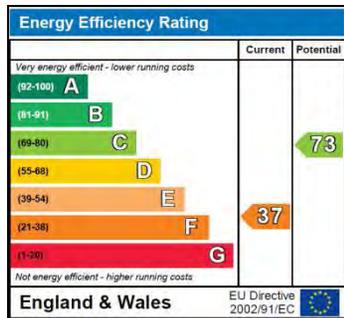
CEP Recommendation

Energy Efficient Buildings

- Increase efficiency of new and renovated homes and buildings between 30% to 50%
 - *Efficient construction and equipment*
 - *Operations and maintenance*
- Create mixed-use, net-zero Scale Project
 - *Lower density neighborhood*
 - *Scale example for future*



Energy Performance Labeling *Energy Efficient Buildings*



- Low-cost performance validation tool
- Available when sold or rented
- Display in public buildings
- Independent certification
- Discount financing
- Aggressive voluntary approaches recommended

Basis for Market Driven Improvement

CEP Recommendation

Energy Efficient Transportation

- Continue successful transit oriented strategies
- Reduce vehicle miles traveled
- Support federal efforts to increase vehicle fuel efficiency
- Support the reduction of carbon content in fuels



CEP Recommendation

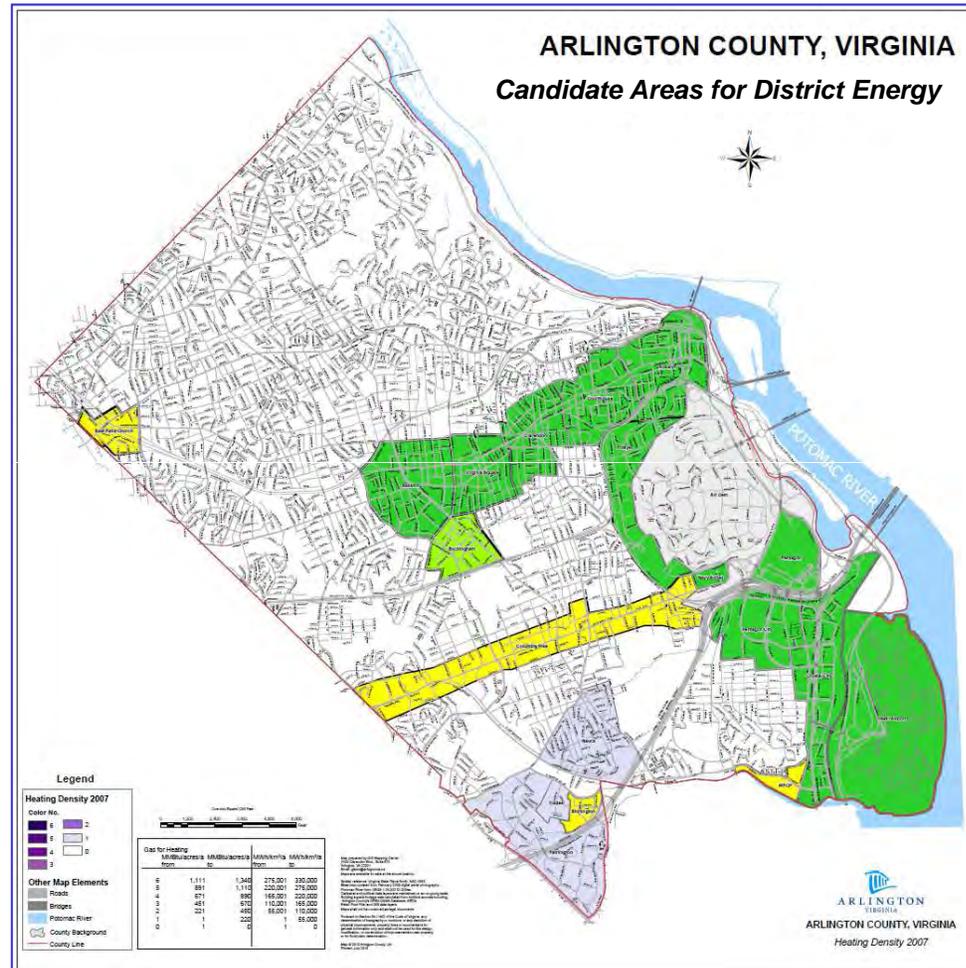
Clean and Renewable Energy

- Increase use of solar photovoltaic to 160 Megawatts by 2025 to reduce summer peak and cut carbon
- Increase use of clean and renewable energy sources for domestic hot water and space heating needs



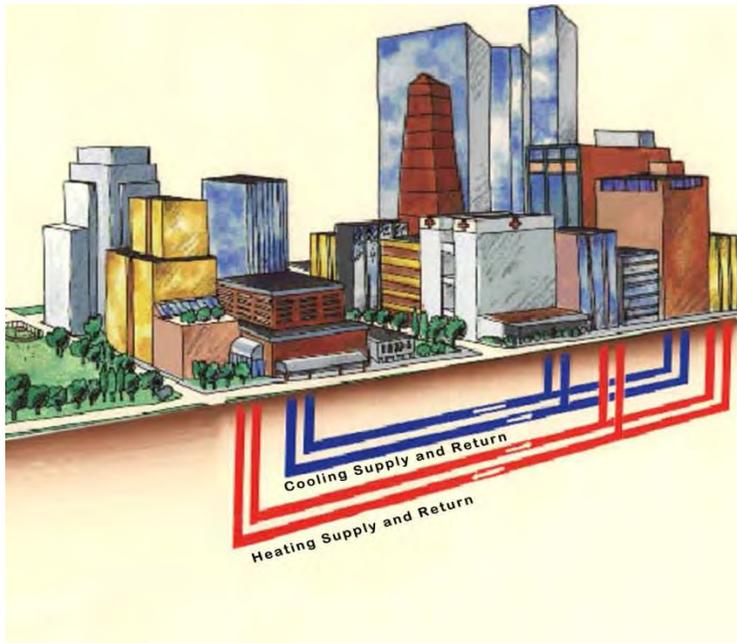
Energy Density Mapping

Possible areas for District Energy



Reliable – Flexible – Clean - Economic

Task Force Recommendation: District Energy Systems



Centralized supply and delivery

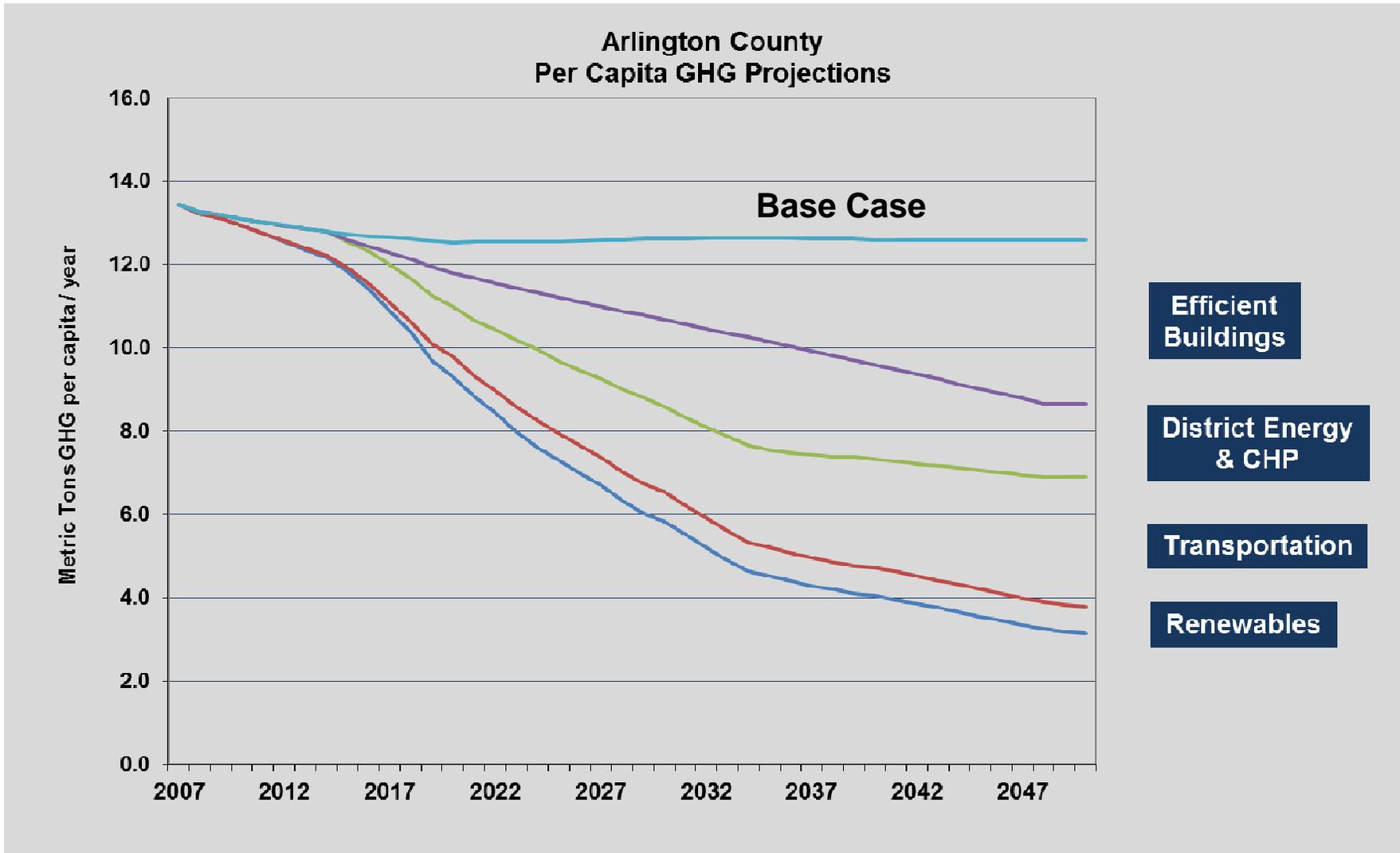
- Heating
- Cooling
- Domestic hot water

