BAQ 2010 Singapore, 9 – 11 November 2010
Breakout Session: Energy Efficiency and Emissions from Industry

Emission Standards for Stationary Sources
An Overview

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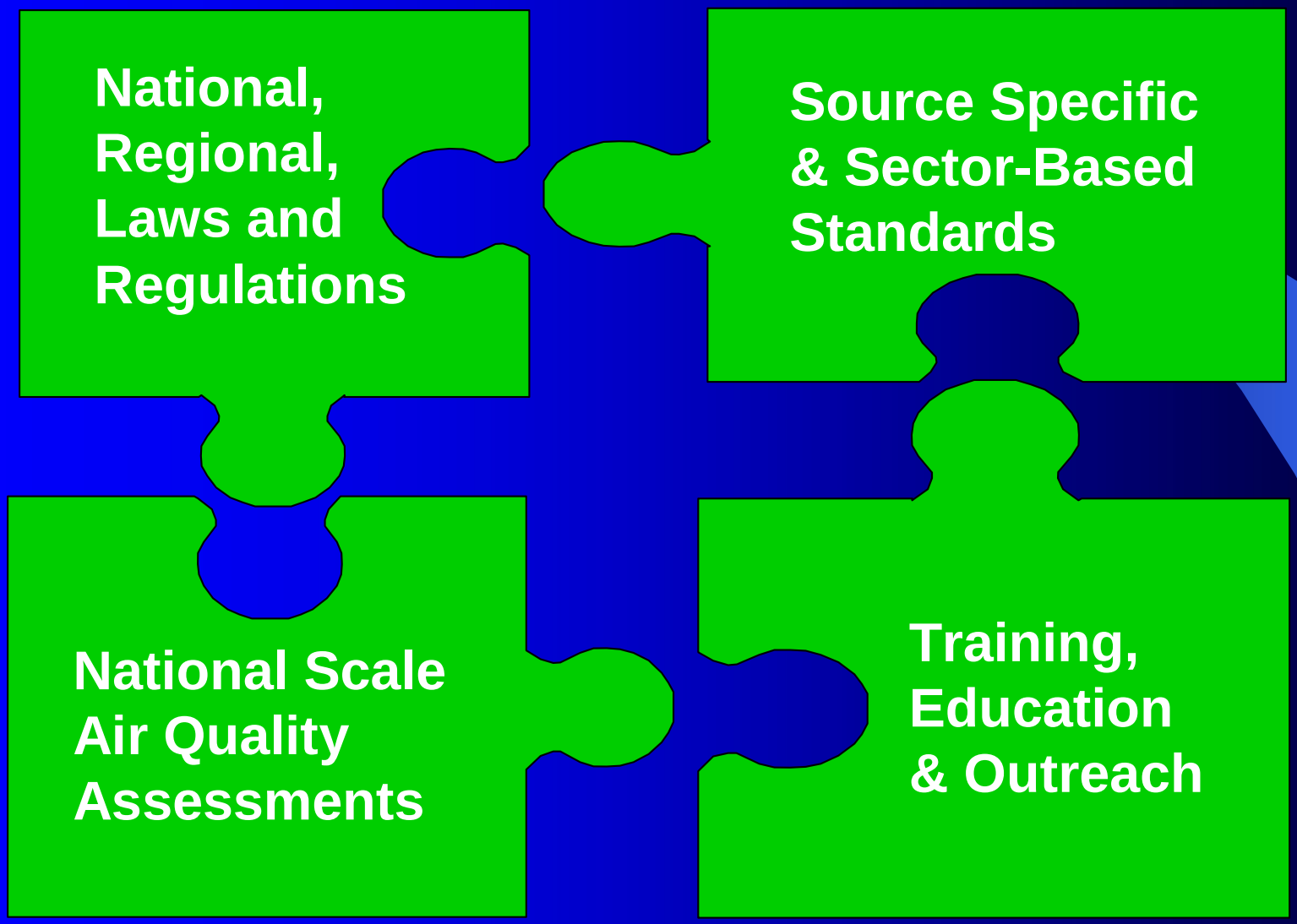
AIR & WASTE MANAGEMENT
ASSOCIATION
SINCE 1907

Pillars of Stationary Source Emission Controls



Control Strategies: Menu of Approaches

- Legally binding emission standards
- Energy efficiency requirements
- Mandatory industrial fuel standards
- Operational restrictions via permitting
- Imposition of work standards including inspection and maintenance
- Public-private partnerships and signing of voluntary agreements with industry sectors

