



Maine Electricity and Waste Sector Overview

The Center for Clean Air Policy
January 28, 2004

Goals for EW Sectors

- Recommend GHG inventory for 1990
- Recommend GHG baselines for 2010, 2020
- Recommend mitigation options for analysis
- Assist CCAP with options analysis
- Recommend alternative policy designs to achieve consensus, assist with development
- Provide clear understanding of choices and recommendations for *data sources, methods and assumptions*

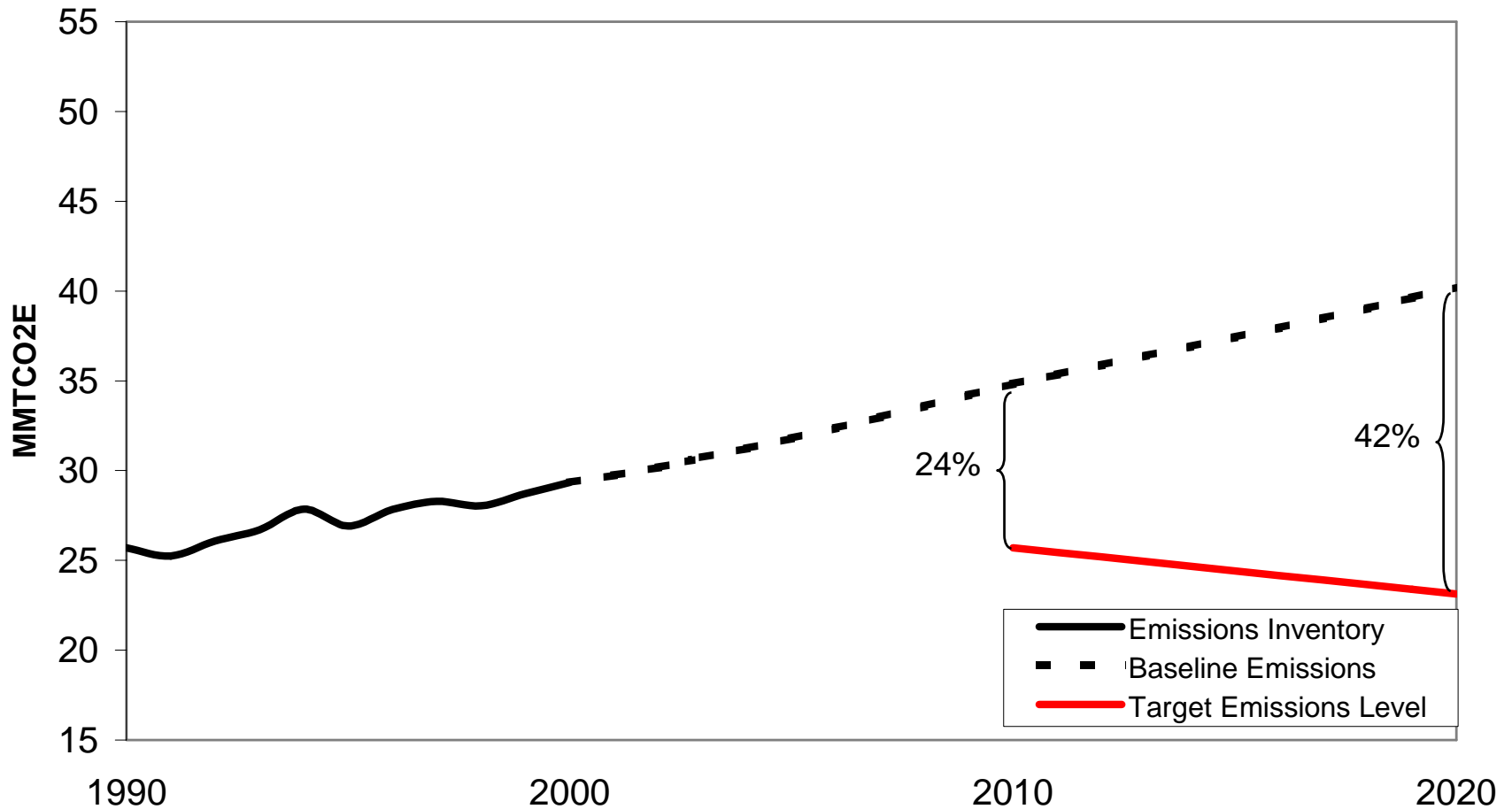
Current Status of EW Goals

- Maine DEP and NESCAUM provided draft inventory for EW for SAG review
- CCAP provided draft, initial baselines for EW for SAG and WG discussions
- Stakeholders provided first cut of potential mitigation options for further review by WG and first cut analysis by CCAP