- Distribution to high-rise buildings
- Closed network of highly insulated pipes
- Optimized energy supply from multiple sources
 - Combined Heat & Power
 - Boilers/Furnaces
 - Absorption Chillers
 - Electric Chillers
 - Solar and Biomass
 - Waste heat recovery
- Typically operated by dedicated DE-Utility

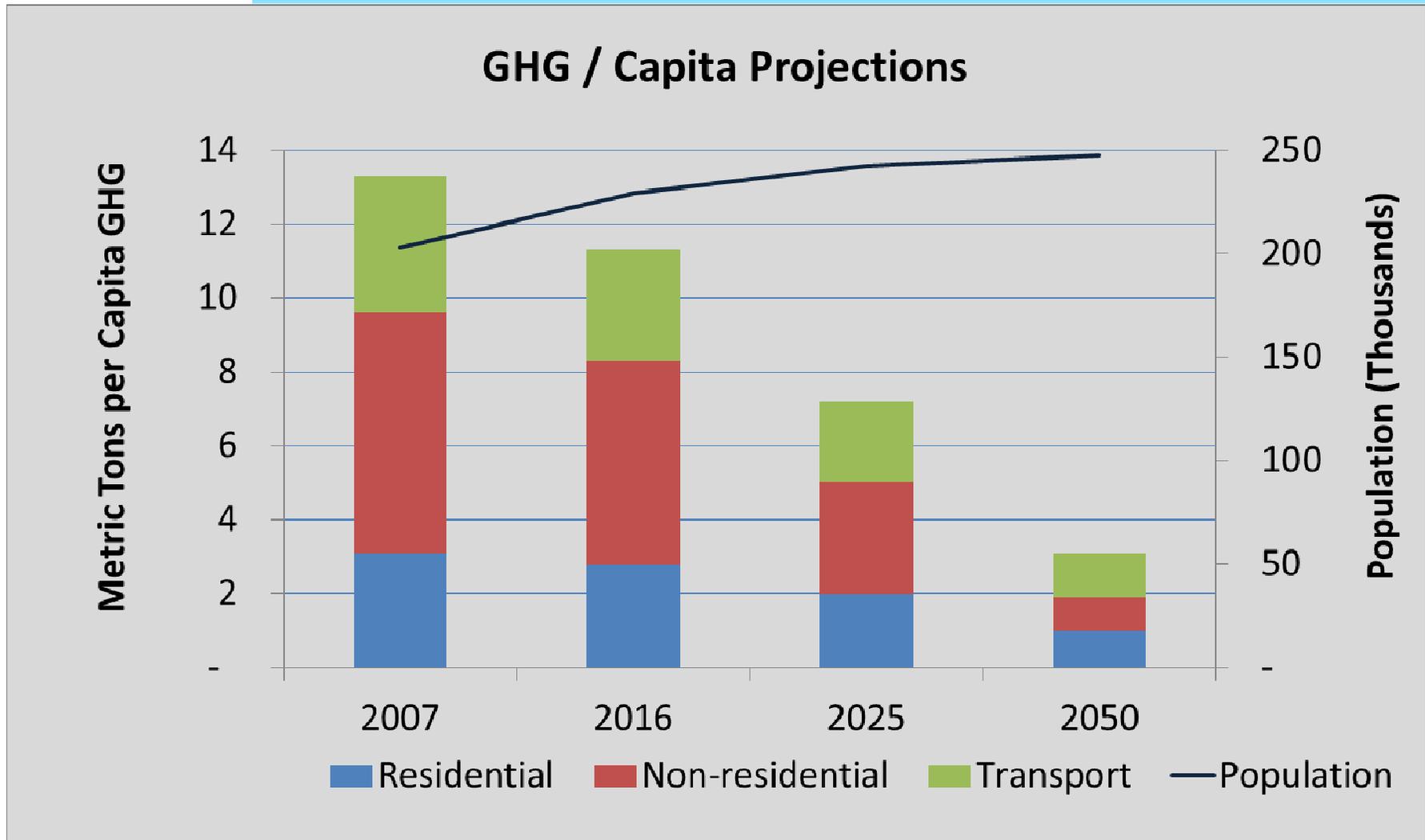
Widely deployed proven technology

Per Capita GHG Emissions

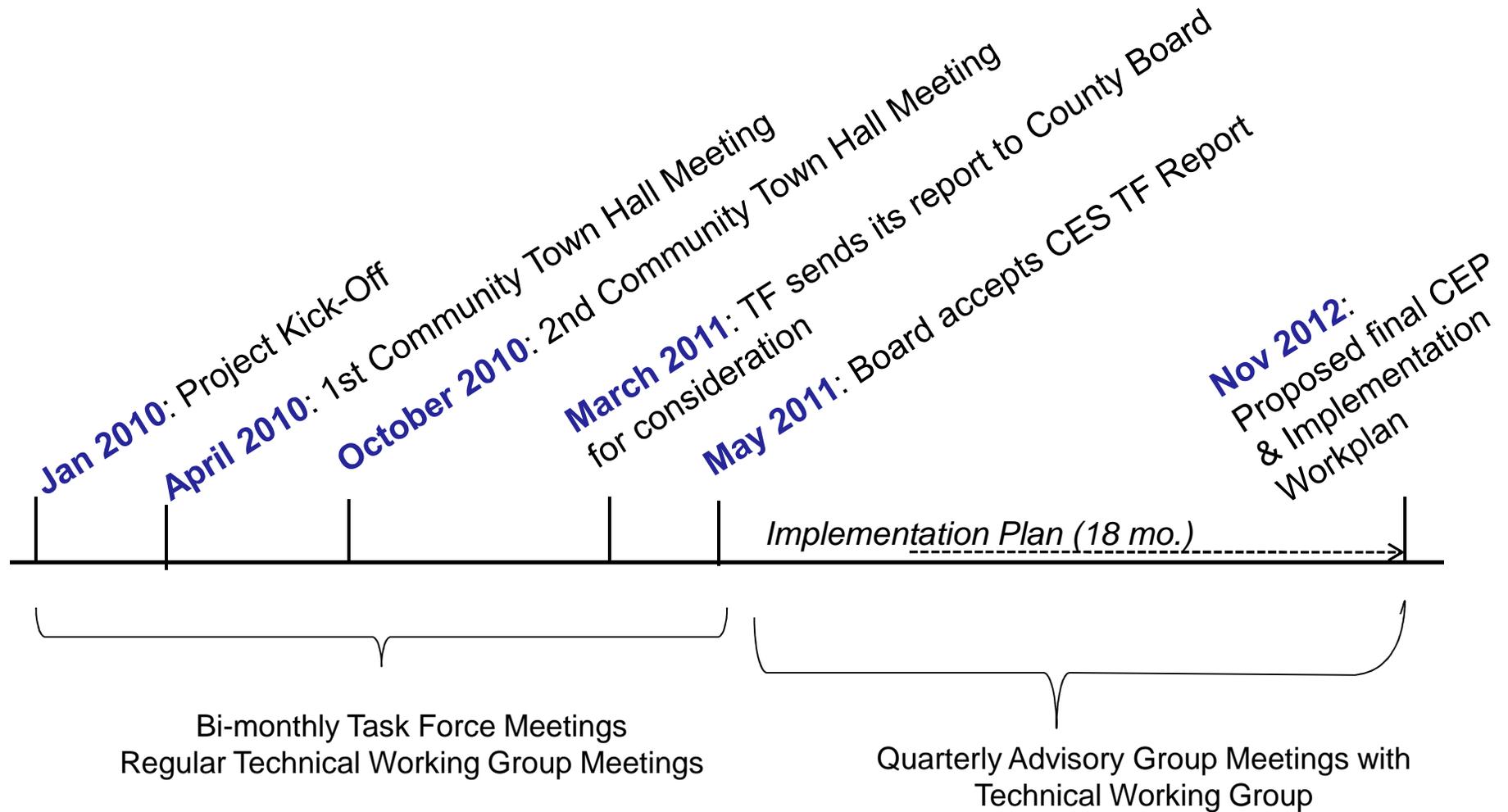
Impacts of Key Energy Policy Recommendations



2050 Results by Sector



Project Timeline



Community Energy Efficiency & Conservation Strategy Plan (CEP)

Creating a Globally Competitive Community



Final Recommendations

Holland Community Energy Plan

2011 to 2050 Goals

Energy Mission

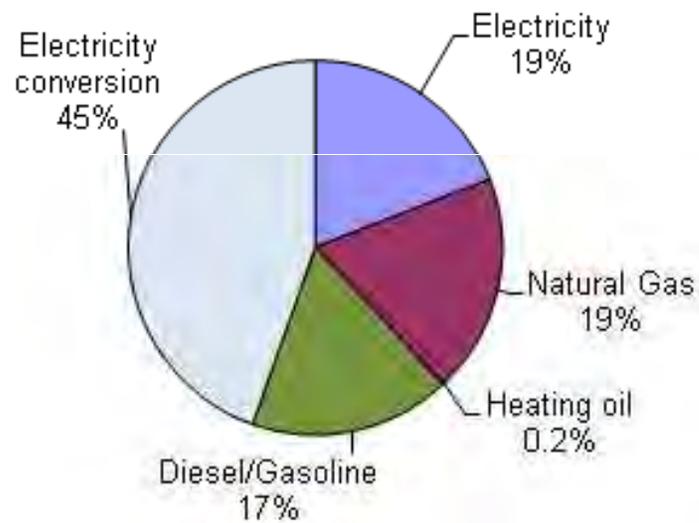
Enhance City attractiveness to investors, businesses and residents through cost effective, reliable clean energy supply