General Considerations When Devising Emission Limits

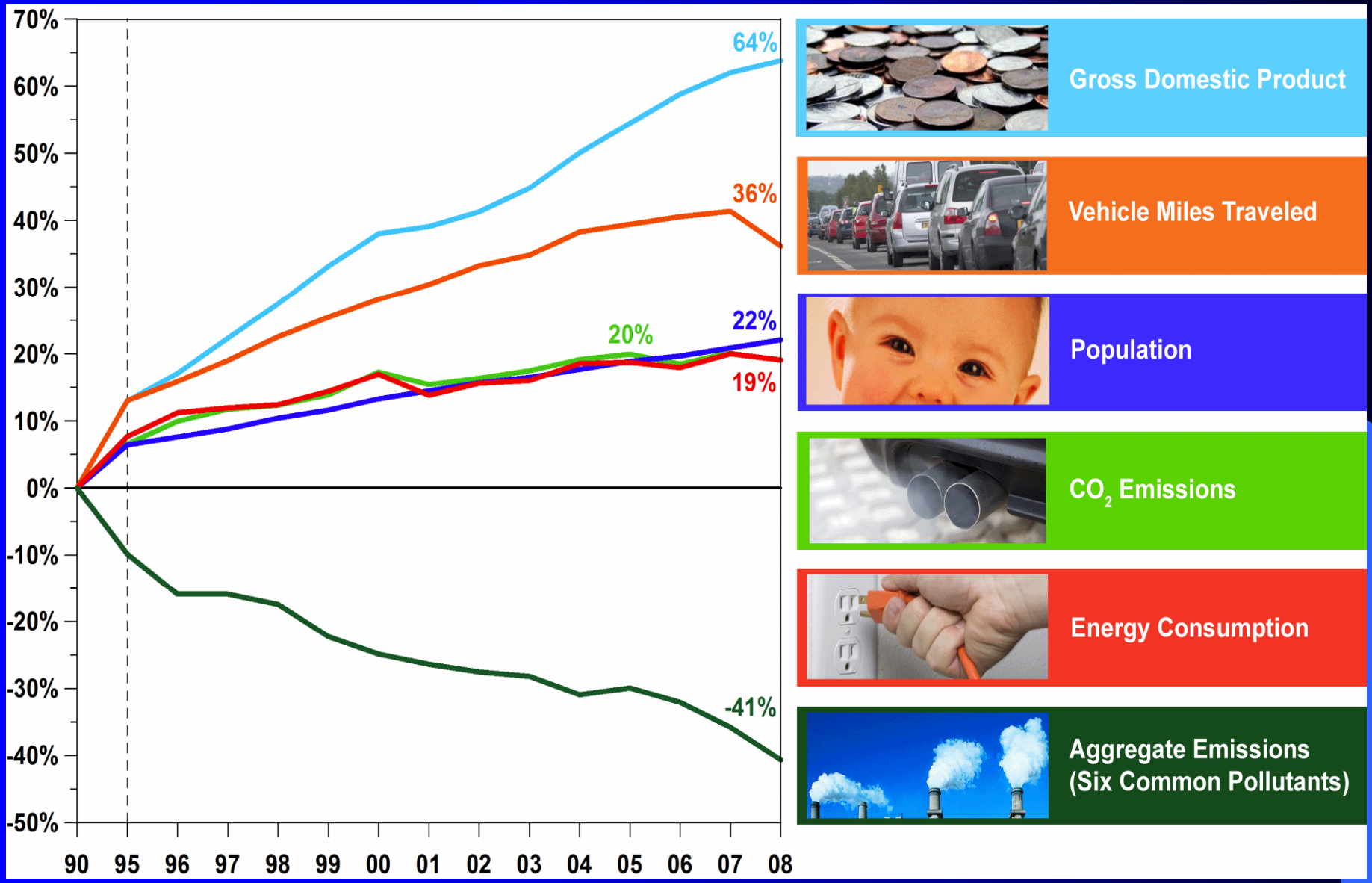
- Magnitude of the Air Pollution problem
- Ambient air quality targets defining "clean air"
- Applicability to new or existing installations
- Threshold capacity and/or throughput for inclusion
- Comparability of processes or methods of operation used successfully on an industrial scale
- Time needed to implement best available techniques

U.S. Air Quality Planning Process

- **Federal legislation with local implementation**
  - Federal government provides policy frameworks
  - State governments implement programs under national guidance
  - The two levels of government share enforcement responsibilities
- **Advantages**
  - Allows states to account for each state's unique conditions
  - Encourages experimentation with new policies and programs
- **Disadvantages**
  - Creates a complex collection of environmental policies
  - Process may be slow, bureaucratic, and cumbersome
  - Lack of direct accountability to the national government