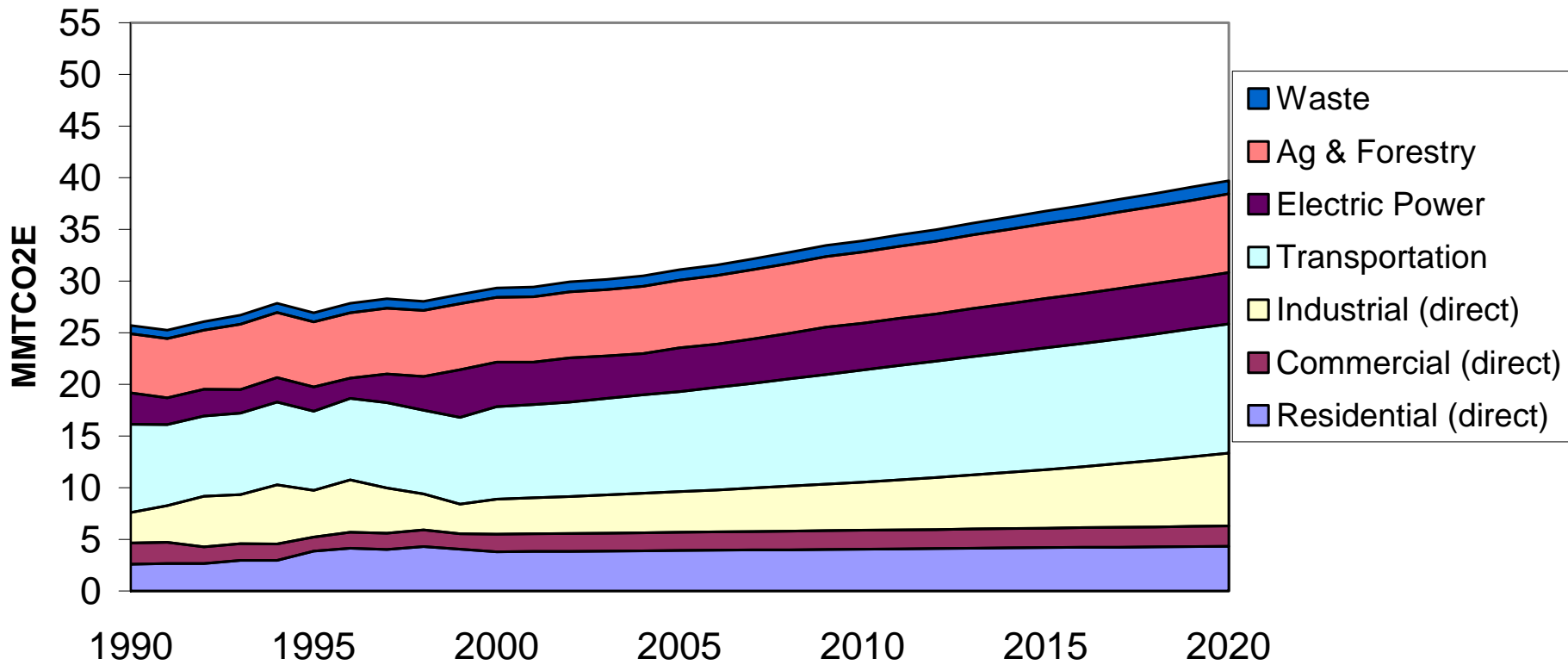
Meeting Agenda for Working Group

- Present and review updated NESCAUM inventory
 - Identify key data issues, next steps for ME DEP
- Present and review updated CCAP baselines
 - Identify key data issues, next steps for CCAP
- Present and review SAG options
 - Identify new or revised options for analysis
 - Discuss work plan for CCAP analysis of options
 - Individual options assessment (data, methods, assumptions)
 - Modeling needs