CEP Goals

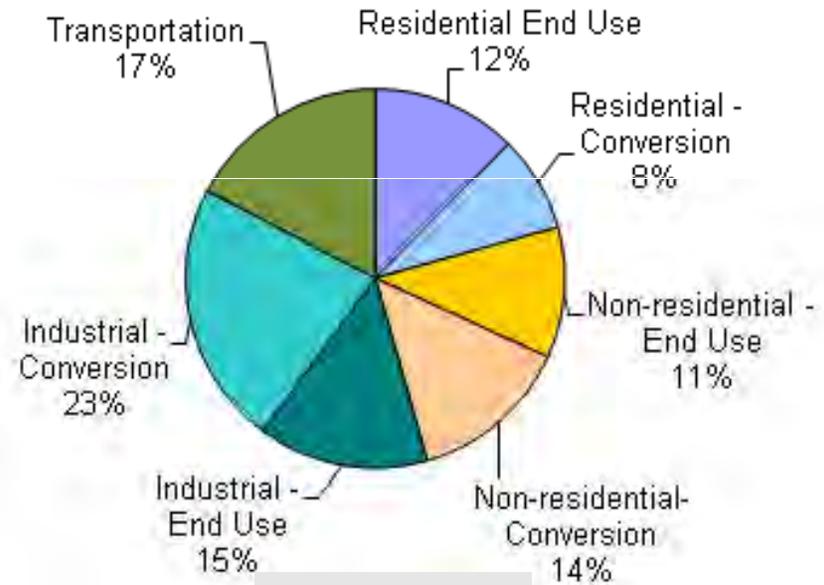
- Lower cost energy than neighbouring communities
- ***Highly reliable electricity supply from local sources***
- ***Industrial Energy Service tailored to investors' needs***
- Flexibility to meet changing technologies, legislation, fuel costs and other market conditions
- Meet commitment to the U.S. Conference of Mayors Climate Protection Agreement
- Be a leader in developing regional energy productivity strategy

City of Holland Baseline Energy Profile ~ estimated \$135 M

Primary Energy / Fuel 2010
9,898,000 MMBtu_e / 2,900,000 MWh_e



by type



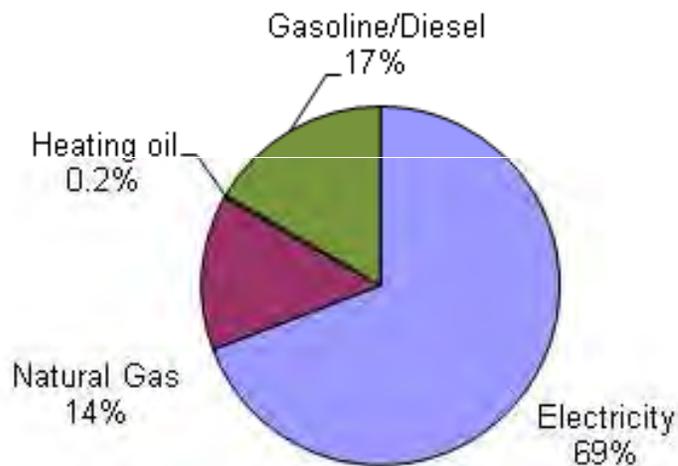
by sector

340 MMBtu_e / 100 MWh_e for each Resident

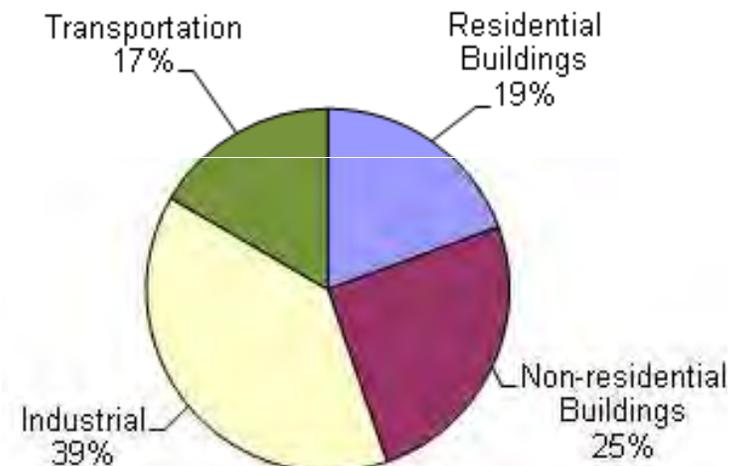
City of Holland Base Line *Carbon Footprint*

