

Energy Optimization and Customer-Sited Renewable Efficiency Potential Study

Presented at Collaborative Meeting
June 21, 2011

Prepared by:



GDS Associates, Inc.
Engineers and Consultants

SAIC
From Science to Solutions

La Capra Associates
Energy Markets Knowledge, Applied

Potential Study Overview

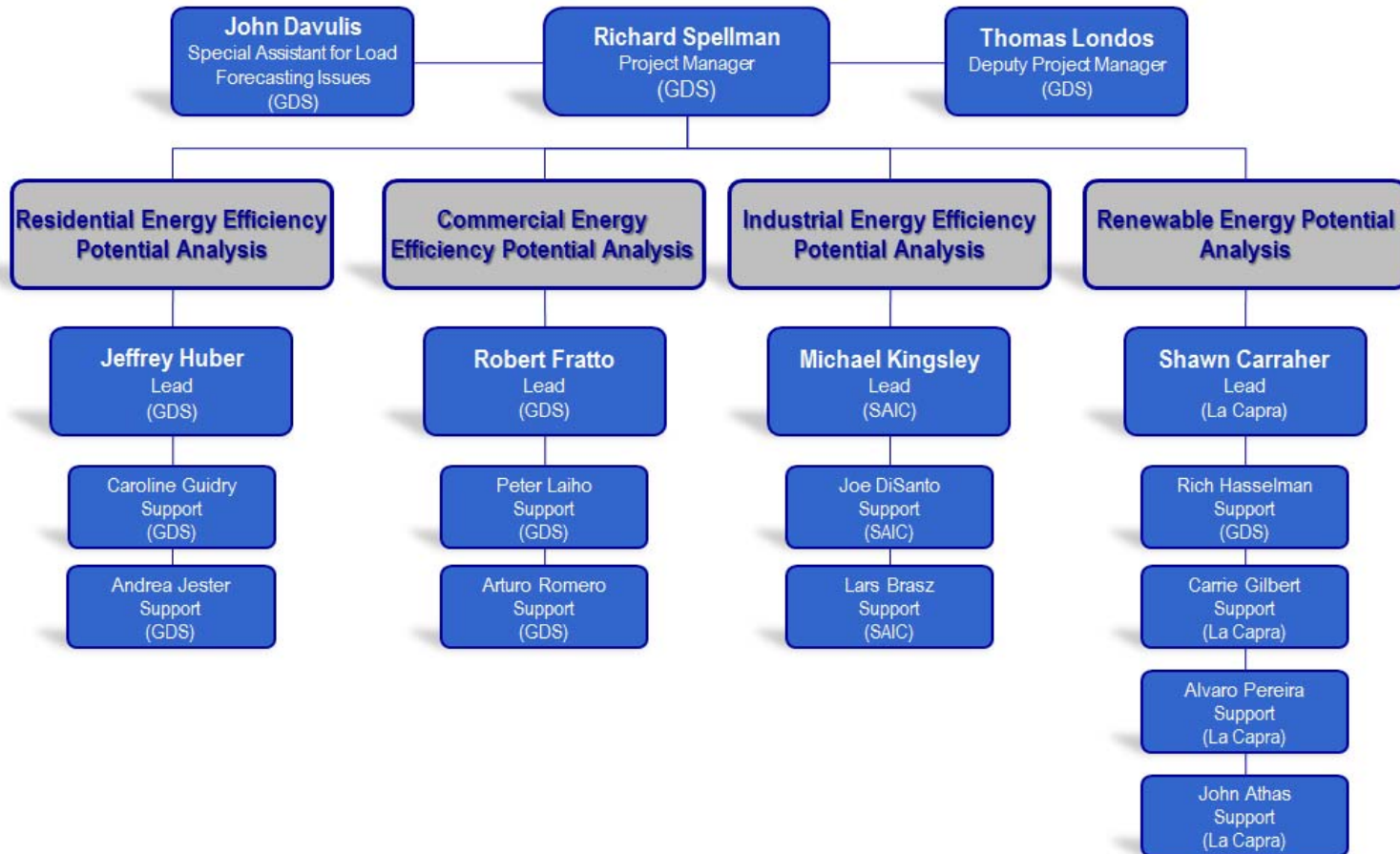
- Introductions and Key Personnel
- Overview of Work Plan
- Energy Efficiency (EE) Potential Study Overview
 - Define “Potential Study”
 - Types of Potential
 - Cost-Effectiveness
 - Residential Sector Methodology
 - Commercial Sector Methodology
 - Industrial Sector Methodology
- Renewable Energy (RE) Potential Study Overview
- Discussion of Data Requests
 - Baseline/Market Assessment Studies
 - Load Forecast
 - Avoided Costs
 - Other Input Assumptions
- Timeline & Major Milestones