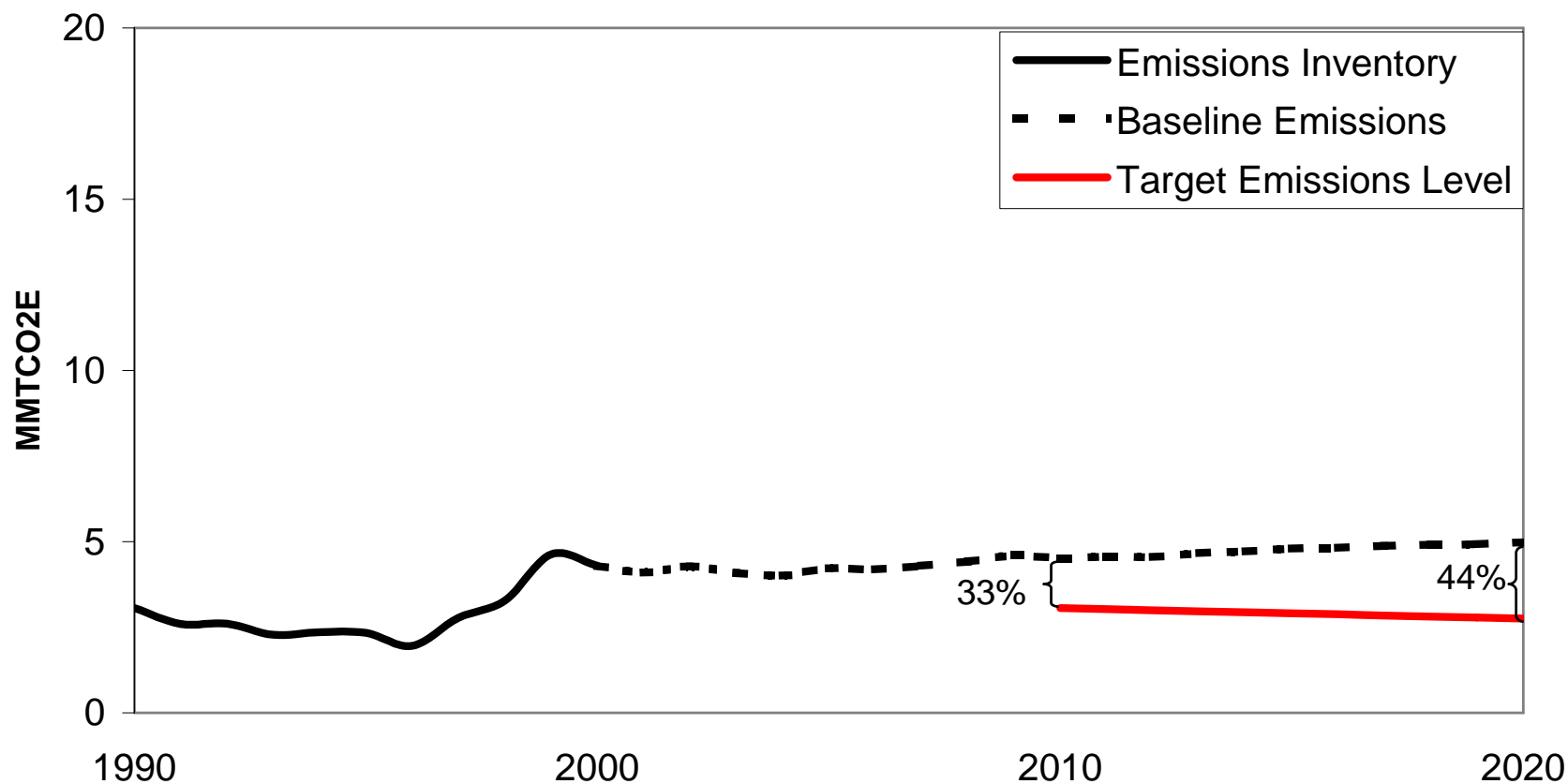
All Sector Baseline & Target



All Sector Baseline



Electricity Inventory 1990-2000



Note: Target level is for illustrative purposes only, and does not represent a mandated target. Target line assumes targets of 1990 sector levels by 2010, 10% below 1990 in 2020

Electricity Inventory 1990-2000

CO2 Emissions (MMTCO2e)	
Electric Power	
1990	3.1
1991	2.6
1992	2.6
1993	2.3
1994	2.4
1995	2.3
1996	2.0
1997	2.8
1998	3.3
1999	4.6
2000	4.3



Electricity Inventory: Sources of Data

- EIA's Electric Power Annual 2001.
 - EIA 2001 State Data:
http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdsh ts.html