2010 Greenhouse Gas Emissions

792,500 metric tons / 873,600 short tons CO_{2e}



by type

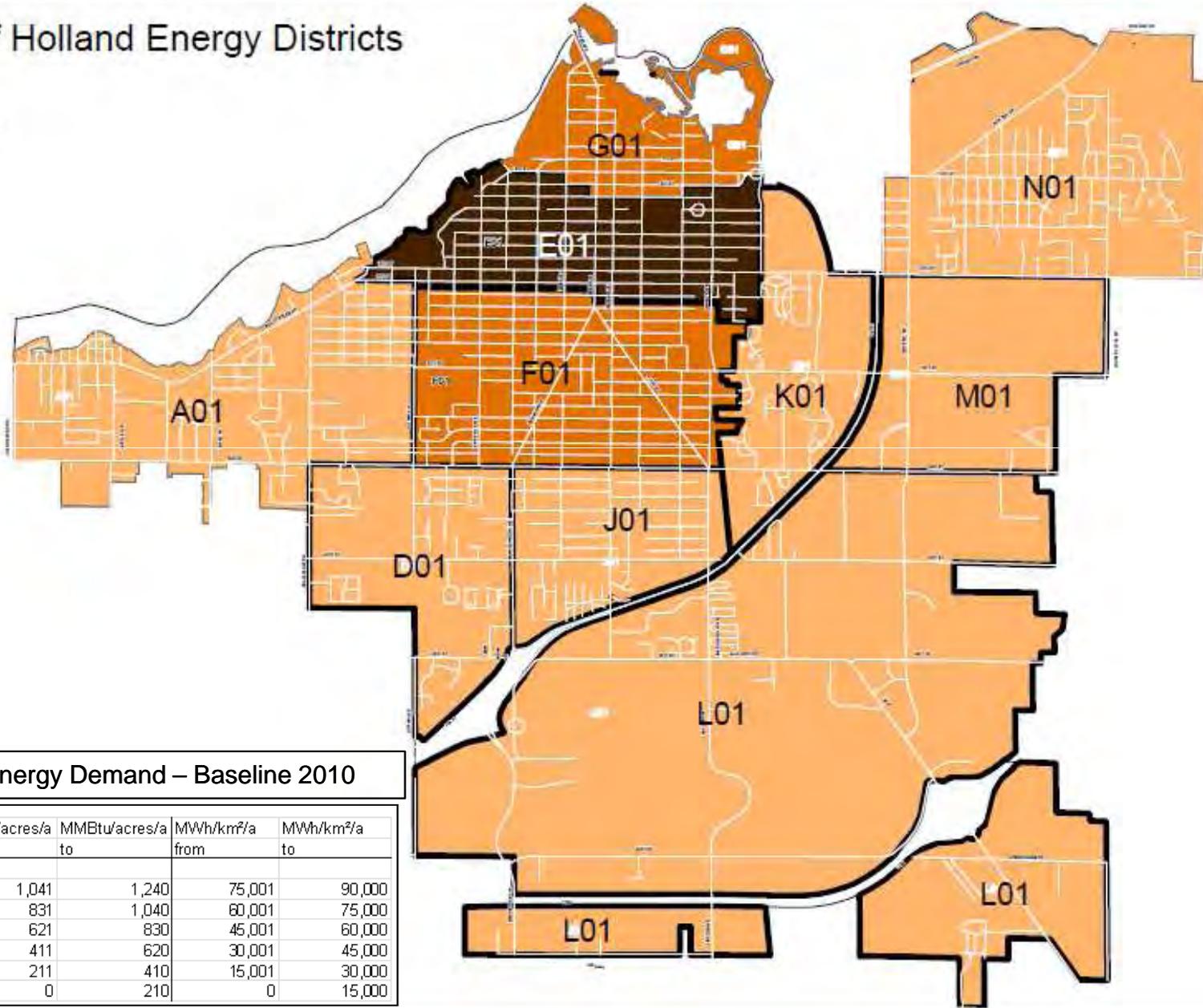


by sector

24 metric tons for each Resident

Baseline Energy Demand 2010

City of Holland Energy Districts

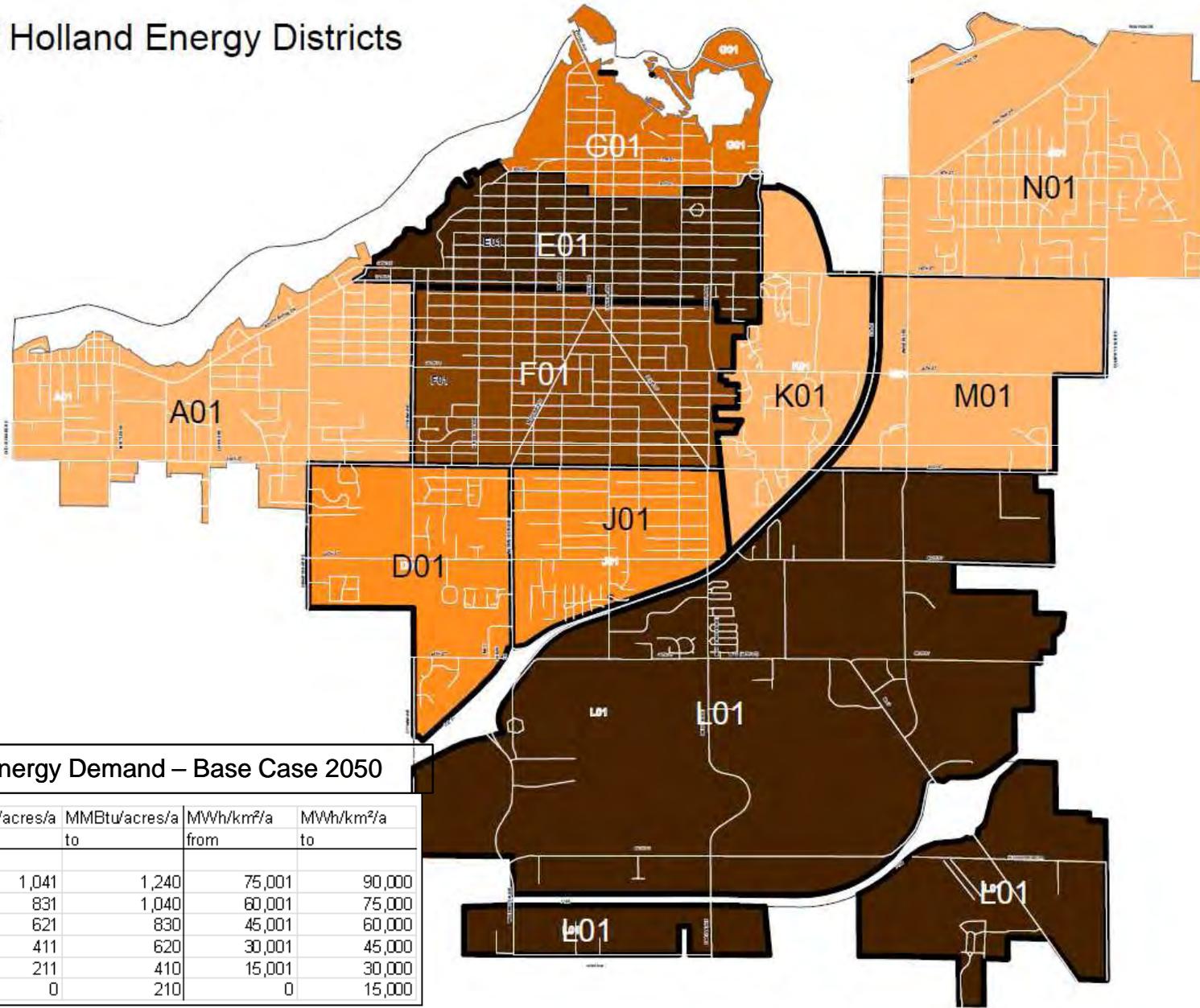


Total Energy Demand – Baseline 2010

	MMBtu/acres/a	MMBtu/acres/a	MWh/km ² /a	MWh/km ² /a
	from	to	from	to
■	1,041	1,240	75,001	90,000
■	831	1,040	60,001	75,000
■	621	830	45,001	60,000
■	411	620	30,001	45,000
■	211	410	15,001	30,000
■	0	210	0	15,000

Base Case Energy Demand 2050

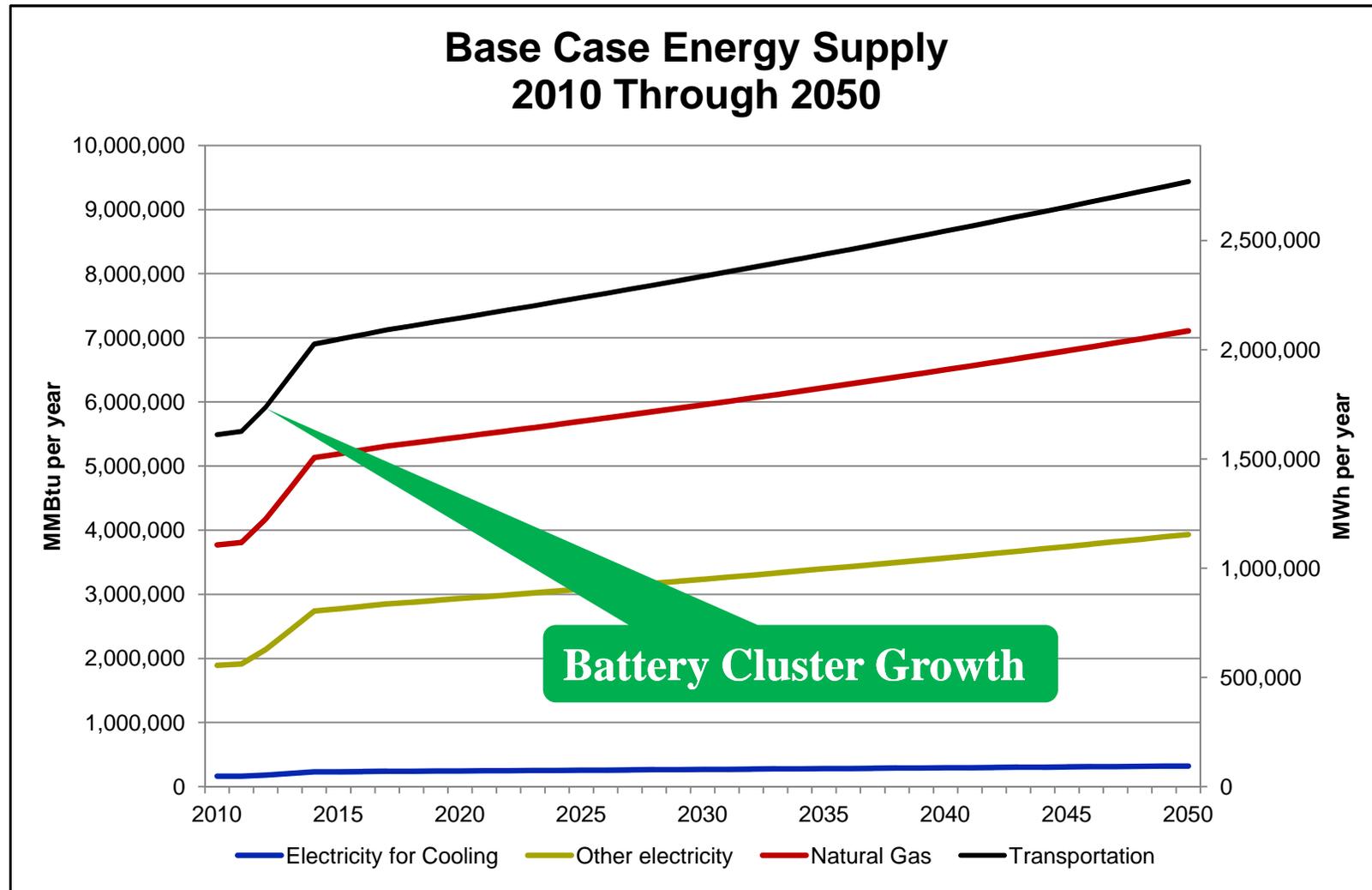
City of Holland Energy Districts



Total Energy Demand – Base Case 2050

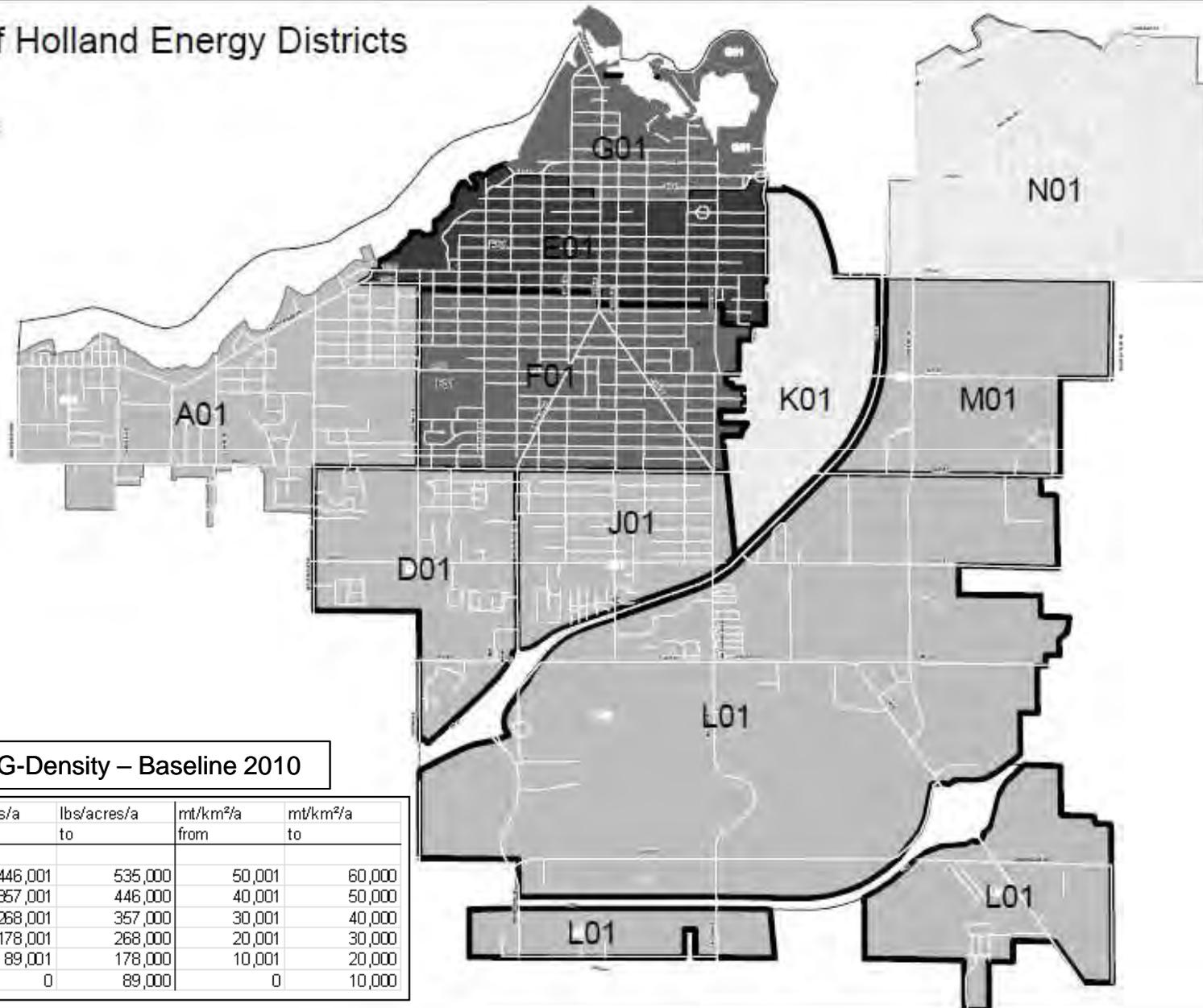
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■	411	620	30,001	45,000
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Energy Supply Outlook 2010 to 2050 Base Case