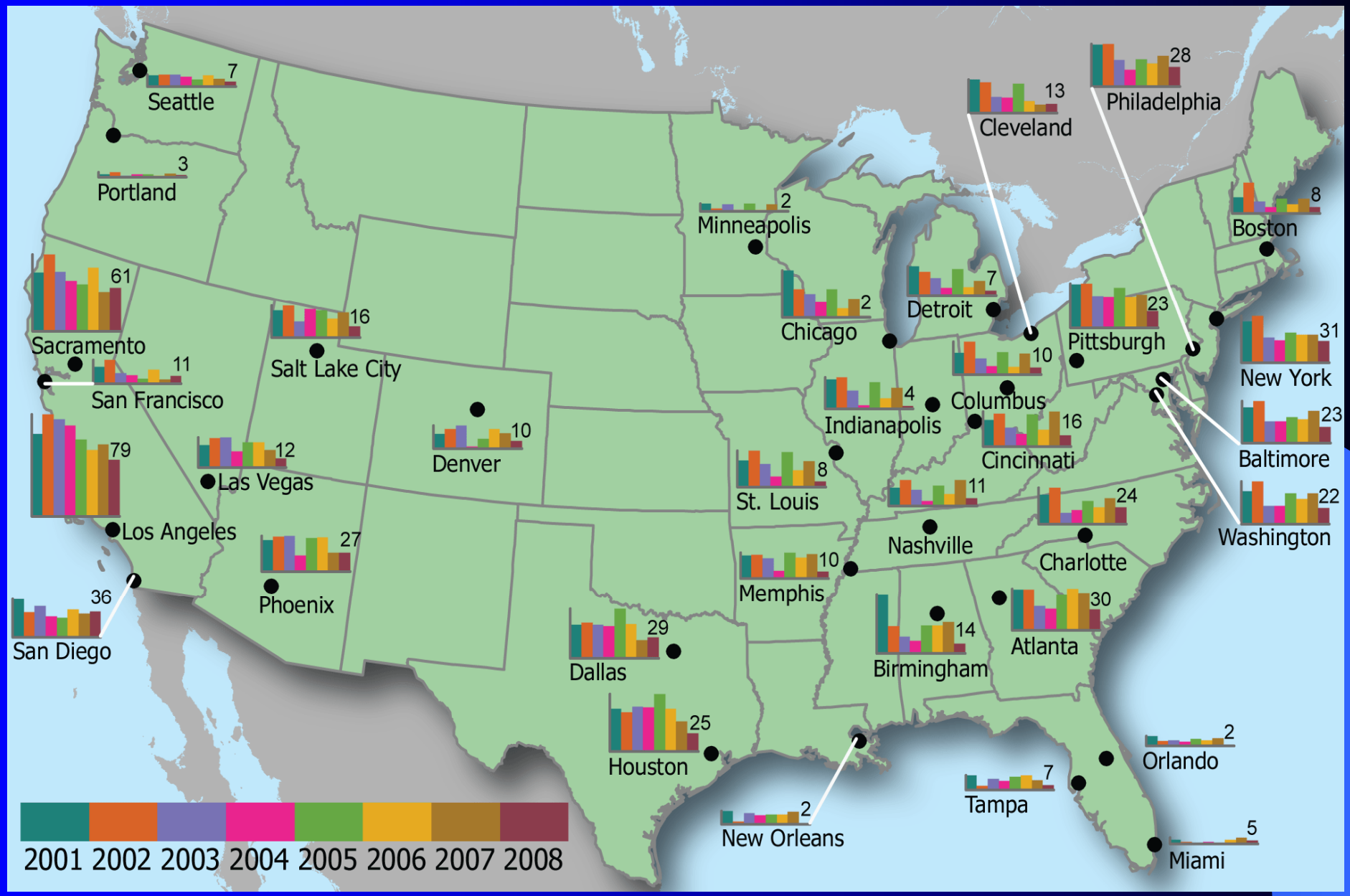
States are accountable for attaining National Ambient Air Quality Standards (NAAQS) through their State Implementation Plan (SIP)