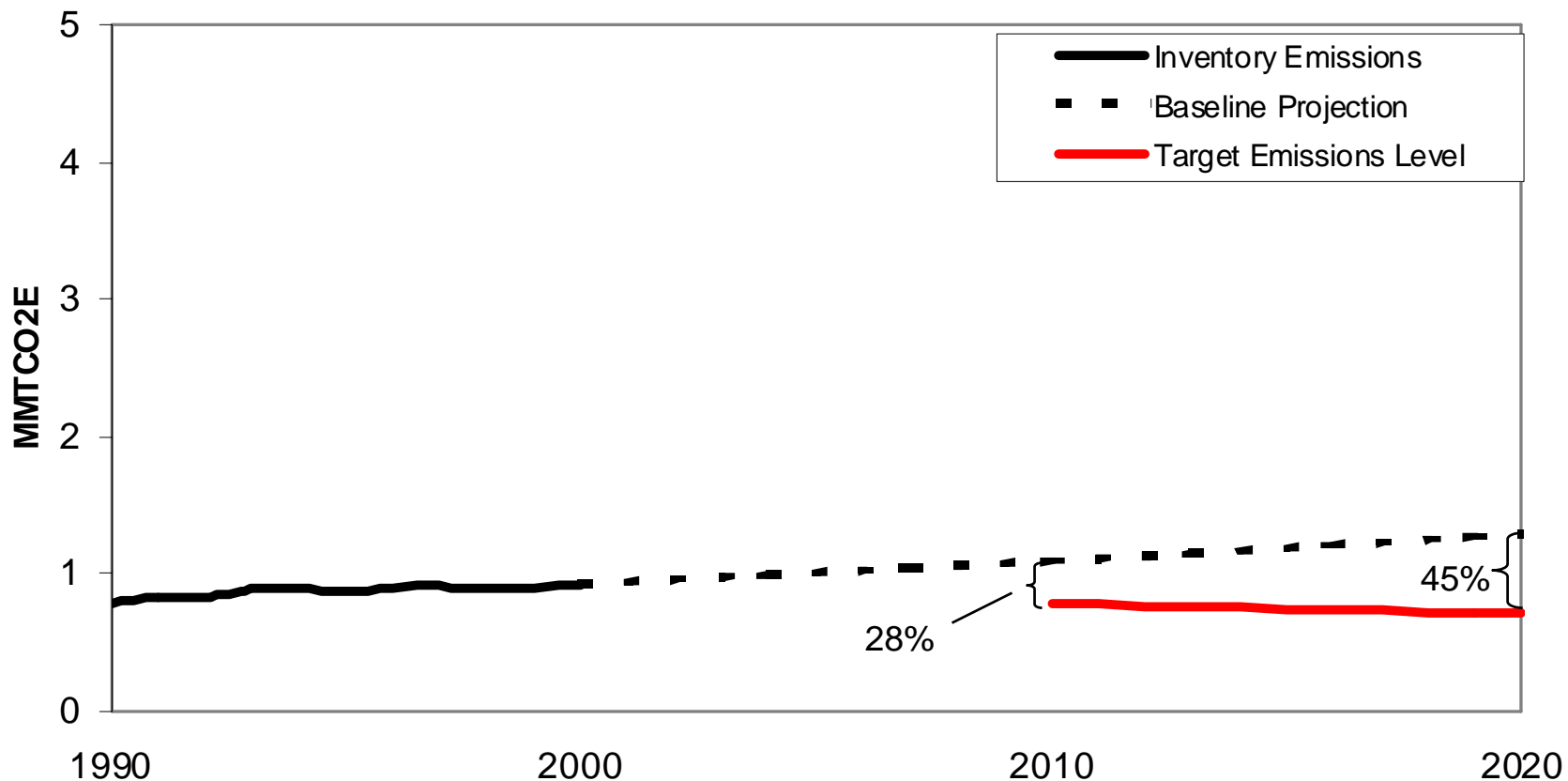
Electricity Inventory: Methodology

- Emission estimates developed by NESCAUM from EIA annual fuel consumption data through application of emission factors.
- 1990 – 2000 inventory reflects total production of electricity in Maine. Does not include potential impact of interstate transmission flows i.e. is not consumption- or demand-based.

Electricity Inventory: Methodology (cont.)

- Data indicates that imports and exports of power in Maine were significant from 1990 - 2000.
- If consumption-based standard is selected for forecast baseline (2000 – 2020), inventory may require adjustment for consistency.

Waste Inventory 1990-2000



Note: Target level is for illustrative purposes only, and does not represent a mandated target.
Target line assumes targets of 1990 sector levels by 2010, 10% below 1990 in 2020