State of Michigan, Public Service Commission

INTRODUCTIONS & KEY PERSONNEL

GDS / SAIC / La Capra Team





State of Michigan, Public Service Commission

OVERVIEW OF WORK PLAN

Planned Tasks

- Task 1: 5/12 Kick-Off Meeting and Revised Work Plan
 - Discussed Outstanding Questions
 - Finalized Deliverables
 - Edited Work Plan to reflect any changes
- Task 2: Complete Energy Efficiency Potential Analysis
- Task 3: Complete Customer-Sited Renewable Energy Potential Analysis
- Other Deliverables



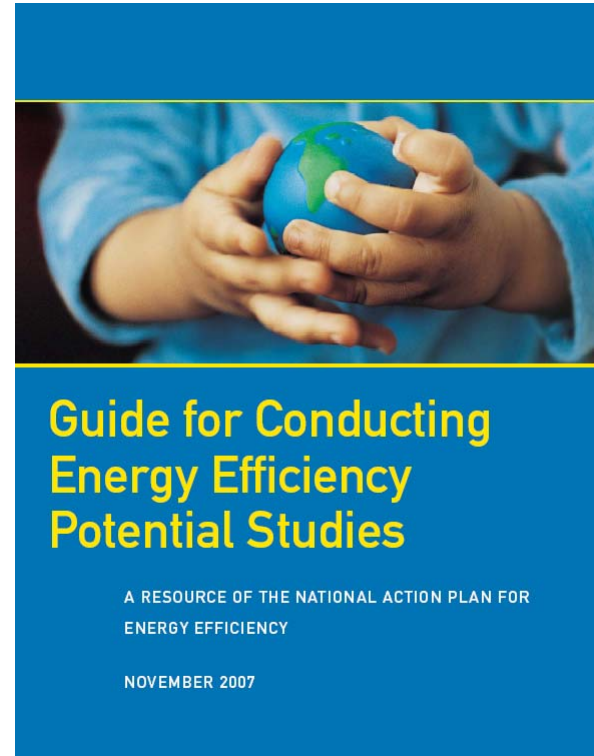
State of Michigan, Public Service Commission

EE POTENTIAL STUDY OVERVIEW




What is a Potential Study?

Simply put, a potential study is a quantitative analysis of the amount of energy savings that either exists, is cost-effective, or could be realized through the implementation of energy efficiency programs and policies.

-National Action Plan for Energy Efficiency



Types of DSM Potential

- **Technical Potential** 
 - Complete saturation of all technically feasible measures evaluated in the study
- **Economic Potential** 
 - Complete saturation of all cost-effective technical potential (TRC test)
- **Achievable Potential** 
 - Base case of all economic potential that is achievable given market barriers and market conditions

Determining Cost-Effectiveness

- TRC Test – Total Resource Cost Test
 - Primary screening test
 - Considers total combined cost to consumer and utility vs. energy supply cost
- UCT Test – Utility Cost Test
 - Considers costs incurred by the utility (including incentive costs) vs. avoided supply costs of energy and demand (≥ 1)
- Participant Cost Test
 - Considers the cost to the consumer vs. consumer benefits (≥ 1)
- Societal Test
 - Similar to TRC Test; considers externality benefits (≥ 1)
- RIM Test – Rate Impact Measure Test
 - Considers costs incurred by the utility as well as lost revenues vs. avoided supply costs of energy and demand (≥ 1)

$$\frac{\$ \text{ Benefit}}{\$ \text{ Cost}} \geq 1$$

Test result of 3.5 means that for every dollar invested, the benefit returned is \$3.50.