U.S. Key Indicators Trends



Source: U.S. EPA

Trends of Number of Days AQI > 100



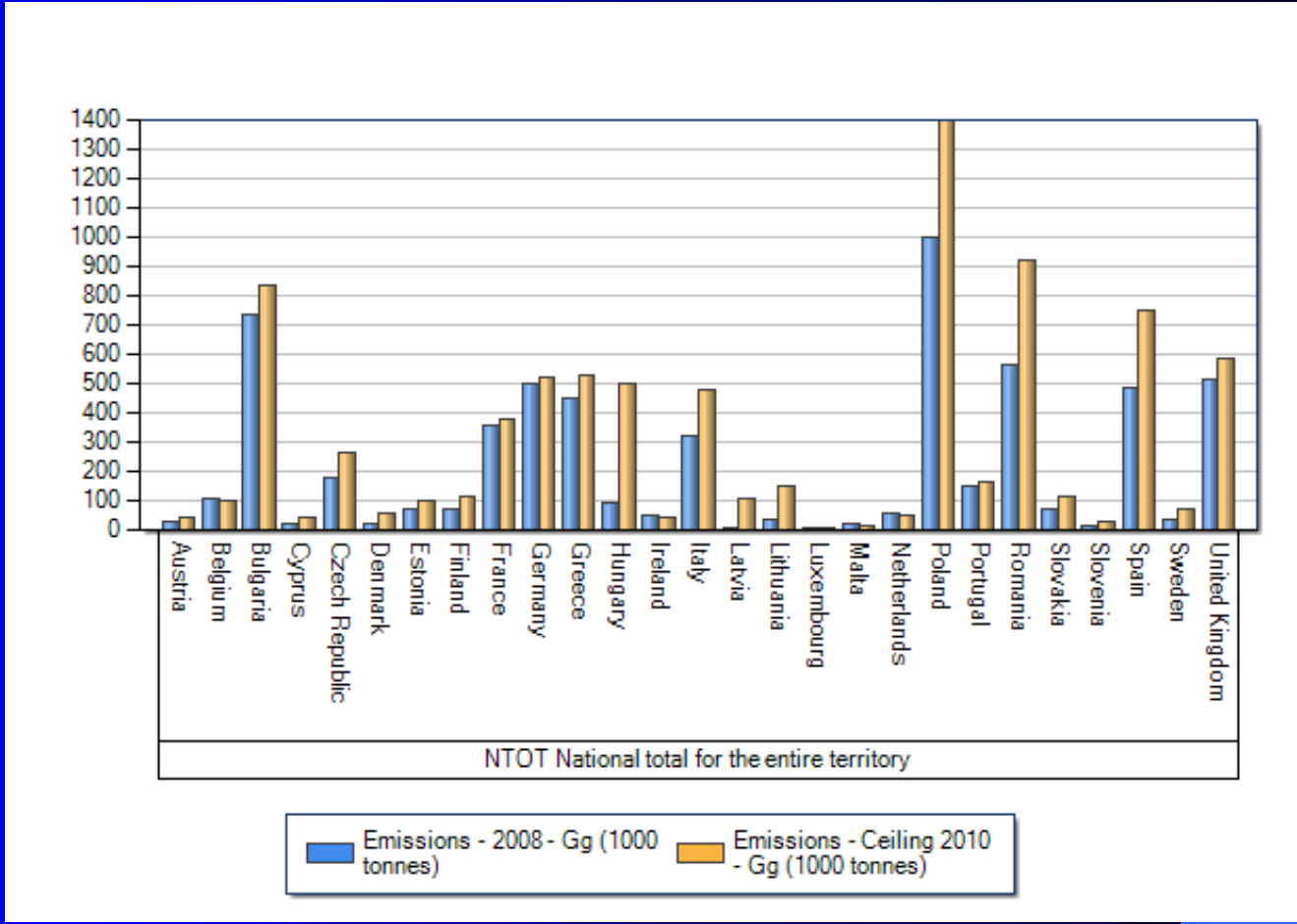
Source: U.S. EPA

EU Air Quality Planning Approach

- EU National Emission Ceilings Directive (NECD, 2001/81/EC)
  - Requires the EU-27 Member States to report annually their emissions and projections
  - Four main air pollutants: SO_2, NO_X, NMVOCs, and NH_3
- Legally binding emission ceilings for each of these pollutants and for each country must be met by 2010
- Target ambient concentrations should be within a limit value plus a margin of tolerance
  - Member States must develop a plan or program for meeting the ambient limit values within a prescribed time period
- Monitoring requirements
  - Ambient air quality monitoring
  - Continuous monitoring (or frequent sampling) of stationary emission sources