Baseline GHG Emissions 2010

City of Holland Energy Districts

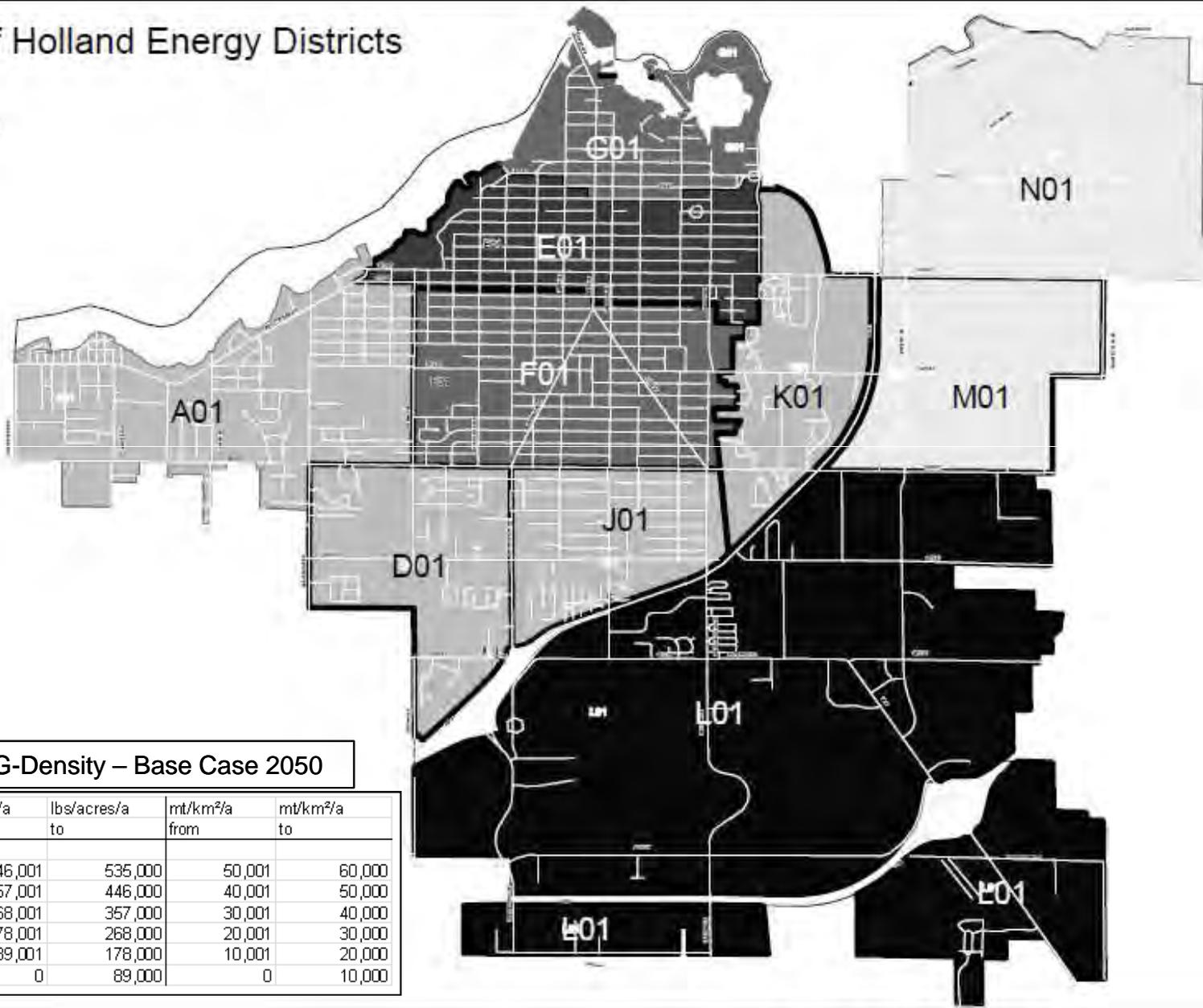


GHG-Density – Baseline 2010

	lbs/acres/a from	lbs/acres/a to	mt/km ² /a from	mt/km ² /a to
■	446,001	535,000	50,001	60,000
■	357,001	446,000	40,001	50,000
■	268,001	357,000	30,001	40,000
■	178,001	268,000	20,001	30,000
■	89,001	178,000	10,001	20,000
□	0	89,000	0	10,000

Base Case GHG Emissions 2050

City of Holland Energy Districts

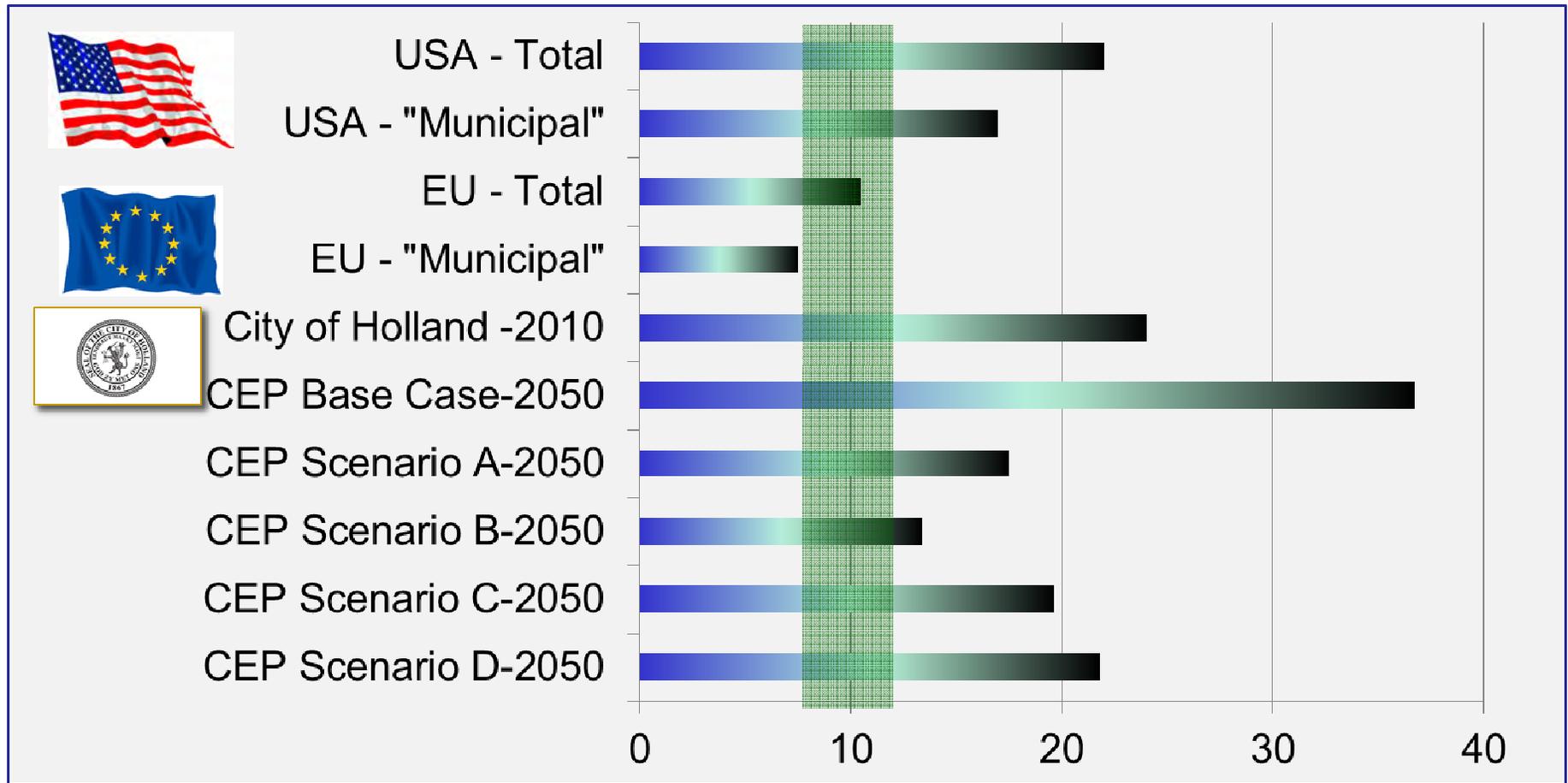


GHG-Density – Base Case 2050

	lbs/acres/a from	lbs/acres/a to	mt/km ² /a from	mt/km ² /a to
■	446,001	535,000	50,001	60,000
■	357,001	446,000	40,001	50,000
■	268,001	357,000	30,001	40,000
■	178,001	268,000	20,001	30,000
■	89,001	178,000	10,001	20,000
□	0	89,000	0	10,000