Typical Residential Measures Considered

End Use Type	End-Use Description	Measures/Programs Includes
Appliances	General Home Appliances	<ul style="list-style-type: none"> * Dehumidifiers * Refrigerators * Freezers * Refrigerator/Freezer Turn-In
Appliances/WH	Kitchen/Laundry	<ul style="list-style-type: none"> * Clothes Washers, Dishwashers * Heat Pump Dryers
Electronics	Home Electronics	<ul style="list-style-type: none"> * Controlled Power Strips * Laptops, Computer Monitors * Televisions (LED, LCD, Plasma) * Set Top Boxes * Misc. Consumer Electronics
HVAC (Envelope)	Building Envelope Upgrades	<ul style="list-style-type: none"> * Insulation * Air Sealing * Duct Sealing * Energy Star Windows * Energy Star New Homes
HVAC (Equipment)	Heating/Cooling /Ventilation Equipment	<ul style="list-style-type: none"> * Efficient Central AC & Heat Pumps and System Tune-Ups * Room AC * Efficient Furnaces/Boilers * Dual-Fuel Systems * Geothermal Heat Pumps * Bathroom Exhaust Fans
Lighting	Indoor/Outdoor Lighting	<ul style="list-style-type: none"> * Incandescent to CFL/LED * CFL to LED
Other	Miscellaneous Efficiency Measures	<ul style="list-style-type: none"> * Pool Pump Motor and Pool Covers * Direct Feedback Devices (In Home Display Units) * Indirect Energy Consumption Feedback
Water Heating	Domestic Hot Water	<ul style="list-style-type: none"> * Efficient Storage Tank WH * Tankless Water Heater (Gas) * Heat Pump WH * Solar WH (w/ Electric Back Up) * Tank Wrap, Pipe Wrap * Low Flow Showerheads, Faucet Aerators * Shower Start Technology, Gravity Film Heat Exchanger

Measure Characterization for MI Potential Study

All

Sectors

- Electric vs. Gas
- Measure Retirement
 - Replace on burnout
 - Retrofit
 - New Construction
 - *Early Retirement*
- Weather Sensitive Measures
 - Upper Peninsula
 - Northern Lower Peninsula
 - Southern Lower Peninsula

Residential

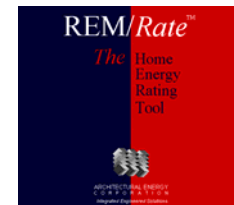
- Type of Housing
 - Single Family
 - Multi Family
 - Manufactured Housing
 - Low Income
- Home Heating/Cooling Type
 - All Electric
 - Gas Heat/Electric Cool
 - Other Heat/Electric Cool
 - Gas Heat/No Cooling

Develop DSM Measure Lists and Characteristics

- Deemed Savings Manuals
- Baseline Market Surveys (DTE/Consumers Energy/Statewide)
- EIA Energy Consumption Survey (RECS)
- Energy Modeling Software
- Other energy efficiency potential studies
- Energy efficiency conference proceedings
- Program Evaluation Reports