EU States SO_2 Emissions Vs. 2010 Emission Ceilings

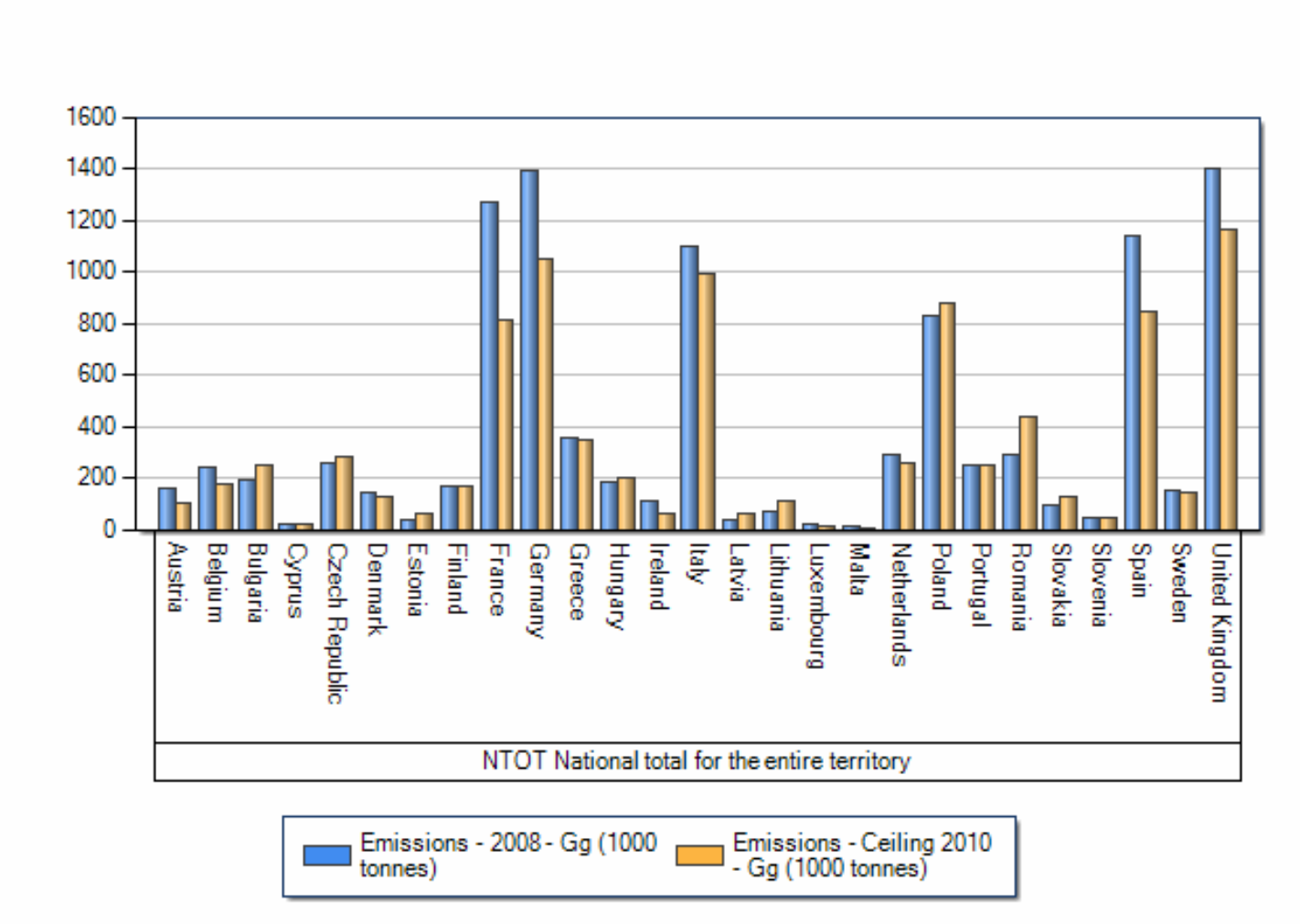
Projected EU-27 SO_2 emissions are 27 % below the ceiling of the NECD for the EU-27 as a whole