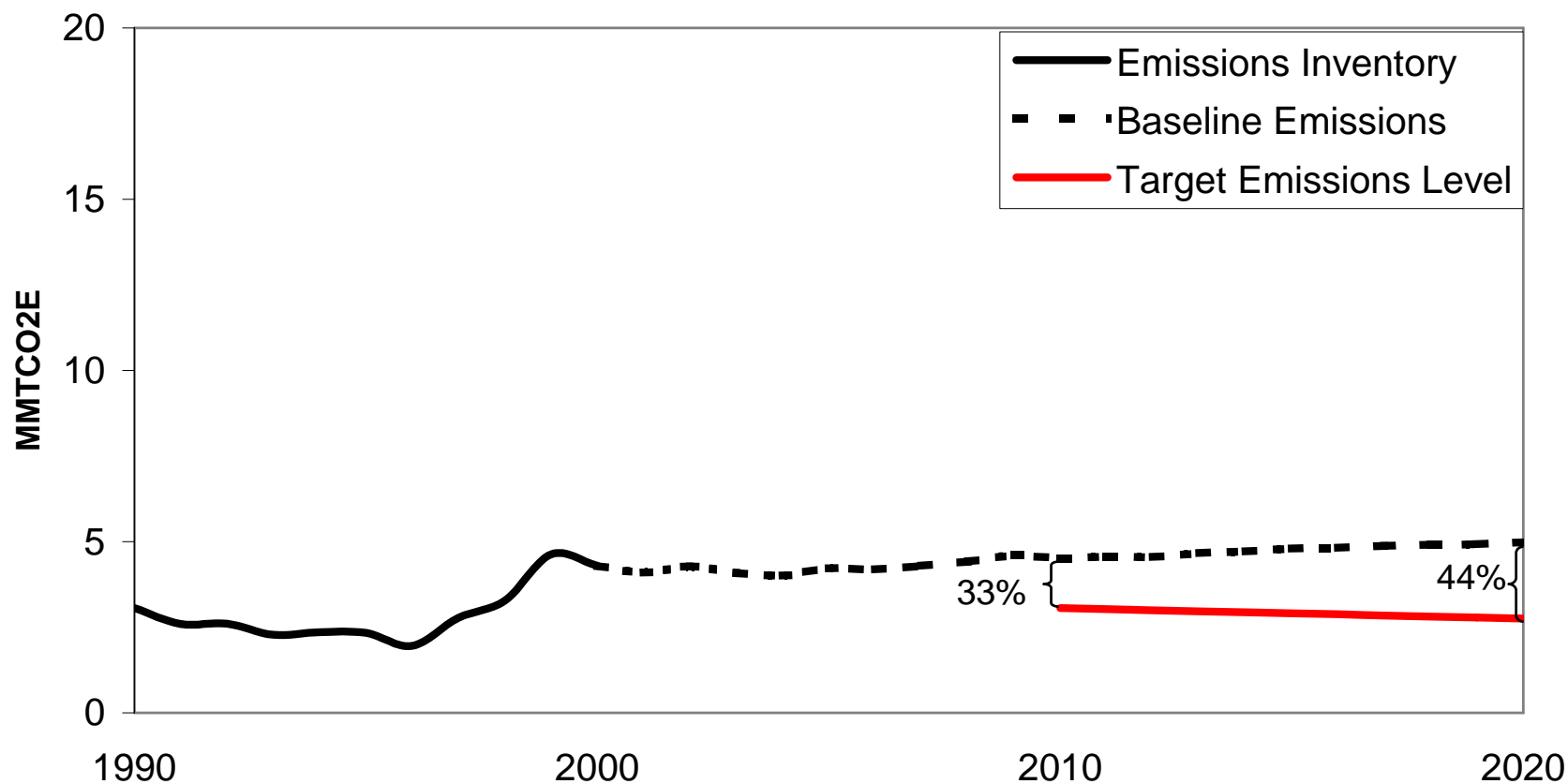
Waste Inventory 1990-2000

CO2 Emissions (MMTCO2e)	
Waste	
1990	0.79
1991	0.83
1992	0.83
1993	0.89
1994	0.89
1995	0.87
1996	0.90
1997	0.91
1998	0.89
1999	0.90
2000	0.93

Waste Inventory: Sources of Data

- Developed by NESCAUM using the US EPA Inventory tool and state-specific information.
- Sources of waste emissions in inventory were landfills and waste combustion (about 89%) and wastewater (about 11%).

Electricity Baseline 2000-2020



Note: Target level is for illustrative purposes only, and does not represent a mandated target. Target line assumes targets of 1990 sector levels by 2010, 10% below 1990 in 2020

Electricity Baseline 2000 - 2020

CO2 Emissions (MMTCO2e)	
Electric Power	
2000	4.3
2001	4.1
2002	4.3
2003	4.1
2004	4.0
2005	4.2
2006	4.2
2007	4.3
2008	4.4
2009	4.6
2010	4.5


CO2 Emissions (MMTCO2e)	
Electric Power	
2011	4.6
2012	4.6
2013	4.7
2014	4.7
2015	4.8
2016	4.8
2017	4.9
2018	4.9
2019	4.9
2020	5.0

Electricity: Key Baseline Assumptions

- Developed from fuel consumption estimates provided by National Emissions Modeling System (NEMS)
- Annual Energy Outlook's regional energy demand and economic growth forecasts based on
 - Delivered price of energy
 - Availability of renewable energy and existing state renewable portfolio standards
 - Changes in efficiency of energy use due to advanced technology
 - No new federal programs or spending (no Clear Skies)
 - Nuclear units relicense when economic but uprate based on exogenous determination (i.e. current plans, EIA and NRC surveys)
 - Natural gas prices determined within model

Electricity: Key Baseline Methodology (Preliminary)

- NEMS provides annual fuel consumption data through 2020 for entire Northeast region.
- Regional CO₂ emissions were estimated by applying standard EIA fuel input emission factors to each category of fuel consumed.
- Regional emissions were apportioned to Maine using the share of Maine CO₂ emissions in year 2000 for the region (estimated from the EPA EGRID database).



Electricity: Key Baseline Methodology (Potential)

- Use of NEMS model for forecasting emissions and impacts will require current baseline to be replaced by model results in reference case
- Use of consumption-based standard will also require baseline revision.



Electricity Baseline: Key Issues for Resolution

- Use of production versus consumption standard
- Use of NEMS model for forecasting impact of mitigation options

Production vs. Consumption Standard

- Production emissions are based on total state electricity generation, estimated by taking 100% of emissions from all electric generating units located within the state.
- Consumption emissions are based on total state electricity demand, and account for exports and imports of power to and from other states or regions.

Production vs. Consumption Standard (cont.)