Framing Community Targets

GHG / Capita



10 mt/capita Goal – Challenging but Achievable

Electric Vehicles

Included in all Scenarios

- EV success critical to Holland's industries
- 2050 Assumptions
 - 7% of car miles
 - 32kWh/100 miles
- GHG - Leaf
 - Base case: 337 g/mi
 - Scenario B: 152 g/mi
- Fuel comparison
 - Jetta-Gas: 232 g/mi
 - Jetta-TDi: 190 g/mi
- National Targets
 - US 2025: 163 g/mi
 - EU 2020: 152 g/mi



Nissan Leaf

- Efficiency: 34 kWh/100 miles
- Cost: ~ 5 cents/mile
- Range: ~ 70 miles
- Weight: 3354lb/1521kg
- Battery: 24 kWh Lithium Ion

Challenge to Achieve Carbon Neutral

CEP Scenario A

Efficient Homes and Buildings

- All Buildings be renovated by 2050
- Voluntary Energy Performance Labeling
- Systematical efficiency upgrade of Single Family Homes
- Living examples in renovation and upgrade of Non-residential, Large MFH and Retirement Communities

Systematically Raise Efficiency

CEP Scenario A

Industrial and City Energy Services

- Tailored Industrial Energy Services with 30 MW of CHP and other media and services to meet customer needs
- District Heating north from 24th street with Hope College / Hospital / Aquatic Center / City as Anchor tenants and Snow melt services
- City Energy Supply with 70 MW CCGT De Young Site by 2016 configured to supply District Heating
- Sourcing “green” electricity from Landfill (10MW)

Extended Opportunities for HBPW

Integrated Industry Park

Example: Gersthofen, Bavaria



- Shared multi-utilities
 - *Heat, steam and cooling*
 - *Compressed air*
 - *Water and Waste water*
 - *Electricity*
 - *Natural gas*
- On-site energy sources
 - *Cogeneration and renewables*
 - *Heat recovery*
- Reduced investments
 - *Reduced duplication*
 - *“Right sizing”*
 - *New technology*
- Reduced energy and climate risks
 - *Commodity and operating costs*
 - *Reliability and quality*
 - *Greenhouse gas emissions*
- Reduced risks attracts investors

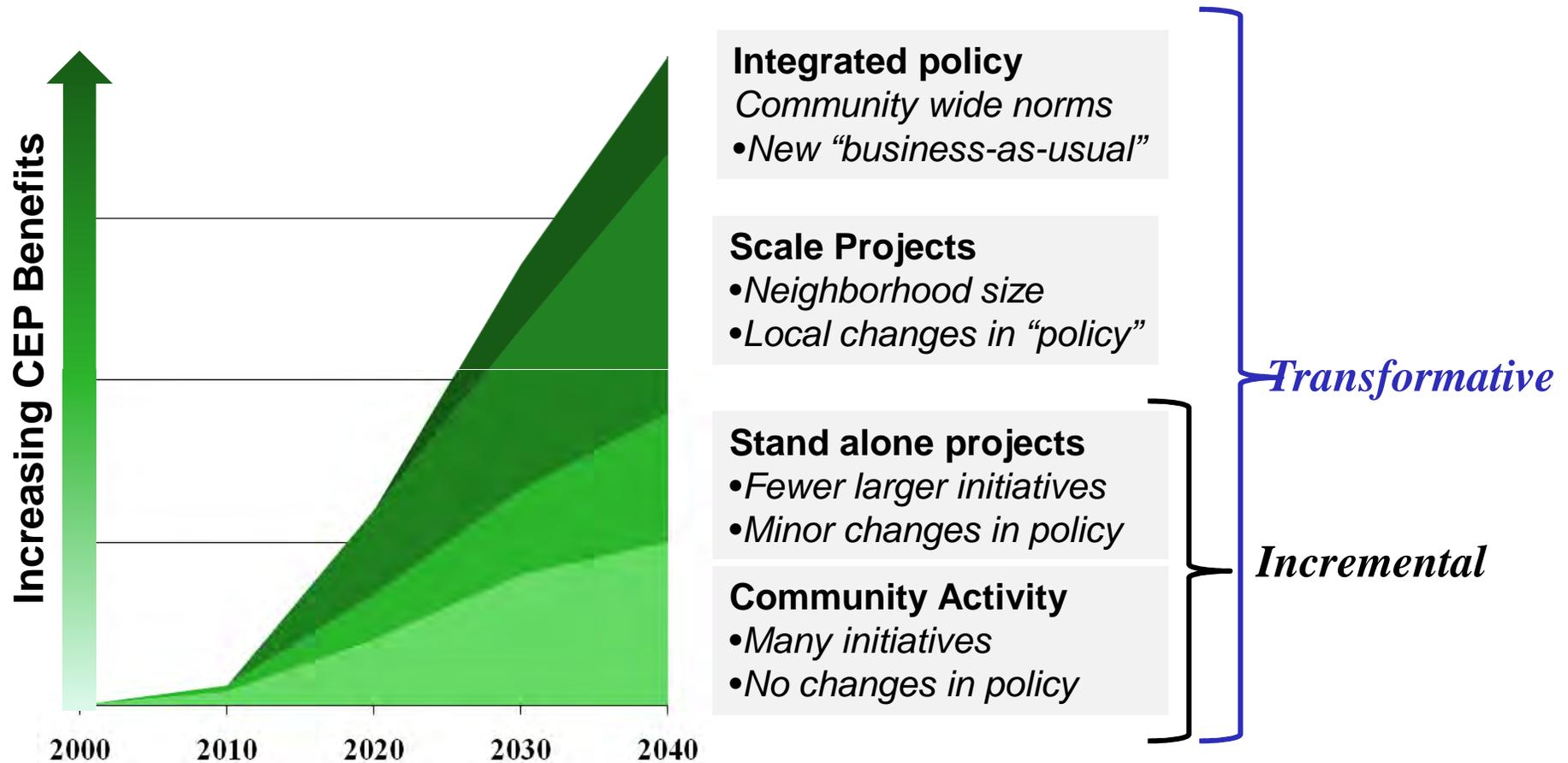
Effective Operations – Quality Jobs

CEP Scenarios B, C and D

- Scenario B....Scenario A plus...
 - *24 MW of Solar PV to eliminate summer peak*
 - *20 MW Biomass generation after 2030*
 - *Source 37 MW_{nom} Wind by 2020*
 - *10% bio-gas/natural gas mix for CHP/CCGT by 2023*
- Scenario C is Scenario B plus...
 - *70 MW Solid Fuel with 30% biomass/ 70% coal*
 - *Do not implement CCGT*
- Scenario D is Scenario C without...
 - *PV, Wind and bio-gas/natural gas mix for CHP*

All Scenarios Focus on Efficiency

Transformative or Incremental *Importance of Early Scale*



Transformation – Rewarding but Uncomfortable!

Scale Projects

Selection Criteria

- High probability of being implemented
- Manageable number of participants
- Large enough for integrated energy solutions
 - *New business models possible*
 - *Efficiency levels*
 - *Distribution – heating, cooling, power, other..*
 - *Distributed clean and renewable supplies*
 - *Smart micro-grids...*
- Economically, socially, environmentally and operationally attractive
- Future linkage to other Scale Projects

Exemplars of Key CEP Strategies

City of Holland CEP

Five Recommended Scale Projects

1. Industrial Park Integrated Energy Services
 - *Encourage industrial investment*
 - *Tailored to meet users corporate energy goals*
2. Historic District Neighbourhood
 - *Pilot for single family home renovation strategy*
 - *Technical, investment and community models*
3. Hope College Campus
 - *Reduced operating costs*
 - *Basis for curricula development*
 - *Node for City District Heating*
4. High School / Hospital / Aquatic Center
 - *Reduced operating costs*
 - *Energy education and outreach*
 - *Possible node for City District Heating*
5. District Heating Initial Network
 - *Increased fuel efficiency and flexibility*
 - *Reduced emissions*
 - *Enhanced property values*