Source: EU EEA

EU States NOx Emissions Vs. 2010 Emission Ceilings

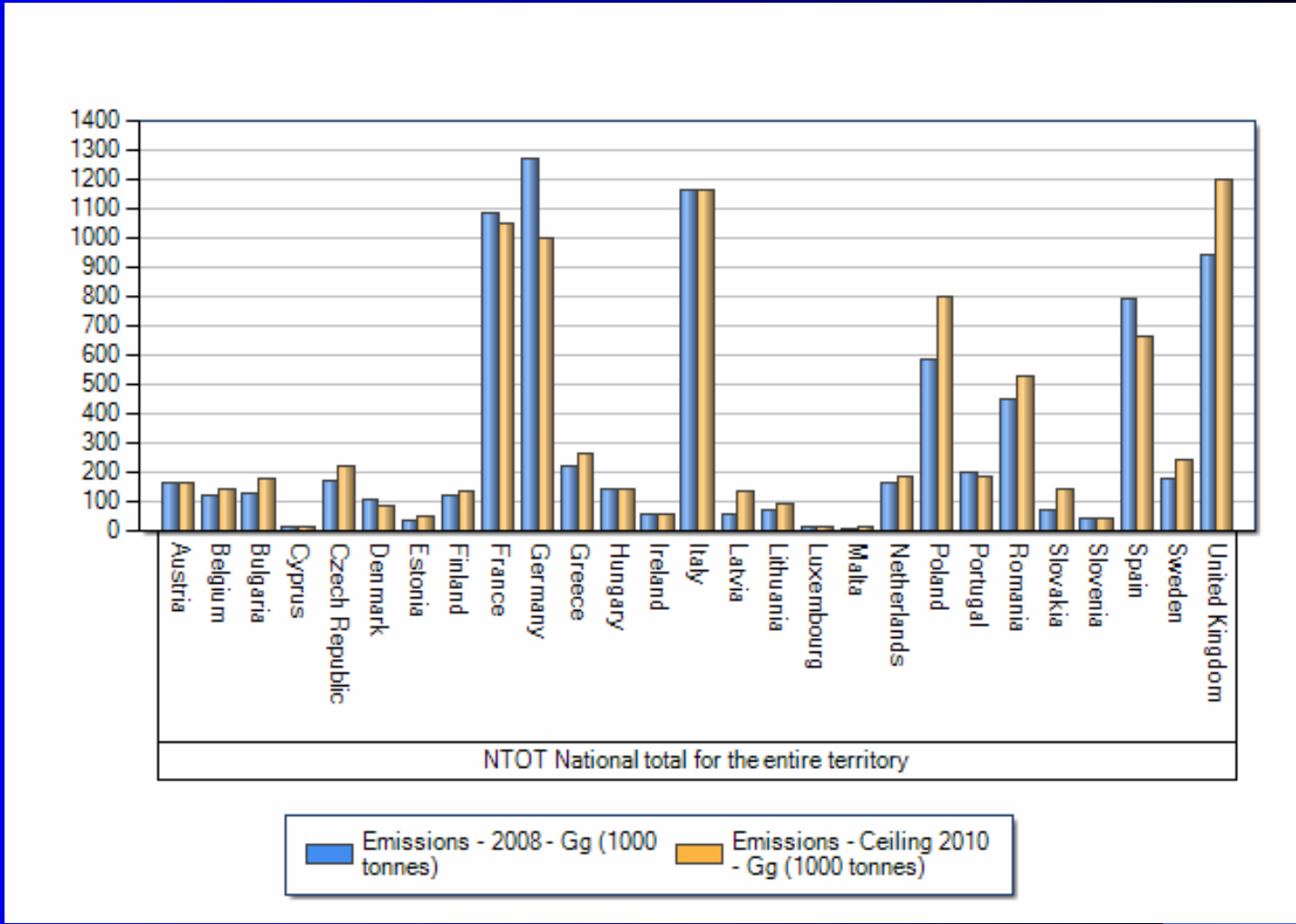
Projected EU-27 NOx emissions are 16 % above the ceiling of the NECD for the EU-27 as a whole



Source: EU EEA

EU States NMVOC Emissions Vs. 2010 Emission Ceilings

Projected EU-27 NMVOC emissions are 5 % above the ceiling of the NECD for the EU-27 as a whole



Source: EU EEA

US vs. EU Air Quality Planning

Key Differences

- The US is a decentralized system of state governments with a powerful national government providing oversight
- The EU is a decentralized system of sovereign nations with a consensus-based commission consisting of representatives from the national governments

Key Challenges

- Overly prescriptive programs may stifle innovation, while programs that are too flexible may not ensure attainment of Clean Air
- The state planning process can be overly bureaucratic and lacking proper resources and emphasis on innovation and tracking progress

Focus on individual pollutants makes it difficult to consider multi-pollutant approaches that may be more effective, both in terms of air quality improvements and compliance costs

U.S. Federal Emission Standards

- New Source Performance Standards ***(NSPS)*** - new construction or major modifications
  - Compound specific emission performance standards and work practices
- National Emission Standards for Hazardous Air Pollutants ***(NESHAP)*** – new and existing industry sectors facilities emitting one or more of the 187 air toxic compounds listed in the clean air act
  - Sectoral performance standards for listed compounds, surrogates, and work practices
  - Maximum Achievable Control Technology ***(MACT)*** for new and existing major sources
  - Generally Achievable Control Technology ***(GACT)*** for new and existing area and urban sources