- Production: Employs direct methodology, allows verification of results (i.e. checking monitored emissions data against fuel use). Is most common method used to estimate national/regional emissions.
- Consumption: Allows state (or region) to estimate and account for emissions associated with in-state electricity use only. Electric grid emissions cannot be traced to specific plants, so no generally accepted estimation method exists. Is appropriate when electricity transmission flows are significant.
- From 1990 - 2000, Maine was a net exporter of electricity in most years, and production emissions typically exceeded the estimated consumption emissions (see next slide).
- It should be noted that the reductions required to meet targets under a consumption standard will vary depending upon level and type (i.e. imports or exports) of annual transmission flows, and may be higher or lower than production-based reductions in future years despite annual historic levels.

Production and Consumption Emissions 1990 - 2000

Maine CO ₂ Emissions (MMTCO ₂ e)				
Year	From Production	From Transmission	From Consumption	% diff
1990	3.1	-0.9	2.2	-29%
1991	2.6	-0.9	1.7	-35%
1992	2.6	-0.7	1.9	-27%
1993	2.3	-0.5	1.7	-24%
1994	2.4	-0.7	1.6	-30%
1995	2.3	0.7	3.0	29%
1996	2.0	-0.4	1.5	-22%
1997	2.8	0.8	3.6	29%
1998	3.3	0.3	3.6	9%
1999	4.6	-0.3	4.4	-6%
2000	4.3	-0.6	3.7	-13%

Forecasting Impacts: NEMS Model

- Forecast model used by EIA for the Annual Energy Outlook.
- NEMS provides results at the regional level, so must be allocated to states.
- **Tellus algorithm for allocation from region to state:**
 - Electricity demand allocated using state share of population (for residential and private transportation) and gross state product (for commercial and industrial sectors and freight transport).
 - Generation, operating costs and emissions (production-based) taken directly from in-state model plants
 - New builds allocated by state share of electricity sales.
- Can estimate production or consumption emissions
- Allows for non-economic preferential dispatch of generating units

Forecasting Impacts: NEMS Model (cont.)

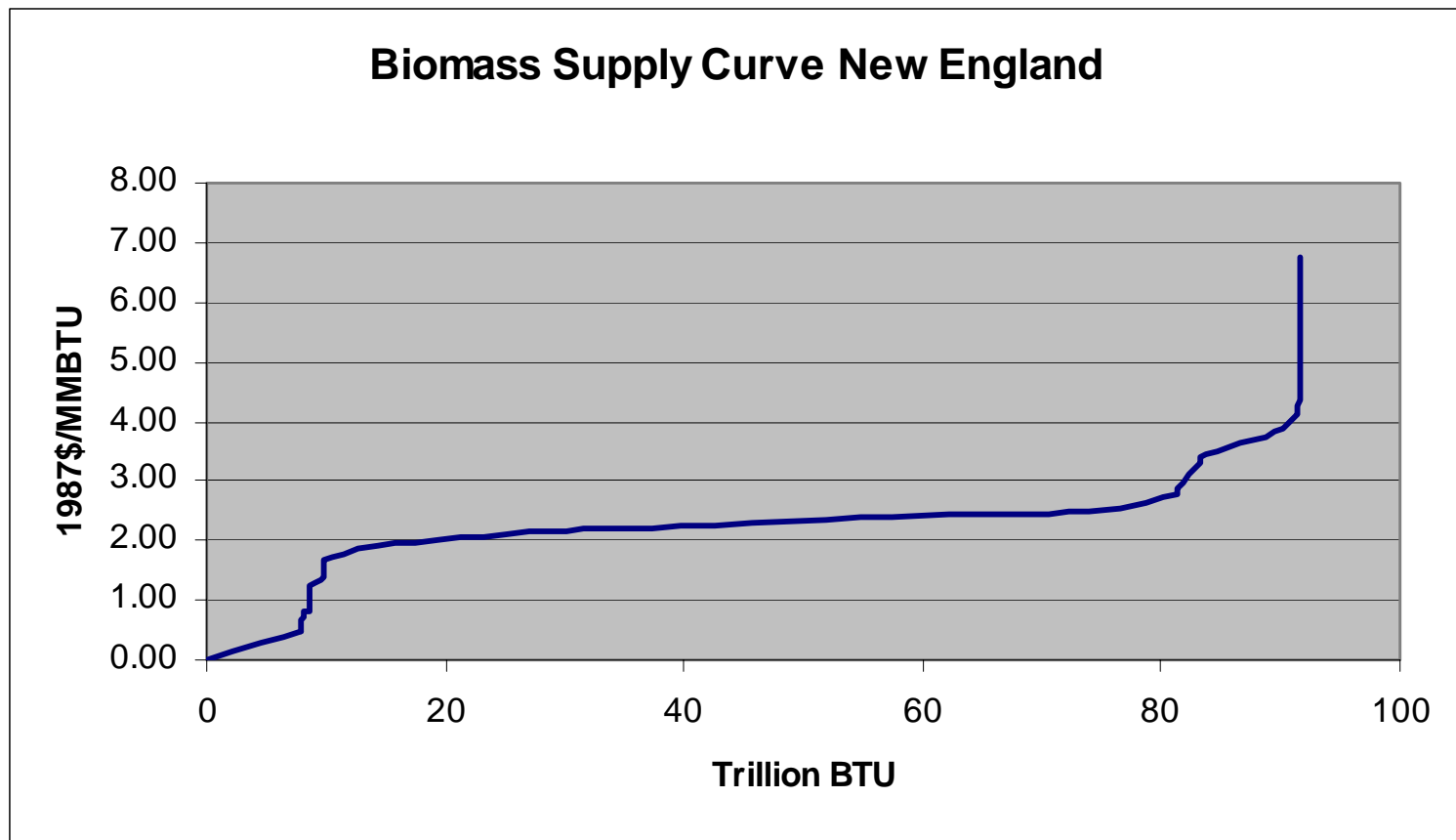
- Captures both primary and interactive/secondary effects (e.g., changes in electricity prices, imports/exports); also captures capacity impacts (e.g., new builds, plant shut-downs).
- Potential limitations: Regional results may introduce uncertainty when allocated to states. Certain specific policy options may also be difficult to model accurately.
- Model assumptions may be varied depending upon stakeholder input, including
 - **Electricity demand**
 - **Biomass and renewable supply, cost and performance**
 - **Natural gas prices**
 - **Inter-state transmission**
 - **Nuclear relicensing and uprating**