Scale Project 2 : Historic District Single Family Neighborhood

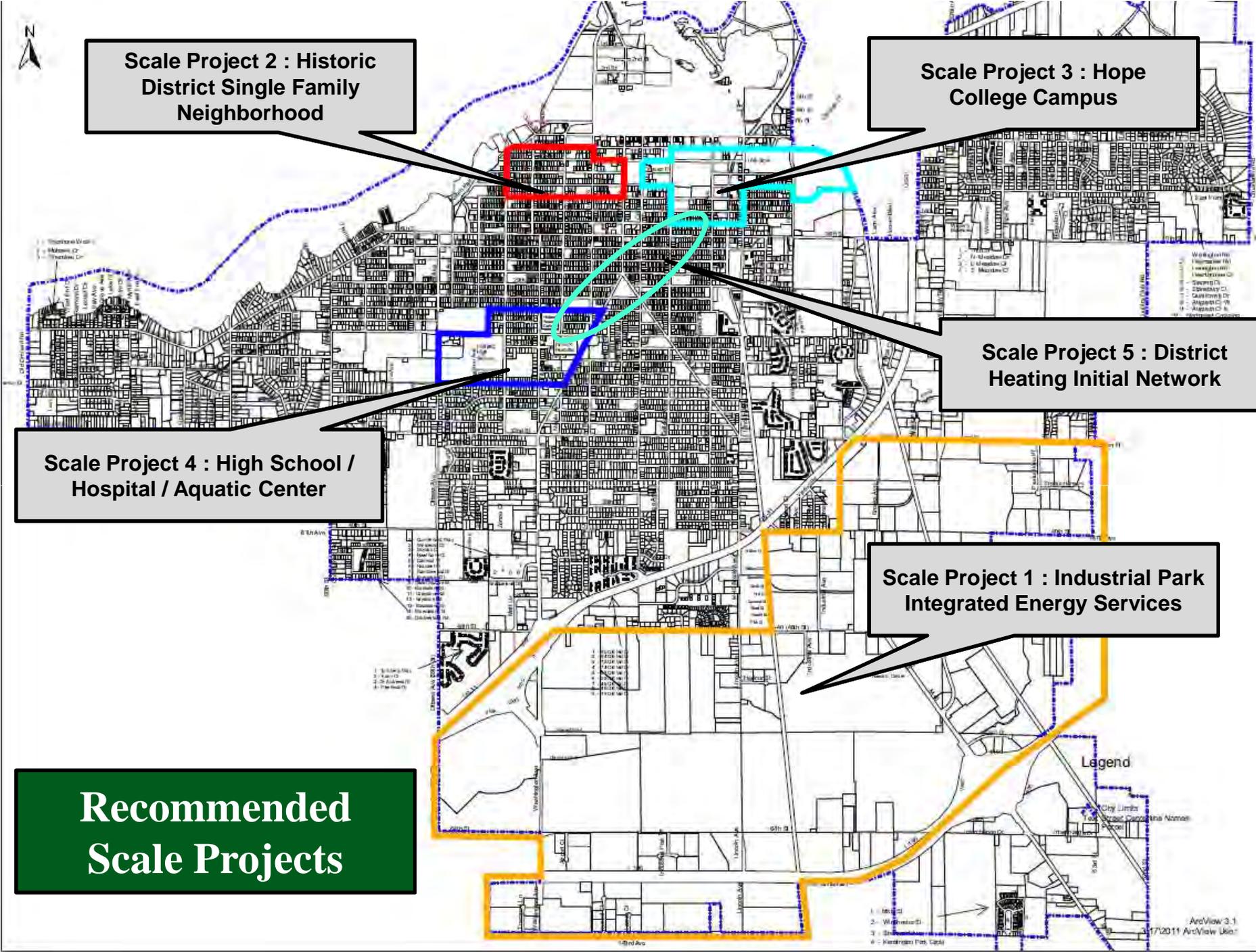
Scale Project 3 : Hope College Campus

Scale Project 5 : District Heating Initial Network

Scale Project 4 : High School / Hospital / Aquatic Center

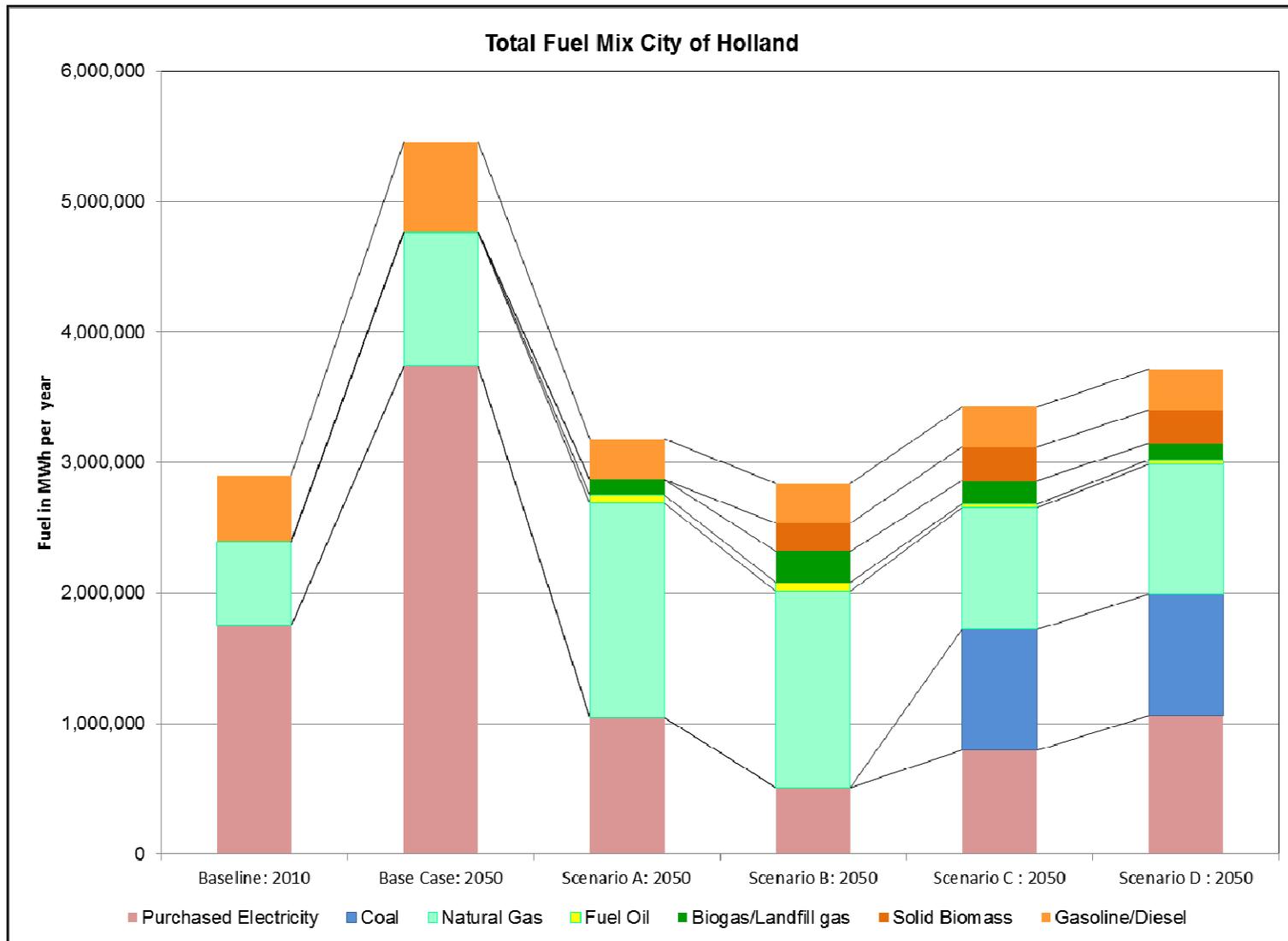
Scale Project 1 : Industrial Park Integrated Energy Services