U.S. EPA New Source Significant Emission Rates (SER)

Pollutant	SER (tpy)	Pollutant	SER (tpy)
Carbon Monoxide	100	Hydrogen Sulfide (H_2S)	10
Nitrogen Oxides	40	Total Reduced Sulfur (Incl. H_2S)	10
Sulfur Oxides	40	Reduced Sulfur Compounds (Including H_2S)	10
PM_{10}	15	Municipal Waste Combustor Organics	3.5×10^{-6}
Ozone	40 (VOCs or NOx)	Municipal Waste Combustor Metals	15
Lead	0.6	Municipal Waste Combustor Acid Gases	40
Fluorides	3	Municipal Solid Waste Landfill Emissions	50
Sulfuric Acid Mist	7		

U.S. States Emission Controls

- State and local control measures
  - Included as part of the State Implementation Plan (SIP) to attain clean air targets
  - Use a menu of approaches including
    - ***RACT***: Reasonably Available Control Technology
    - ***BACT***: Best Available Control Technology
    - ***LAER***: Lowest Achievable Emission Rates
- EPA maintains a clearinghouse with case-specific information on the "Best Available" air pollution technologies
  - Share knowledge among the States
  - Address mainly controls of the emissions of SO_2, NOx, and VOC

Select U.S. New Source Performance Standards for Combustion Sources

Stationary source type	Heat Input Capacity	Fuel	SO_2 Limit Value
Large Industrial boilers	> 100 million BTU/hour	Coal	– *544 grams/ million BTU* – Controlled to 90% below potential concentration
		Oil	– *363 grams/ million BTU* – Controlled to 90% below potential concentration
Mid-size Industrial boilers	≤ 100 million BTU/hour ≥ 10 million BTU/hour	Coal	– *544 grams/million BTU* – Controlled to 90% below potential concentration, or – *272 grams/ million BTU* – Controlled to 50% below potential concentration
Primary smelters (zinc, lead, or copper)	Not specified		0.065 percent by volume
Stationary gas turbines	Heat input capacity > 10 million BTU (10.7 GJ)/hour	Gas or Light Fuel Oil	– 0.015% by volume at 15% oxygen on a dry basis of gases emitted, or – fuels that contains sulfur ≤ 0.8% by weight

EU IPPC Directive

- Integrated Pollution Prevention and Control Directive (2008/1/EC, 15 January 2008)
- Includes measures to prevent or to reduce emissions in the air, water and land
- Public information on the operation of installations, their potential effect on the environment, and applications for permits for new or substantially modified installations
- Emission limit values to be based on the best available techniques,
  - No specification of prescribed techniques or technology
  - Consideration of the technical characteristics of the installation concerned, its geographical location and local environmental conditions.

"best available techniques"

means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.

Select EU Threshold Values

- **Energy industries**
  - Combustion installations with a rated thermal input exceeding 50 MW
- **Production and processing of metals**
  - Ferrous metals including hot-rolling mills: capacity exceeding 20 tonnes of crude steel per hour
  - Ferrous metal foundries: production capacity exceeding 20 tonnes per day
- **Mineral industry**
  - Cement clinker in rotary kilns: production capacity exceeding 500 tonnes per day
  - Lime in rotary kilns: production capacity exceeding 50 tonnes per day
  - Glass manufacture: melting capacity exceeding 20 tonnes per day
  - Melting mineral substances: melting capacity exceeding 20 tonnes per day
  - Ceramic products firing (roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain): production capacity exceeding 75 tonnes per day

Source: Extract from EU IPPC Directive

Electric Power Emission Limits: EU vs. US

Electric output capacity	SO_2 Limit value
50 MW and < 100 MW	Coal and oil: 850 mg/m^3 Gas: 35 mg/m^3
100 MW and < 300 MW	Coal: 200 mg/m^3 Oil: 400 mg/m^3 to 200 mg/m^3 (linear decrease) Gas: 35 mg/m^3
300 MW	Coal and oil: 200 mg/m^3 Gas: 35 mg/m^3

EU

Stationary source type	Heat Input Capacity	Fuel	SO_2 Limit value
Fossil-fuel Electric Power Plants (constructed after 1971 August 14)	Heat input capacity > 250 MMBTU per hour	Coal Oil and Gas	*544 grams/ MMBTU* *363 grams/ MMBTU*
Fossil-fuel Electric Power Plants (constructed after 1978 September 18)	Heat input capacity > 250 MMBTU per hour	Coal	*544 grams/ MMBTU* Controlled to 90% below potential concentration, or *272 grams/ MMBTU* and controlled to 70% below potential concentration
		Oil and Gas	*363 grams/ MMBTU* and controlled to 90% below potential concentration, or 91 grams/ MMBTU

U.S.