NEMS Electricity Demand

Year	New England Electricity Demand (million MWh)
2001	118.8
2002	120.7
2003	121.5
2004	123.8
2005	127.1
2006	130.2
2007	132.9
2008	135.4
2009	137.3
2010	139.2

Year	New England Electricity Demand (million MWh)
2011	141.0
2012	142.9
2013	144.6
2014	146.3
2015	148.3
2016	150.2
2017	152.1
2018	154.1
2019	156.1
2020	158.4
Avg annual growth rate 2001- 2010	1.53%

NEMS Biomass Supply Curve



NEMS Cost and Performance Data

Parameter	Wind	Biomass	Landfill Gas	Combined Cycle	Combustion Turbine
Capital Cost (\$/kW)					
installed 2005	1031	1,602	1,417	466	343
installed 2010	1016	1,466	1,402	461	340
installed 2015	975	1,417	1,387	456	336
installed 2020	932	1,315	1,373	451	332
Availability (%)	39	80	90	87	92
Fixed O&M (\$/kW-yr.)	26	45	10	16	6
Variable O&M (\$/MWh)	0	2.9	0	0	0
Var cost inc fuel (\$/MWh)	0	26	0	26-27	40-41
Typical Size (MW)	50	100	50	50	5

NEMS Natural Gas Prices

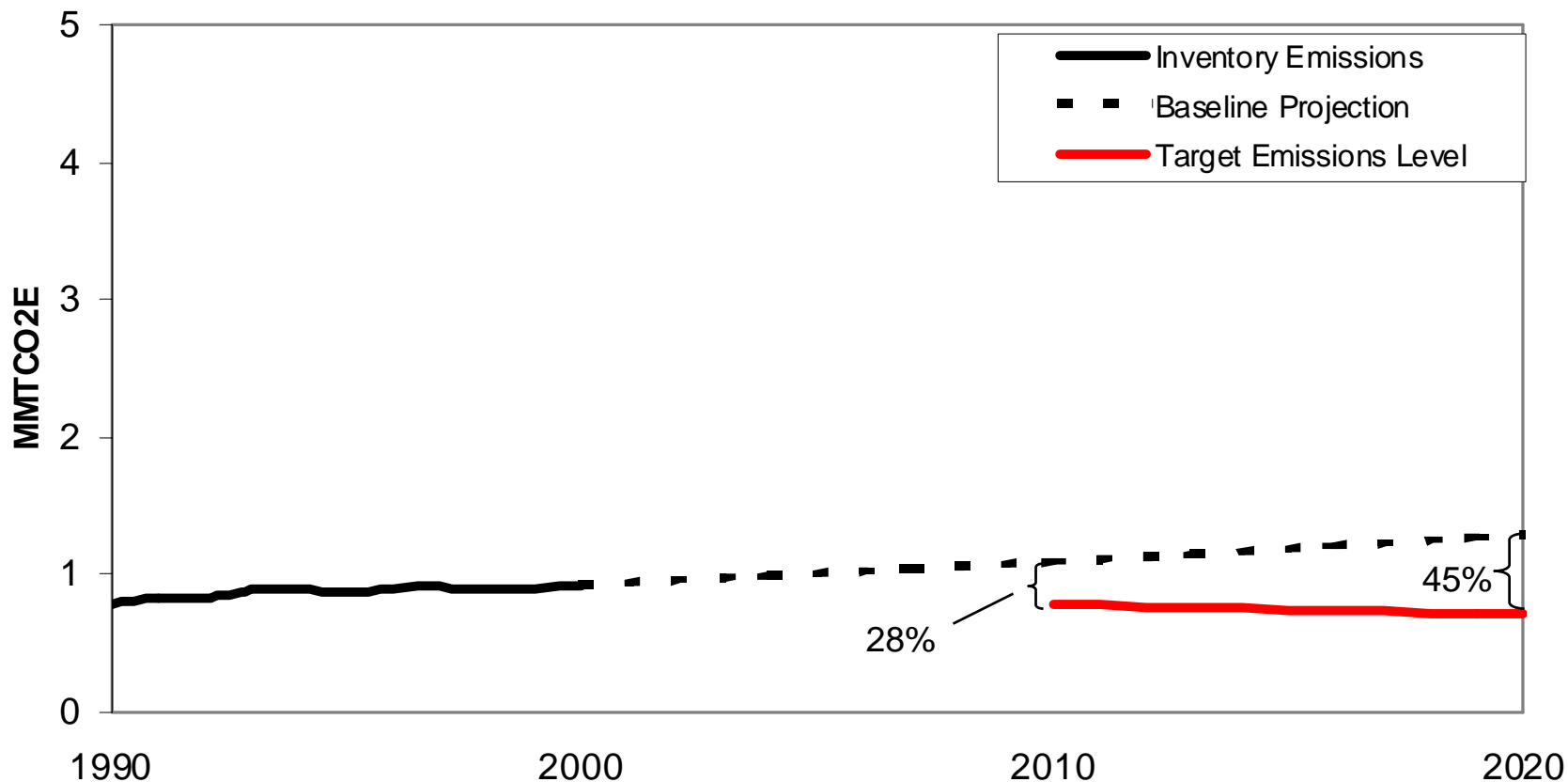
NEMS AEO 2004 Natural Gas Prices (2002 \$ per thousand cubic foot)		
Year	Lower 48 Wellhead Average	New England Electricity Sector Delivered
2001	\$ 4.14	\$ 5.01
2002	\$ 2.95	\$ 4.61
2003	\$ 4.90	\$ 6.05
2004	\$ 3.88	\$ 4.86
2005	\$ 3.54	\$ 4.42
2006	\$ 3.48	\$ 4.31
2007	\$ 3.53	\$ 4.41
2008	\$ 3.64	\$ 4.53
2009	\$ 3.47	\$ 4.51
2010	\$ 3.40	\$ 4.53

NEMS AEO 2004 Natural Gas Prices (2002 \$ per thousand cubic foot)		
Year	Lower 48 Wellhead Average	New England Electricity Sector Delivered
2011	\$ 3.56	\$ 4.67
2012	\$ 3.75	\$ 4.82
2013	\$ 3.93	\$ 5.01
2014	\$ 4.01	\$ 5.20
2015	\$ 4.19	\$ 5.25
2016	\$ 4.22	\$ 5.33
2017	\$ 4.23	\$ 5.34
2018	\$ 4.17	\$ 5.35
2019	\$ 4.13	\$ 5.29
2020	\$ 4.28	\$ 5.26
Avg annual growth rate (2001-2020)	0.17%	0.25%