Recommended Scale Projects



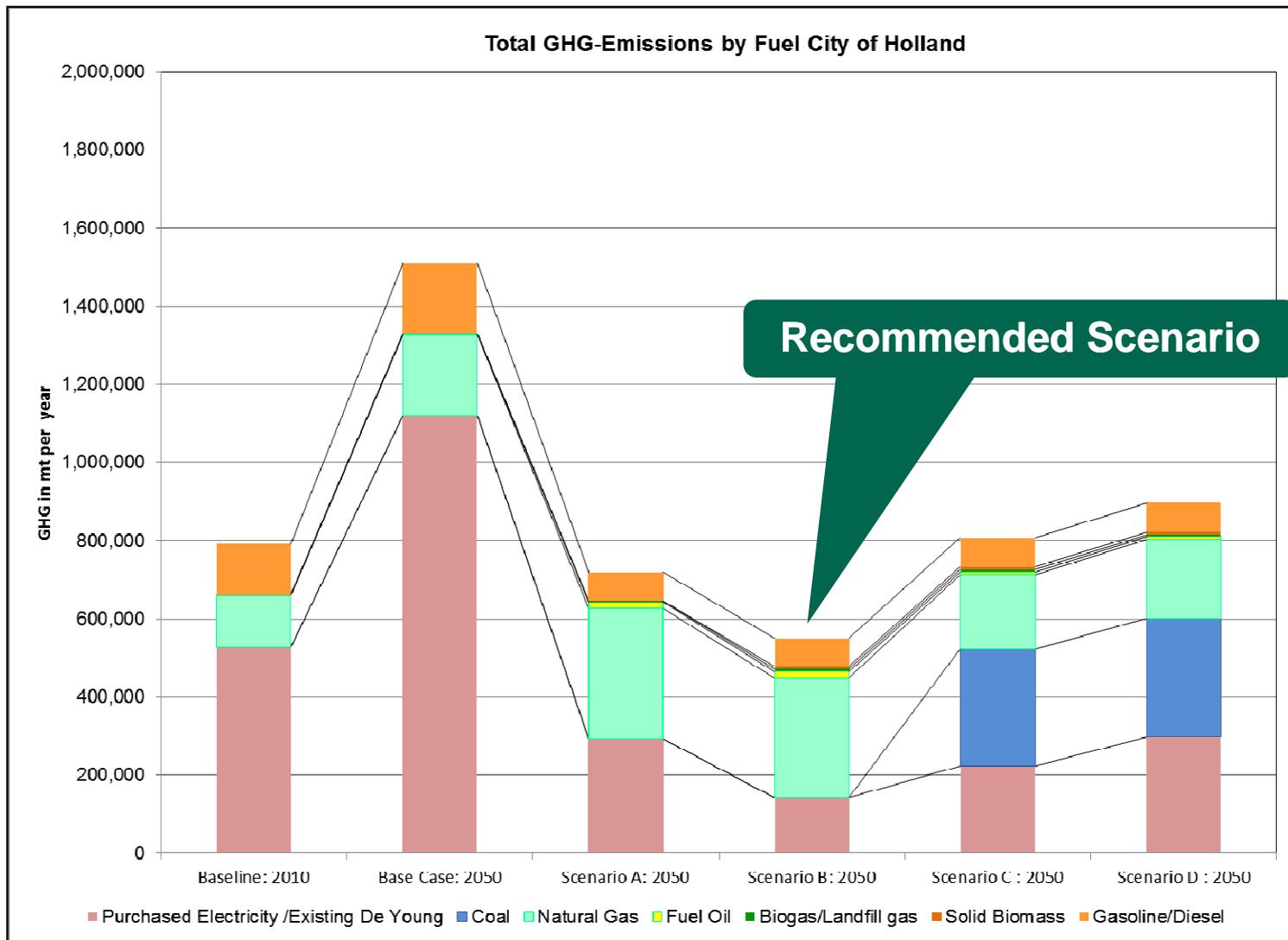
Scenario Results

Total City Fuel Mix - 2050



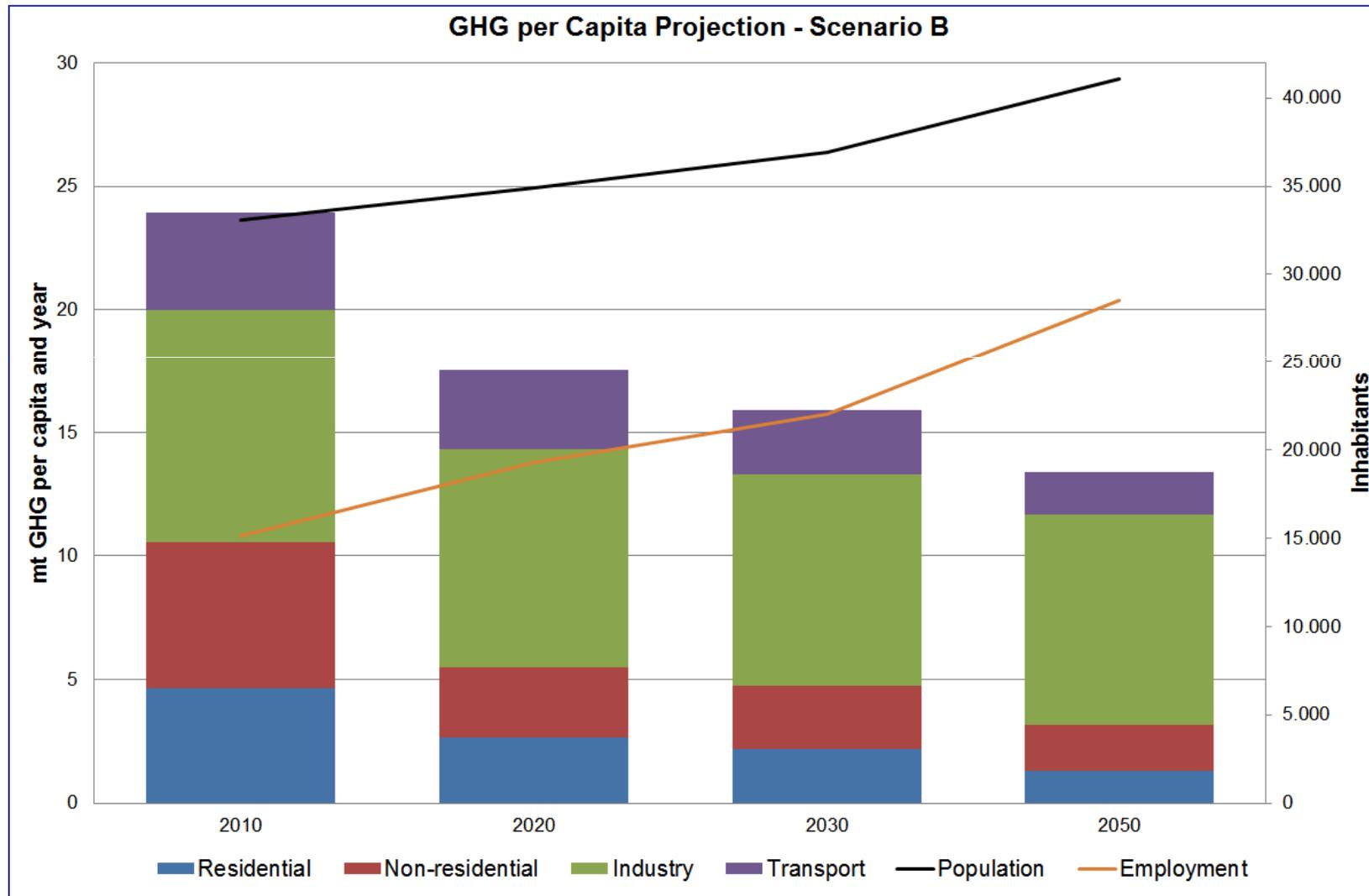
Analysis Drives Recommendation

Total GHG by Fuel - 2050



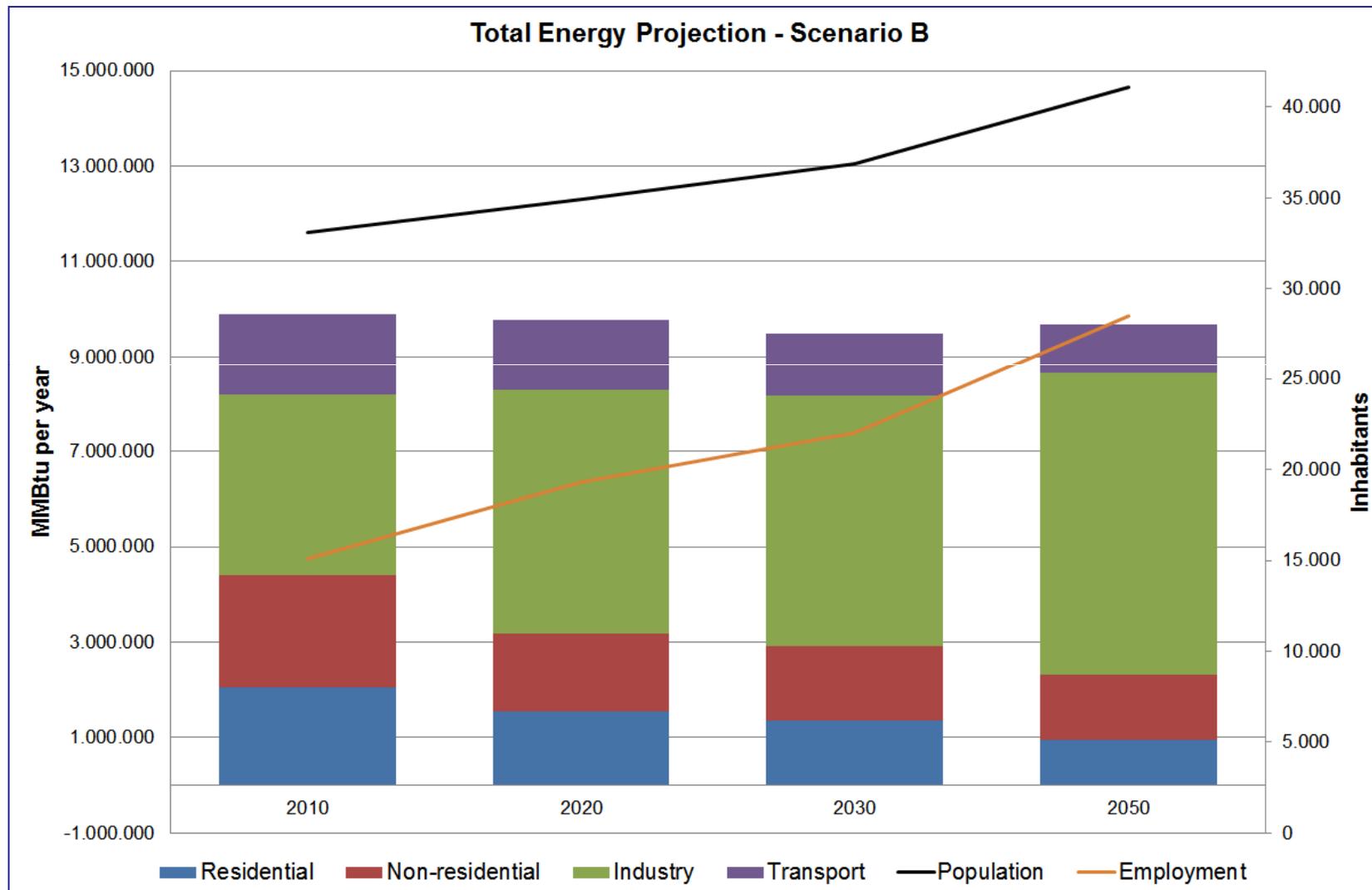
Results by Sector

GHG Per Capita 2010 to 2050



Results by Sector

Total Fuel 2010 to 2050



Benefits of Winning!



Resident

- *Lower utility costs*
- *Resale value*
- *Employment*
- *Quality of life*

- *Environmental impact*
- *Attractive development*
- *Competitive energy services*
- *New business opportunities*

Industry

- *Tailored energy*
- *Lower costs*
- *Sell waste energy*
- *Reduced CO₂ risks*

Academic

- *Sustainable curriculum*
- *Lower costs*
- *Student magnet*
- *Global network*

Utility

- *Higher returns*
- *Emissions reduction*
- *Customer intimacy*
- *Diversification*

Banks

- *Collateral Value*
- *Credit worthiness*

Commercial

- *Reduced costs*
- *Rental values*
- *Low vacancy*
- *Productivity*

Developer

- *Premium prices*
- *Low carrying time*
- *Reduced investment*

New Relationships – New Rules

Four years later....

September 2011 Press Item

- Passed CEP in 2007 by unanimous council vote
- National Role Model
- Over 2,000 Green jobs
- City influencing regional and national policy

Guelph boasts lowest jobless rate in country

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It may not be an all-time low, but Guelph's unemployment rate for August came close at 4.7 per cent – the lowest in the country.

“...Initiatives such as Guelph's Community Energy Initiative contribute to the long-term prosperity of the city and make it more appealing to business investment ...”

— Your Voice in Guelph —
Guelph TRIBUNE