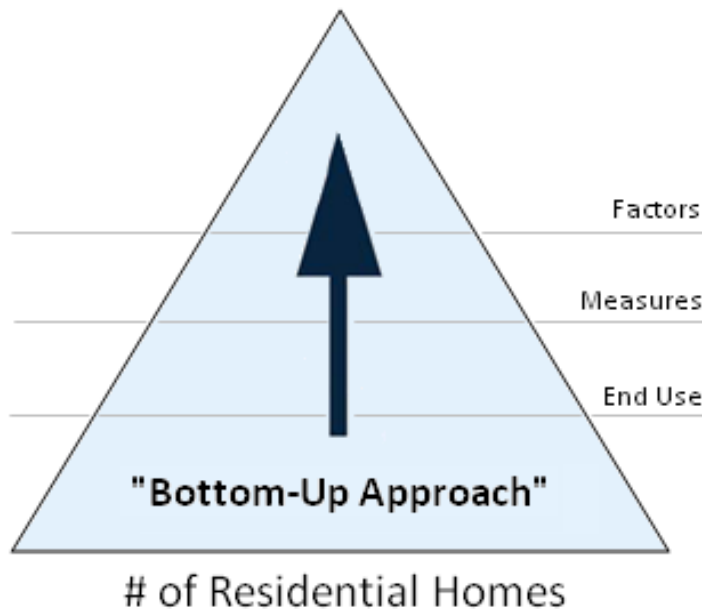


GDS Associates, Inc.
Engineers and Consultants



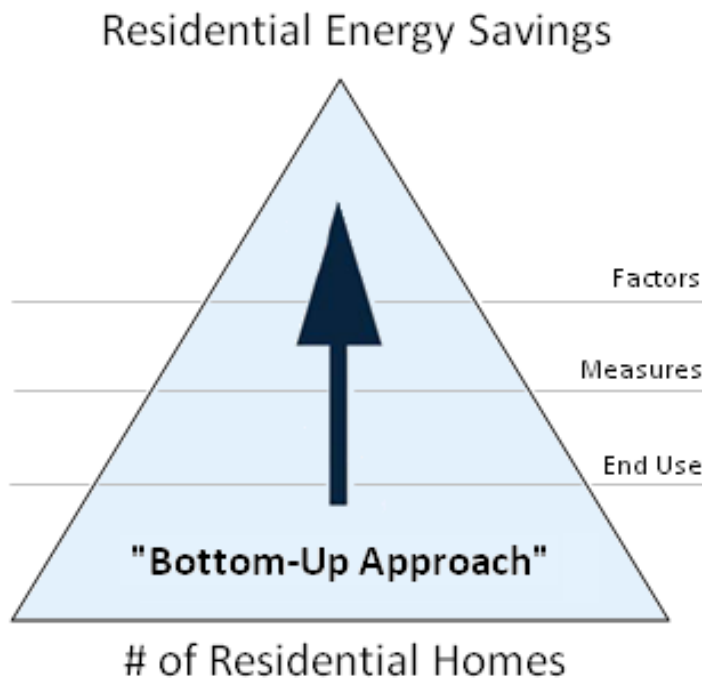
Residential Sector Methodology

Residential Energy Savings



Technical Potential of Each Measure =
Total Number of Households
x Base Case End Use Intensity (kWh/Unit)
x Base Case Factor (measure applicability)
x Remaining Factor (not yet converted)
x Applicability Factor (technically feasible)
x Savings factor (% savings)

Example: Developing Tech. Potential Estimates



Tech. Potential Example:

- 100,000 homes
- 75% have dishwashers
- 25% of all dishwashers are energy efficient (*Remaining potential is 75%*)
- 70 kWh annual savings

$100,000 * 75\% = 75,000$ homes

$75,000 * 75\% (100\%-25\%) = 56,250$ homes

$56,250 * 70\text{kWh} = 3,937,500$ kWh

Developing Achievable Potential Estimates

- Continues to include all cost-effective measures
- Accounts for timing of measure turnover
 - Only 50% of measures with a 20 year useful life will be eligible for replacement (assuming a replace-on-burnout approach) during the 10-year period of study
- Recognizes market barriers to measure penetration
 - *Achievable potential assumes less than 100% of eligible measures will be replaced with energy efficient alternatives*
 - *Market barriers can include: high up-front costs, lack of customer awareness, lack of technology availability, customer unwillingness to adopt technologies*

Commercial Sector DSM Potential

- Preliminary measure list includes:
 - Hundreds of Electric and Gas DSM Measures
- Measures will be matched, wherever possible, to Michigan Energy Measures Database
- GDS measure data and other industry sources will be used to fill the gaps
- Weather sensitive measure savings by region
 - Like residential sector, three regions will be included for weather sensitive measures