IFC EHS Guidelines: Air Emissions and Ambient Air Quality

- The International Finance Corporation (IFC) - an arm of the World Bank Group - issued guidelines in 2007 for air emissions control
- The guideline apply to facilities or projects that generate emissions to air at any stage of the project life-cycle
  - Augmented by sector specific guidance
- The guidelines addresses good international industry practices (GIIP),
  - Emissions of NOx, SO_2, CO, VOCs, PM and metals
  - Emissions of ozone depleters (ODS) and GHGs
  - Stack height guidance
  - Small vs. large combustion facilities
  - Fugitive emissions
  - Monitoring and source testing

Small Combustors Emission Guidelines

- The table is an extract from the IFC Guidelines for Small Combustors (April 30, 2007)
- Guidelines values apply to
  - facilities operating more than 500 hours/year
  - Annual capacity utilization factor of more than 30 %
- Stricter performance levels would be applicable
  - for facilities located in industrial/urban areas with degraded airsheds
  - close to ecologically sensitive areas

Combustion Technology / Fuel	**Emissions Guidelines Nitrogen Oxides (NOx)** (in mg/Nm3 or as indicated)	**Dry Gas, Excess O_2 Content (%)**
Stationary Engines (3MWth – 50MWth)		
Gas	200 (Spark Ignition) 400 (Dual Fuel) 1,600 (Compression Ignition)	15
Liquid	If bore size diameter [mm] < 400: 1460 (or up to 1,600 if justified to Maintain high energy efficiency) If bore size diameter [mm] > or = 400: 1,850	15
Turbine		
Natural Gas =3MWth to < 15MWth	42 ppm (Electric generation) 100 ppm (Mechanical drive)	15
Natural Gas =15MWth to < 50MWth	25 ppm	15
Fuels other than Natural Gas =3MWth to <15MWth	96 ppm (Electric generation) 150 ppm (Mechanical drive)	15
Fuels other than Natural Gas =15MWth to < 50MWth	74 ppm	15

Benefits of Sector-Based Approaches

- **Benefits to Public**
  - Focus efforts on reducing emissions of greatest public health interest
  - Optimize social $ spent
  - Better able to address local concerns
- **Benefits to Industry**
  - Reduce costs of control or over-control in the wrong areas
  - Avoid "stranded" costs associated with piecemeal investment in control equipment for individual pollutants
  - Increase flexibility for adapting to changing economic and environmental conditions
- **Benefits to Regulators**
  - Resolve litigation and eliminate backlog
  - Opportunities for innovation (opportunities to consider comprehensive control strategies that integrate analyses on multi-pollutants)

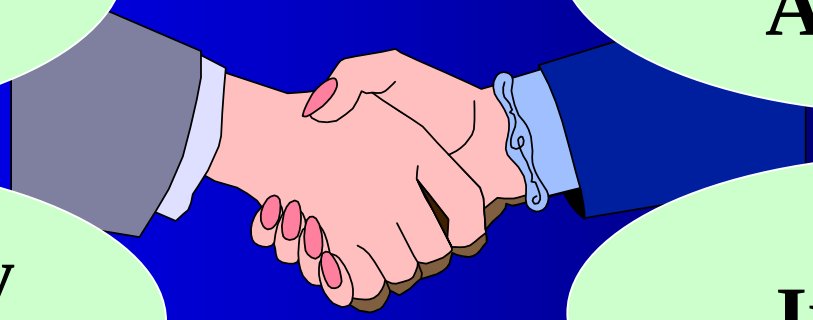
Example of an Integrated Control Approach

- Under NSPS only
  - A new cement facility may consider using a lower cost lime injection system
- Under combined NSPS and NESHAP for HCl and Hg
  - For the same facility the overall most cost-effective control alternative may be a wet scrubber for control of all three pollutants
- Such a multi-pollutant integrated sectoral based approach avoids piecemeal investments in individual control equipment

Meaningful implementation of stationary source control strategies depends on successful partnerships among stakeholders

Regulatory Agency

State/Provincial Agencies



Civil Society Groups

Industry

Thank you for your attention