Electricity Baseline: Next Steps

- Select production- or consumption-based standard
- Confirm assumptions to be used in NEMS

Waste Baseline 2000 - 2020




Note: Target level is for illustrative purposes only, and does not represent a mandated target.
Target line assumes targets of 1990 sector levels by 2010, 10% below 1990 in 2020

Waste Baseline 2000 - 2020

CO2 Emissions (MMTCO2e)	
Waste	
2000	0.93
2001	0.95
2002	0.96
2003	0.98
2004	0.99
2005	1.01
2006	1.03
2007	1.04
2008	1.06
2009	1.08
2010	1.10

CO2 Emissions (MMTCO2e)	
Waste	
2011	1.12
2012	1.13
2013	1.15
2014	1.17
2015	1.19
2016	1.21
2017	1.23
2018	1.25
2019	1.27
2020	1.29



Waste: Key Baseline Methodology (Preliminary)

- Developed from emission estimates for waste sector estimated for inventory.
- Historical growth rate for 1990 – 2000 applied to 2000 value to develop future estimates



Waste: Key Issues for Resolution

- Accounting for imports or exports of waste



Waste: Next Steps

- Develop methodology to account for waste imports/exports as needed

Electricity: Revisions to 12/17 Version

- Inventory: Initial emission estimates from Electric Power Annual updated with NESCAUM estimates based on EPA 2001 data
- Baseline: 2000 – 2020 baseline developed from IPM Clear Skies reference case replaced
- Baseline: List of IPM assumptions deleted

Waste: Revisions to 12/17 Version

- Replaced state default data in EPA Inventory Tool with data provided by NESCAUM.



Electricity: Further Potential Adjustments

- Inventory: May be updated depending upon release of Electric Power Annual 2002 state-level data.



Waste: Further Potential Adjustments

- None anticipated



Electricity and Waste Sector Options

- See EW Assumptions document