Preliminary List of Commercial Electric Measures

End-Use Type	Typical Measures		
Office Equip.	<ul style="list-style-type: none"> • Energy Star Refrigerator 	<ul style="list-style-type: none"> • Energy Star Office Equipment 	<ul style="list-style-type: none"> • PC Power Management
Water Heating	<ul style="list-style-type: none"> • Heat Pump Water Heater • Solar Water Heating • Booster Water Heater 	<ul style="list-style-type: none"> • Point of Use Water Heater • Efficient Electric Water Heater • High Efficiency Dishwasher 	<ul style="list-style-type: none"> • Low Flow Pre-Rinse Spray Nozzles • High Efficiency Clothes Washer • Ozone Laundry System
Pools	<ul style="list-style-type: none"> • Efficient Pump w/Controls • Heat Pump Pool Heater 	<ul style="list-style-type: none"> • Solar Pool Heater • Pools Covers 	<ul style="list-style-type: none"> • High Efficient Spas & Hot Tubs
Envelope	<ul style="list-style-type: none"> • Energy Efficient Windows • Insulation & Weatherization 	<ul style="list-style-type: none"> • Cool Roofing 	<ul style="list-style-type: none"> • Integrated Building Design
HVAC	<ul style="list-style-type: none"> • High Eff. Chiller & HVAC • Adv. Tune-up/Diagnostics • Retro commissioning 	<ul style="list-style-type: none"> • Programmable Thermostats • Energy Management Systems • Occupancy Control System 	<ul style="list-style-type: none"> • Ductless (mini split) • Ground Source Heat Pump • Commissioning
Cooking	<ul style="list-style-type: none"> • High Eff.. Steamer • High Eff.. Fryer • High Eff. Electric Griddle 	<ul style="list-style-type: none"> • High Eff.. Holding Cabinet, • High Eff. Combination Oven 	<ul style="list-style-type: none"> • Kitchen Hood Controls • Induction Cooktops
Refrigeration	<ul style="list-style-type: none"> • Vending Miser • Case Covers • Economizer • High Eff. Cooler & Freezer • Reach-In Freezer 	<ul style="list-style-type: none"> • High Efficiency Ice-makers • Evaporator Fan Motor Controls • H.E. Evaporative Fan Motors • Zero-Energy Doors 	<ul style="list-style-type: none"> • Door Heater Controls • Discus and Scroll Compressors • Floating Head Pressure Control • LED Lighting in Refrigeration
Lighting	<ul style="list-style-type: none"> • High Performance T8s • High Efficiency Fixtures • T5s • High Efficiency Lighting Controls 	<ul style="list-style-type: none"> • High Intensity Fixture • LED Exit Signs • LED Traffic Signals • Specialty Retail Lighting 	<ul style="list-style-type: none"> • CFL Fixture & Screw-in • LED Fixture & Screw In • Occupancy Sensors
Space Heating	<ul style="list-style-type: none"> • High Eff Heat Pump • Hydronic Heat Pump • Insulation & Weatherization 	<ul style="list-style-type: none"> • Ground Source Heat Pump • Ductless (mini-Split) 	<ul style="list-style-type: none"> • High Efficiency Pumps • Variable Speed Drive Control
Non-HVAC Motors	<ul style="list-style-type: none"> • Efficient Motors 	<ul style="list-style-type: none"> • Variable Frequency Drives (VFD) 	
Compressed Air	<ul style="list-style-type: none"> • Non-Controls 	<ul style="list-style-type: none"> • Controls 	

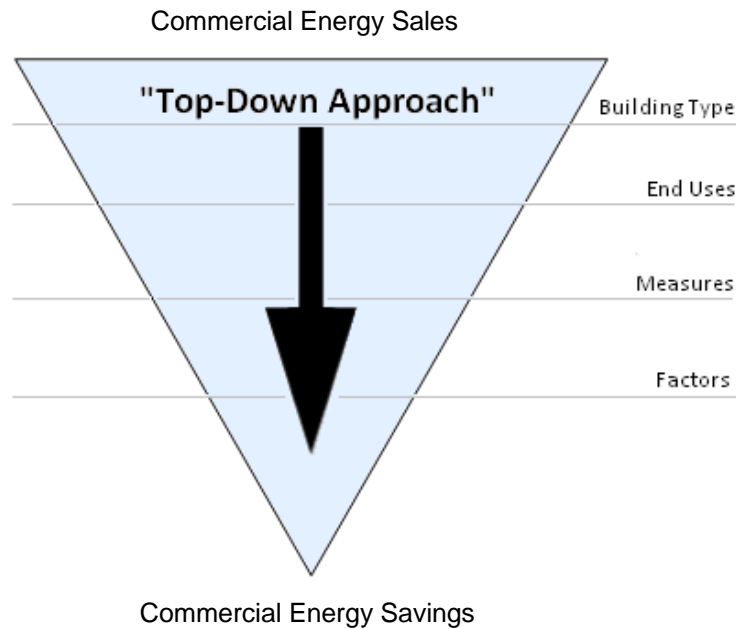
Preliminary List of Commercial Gas Measures

End-Use Type

Typical Measures

End-Use Type	Typical Measures		
Water Heating	<ul style="list-style-type: none"> • High Efficiency Stand Alone Commercial Water Heater • Indirect Water Heater • Low Flow Shower Head • Low Flow Pre-Rinse Spray Nozzle • Wastewater, Filtration/Reclamation • High Efficiency Gas Pool Water Heater 	<ul style="list-style-type: none"> • Condensing Stand Alone Commercial Water Heater • Heat Recovery Water Heater • Faucet Aerator • Circulation Pump Time Clocks • Ozone Commercial Laundry System • Pool Cover 	<ul style="list-style-type: none"> • On-Demand, Tankless Water Heater • Pipe Wrap • Graywater Heat Exchanger/GFX • Solar Water Heating with Gas Auxiliary Tank • High Efficiency Clothes Washer • Solar Pool Heater
Space & Water Heating	<ul style="list-style-type: none"> • Combination Water Heater/Furnace 	<ul style="list-style-type: none"> • Combination Water Heater/Boiler (Condensing) 	<ul style="list-style-type: none"> • Combination Water Heater/Boiler (Non-Condensing)
Building Envelope	<ul style="list-style-type: none"> • Double Glazing Low Emissivity Windows • Improved Roof/Ceiling Insulation • Integrated Building Design 	<ul style="list-style-type: none"> • Triple Glazing Low Emissivity Windows • Improved Below-Grade Insulation 	<ul style="list-style-type: none"> • Improved Wall Insulation • Air Sealing
Space Heating Conditioning	<ul style="list-style-type: none"> • Packaged Absorption Chiller/Heater with Fan Coil 	<ul style="list-style-type: none"> • Gas Fired Absorption Heat Pump 	<ul style="list-style-type: none"> • Direct-Fired Absorption Chiller/Heater
HVAC Controls	<ul style="list-style-type: none"> • EMS Install • Retrocommissioning 	<ul style="list-style-type: none"> • EMS Optimization • Commissioning 	<ul style="list-style-type: none"> • Zoning • Programmable Thermostat
Space Conditioning	<ul style="list-style-type: none"> • Desiccant Dehumidifier/Air Conditioner • Engine-Driven Chiller 	<ul style="list-style-type: none"> • High-Efficiency Gas-Fired Rooftop Unit • Double-Effect Absorption Chiller 	<ul style="list-style-type: none"> • Packaged Absorption Chiller • Micro Channel Heat Exchangers
Cooking	<ul style="list-style-type: none"> • High Efficiency Gas Griddle • High Efficiency Gas Conveyer Oven • Power Burner Range 	<ul style="list-style-type: none"> • High Efficiency Gas Combination Oven • High Efficiency Gas Rack Oven • High Efficiency Fryer 	<ul style="list-style-type: none"> • High Efficiency Gas Convection Oven • High Efficiency Gas Boiler • High Efficiency Gas Steamer
Space Heating	<ul style="list-style-type: none"> • High Efficiency Furnace • High Efficiency Steam Boiler • Insulate Unconditioned Basement/Crawl Space Piping • Stack Heat Exchanger • Boiler Heating Pipe Insulation • Boiler Tune-up • Destratification Fans • Exhaust Hood – Demand Ventilation 	<ul style="list-style-type: none"> • High Efficiency Hot Water Boiler • Gas Unit Heater – Power Vented • Gas Unit Heater – Condensing • Heat Recovery from Air to Air • Boiler Reset Controls • Boiler O2 Trim Controls • Boiler Parallel Positioning • Demand Controlled Ventilation 	<ul style="list-style-type: none"> • Condensing Boiler • Insulate and Seal Ducts • Infrared Heater • Ceiling Insulation • Boiler Blowdown Heat Exchanger • Repair/Replace Malfunctioning Steam Traps • Insulate Steam Lines/Condensate Tank • Direct Gas-Fired AHU

Commercial Buildings Sector Methodology



For Each Commercial Building Type:

Technical Potential of Each Measure =

Total End Use Energy Sales

x Base Case Factor (measure applicability)

x Remaining Factor (not yet converted)

x Applicability Factor (technically feasible)

x Savings factor (% savings)

Total Technical, Economic & Achievable Potential

■ Technical Potential

- Technically feasible measures sorted from lowest to highest levelized cost (or TRC) to capture measure interactions
- Savings summed for all measures assuming complete saturation

■ Economic Potential

- Using the GDS Benefit/Cost model, TRC test results are calculated for each measure based on per measure savings, considering measure interactions.
- Measures with $TRC < 1.0$ are removed from the analysis
- Technically feasible measures are sorted from lowest to highest TRC values
- Savings summed for all measures assuming complete saturation

■ Achievable Potential

- Estimate achievable long term penetration rates based on expected program marketing efforts, incentive levels, industry experience, market barriers and market conditions
- Apply achievable long term penetration rates and natural equipment replacement rates for market driven measures to determine achievable economic potential over the study horizon
- GDS Model has capability to utilize various ramping methods for long-term participation, such as straight line or S-Curve.

Key Commercial Model Inputs

Input

Typical Sources

Commercial Sales by Building Segment

Utility Sales Forecasts, U.S. Energy Information Administration

End-Use Allocation by Building Segment

U.S Energy Information Administration - Commercial Buildings Energy Consumption Survey, Other Potential Studies from Michigan & Neighboring States

Measure Life and Cost

Measure Savings Factor

Measure Costs

Michigan Energy Measures Database, other recent potential studies, reports, papers, calculation tools and documents from sources such as: DOE, EPA, Energy Star, Lawrence Berkley National Lab, Energy Efficiency Organizations, Utilities, ACEE, FEMP, Equipment

Base Case Factor

Manufacturers and Suppliers

Remaining Factor

Applicability Factor



Commercial Model Outputs

- Technical, Economic and Achievable Potential
 - By Building Type
 - By End Use
 - By Building Type and End Use
- Installed Units for each Measure
 - GDS Benefit-Cost Model Inputs
 - Used to Determine Incentive Budget
 - Bundled by Program to Create Program Budgets
- Total Installed Measure Costs
- Measure Related MMBTU Impacts



Industrial Sector Energy Efficiency Potential

- Define Major Industries in Terms of Energy Use (Adjust for Current Economic Situation)
- Characterize Major Energy End Uses For Each Industry
- Determine Applicable Best Practice EEMs
- Analyze Technical EE Potential
- Apply Economic Analysis to Determine Economic EE Potential
- Determine Achievable EE Potential Given Market Barriers



Industrial Sector Resources

- State of Michigan Department of Energy, Labor and Economic Growth
- Michigan Economic Development Corporation
- Michigan Industrial Energy Center
- DOE/EERE Industrial Technologies Program
- Industrial Assessment Centers Database
- American Council for an Energy-Efficient Economy: Industrial Sector Pages
- Midwest Energy Efficiency Alliance
- Clean Energy Coalition



State of Michigan, Public Service Commission

RENEWABLE POTENTIAL STUDY OVERVIEW



State of Michigan, Public Service Commission

DISCUSSION OF DATA REQUESTS

Data Requests

■ Recent Potential Studies

- Detroit Edison Company (2010)
- Midwest Energy Efficiency Alliance (2006)

■ Market Assessment/Baseline Studies

- State-Administered (*Residential, Commercial, Electric, Natural Gas*)
- Detroit Edison (*Residential, Commercial, Electric, Natural Gas*)
- Consumers Energy (*Residential, Electric, Natural Gas*)

■ Load Forecasts

■ Avoided Costs



State of Michigan, Public Service Commission

TIMELINE & MAJOR MILESTONES

Project Milestones

Overall Project Schedule for DTMB Energy Efficiency/Renewable Energy Potential Study Project																										
Milestone	Task Description	Weeks From Contract Start Date																								
		5/13	5/20	5/27	6/3	6/10	6/17	6/24	7/1	7/8	7/15	7/22	7/29	8/5	8/12	8/19	8/26	9/2	9/9	9/16	9/23	9/30	10/7	10/14	10/21	10/28
1	Attend Project Kick-Off Meeting and Prepare Final Scope of Work, Budget and Project Schedule	X																								
2	Develop list of energy efficiency and renewable energy measures to be included in the study																									
3	Develop baseline profiles for energy efficiency and renewable energy measures																									
4	Develop EE measure costs, savings and useful lives; develop costs and production estimates for renewable energy alternatives																									
5	Conduct benefit/cost analysis of energy efficiency measures; screen renewable energy alternatives for cost effectiveness																									
6	Develop estimates of energy efficiency potential by measure by market segment; develop estimates of renewable energy potential by type of alternative																									
7	Complete draft EE report and draft renewable energy potential report																									
8	Complete final EE report and final renewable energy potential report																									
9	Present study results to DTMB management																									

Contact Information:

Dick Spellman
(GDS)

- dick.spellman@gdsassociates.com
- (770) 799-2340

Robert Fratto
(GDS)

- bob.fratto@gdsassociates.com
- (207)221-2565

Jeffrey Huber
(GDS)

- jeffrey.huber@gdsassociates.com
- (770) 799-2339

Mike Kingsley
(SAIC)

- kingsleym@saic.com
- (315) 437-1869

Shawn Carraher
(La Capra)

- scarraher@lacapra.com
- (978) 944-3843