Integrated Planning to Mitigate Emissions of Urban Air Pollutants and Greenhouse Gases

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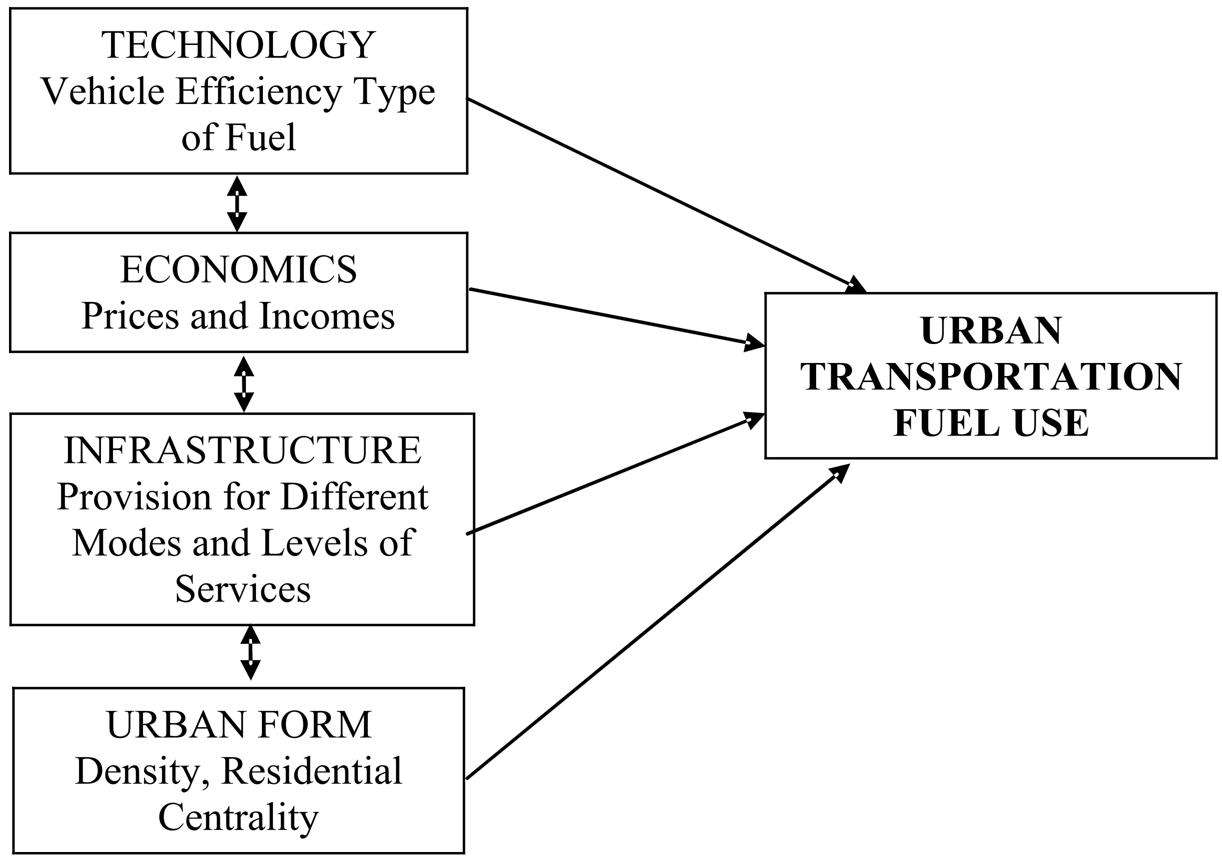
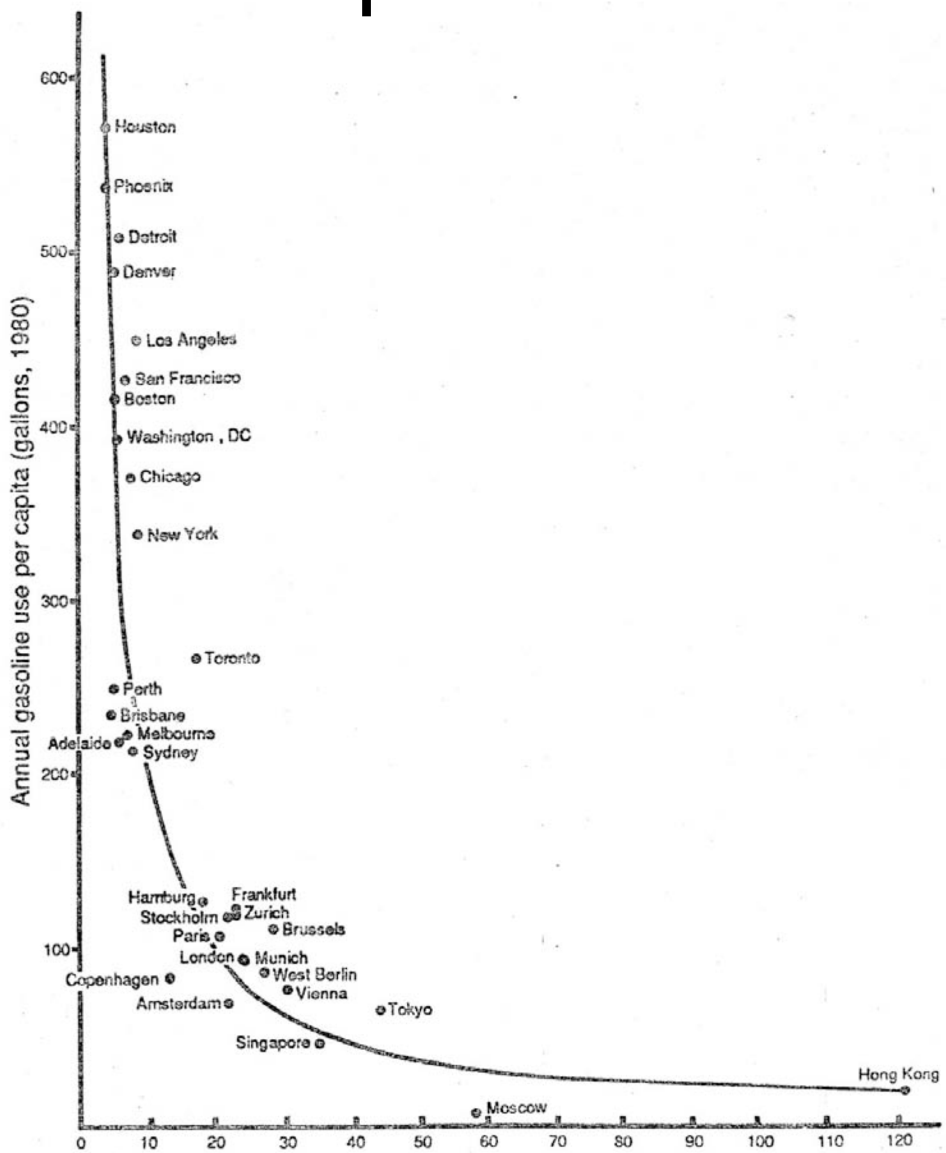
Factors Affecting Transportation Fuel Use in Cities

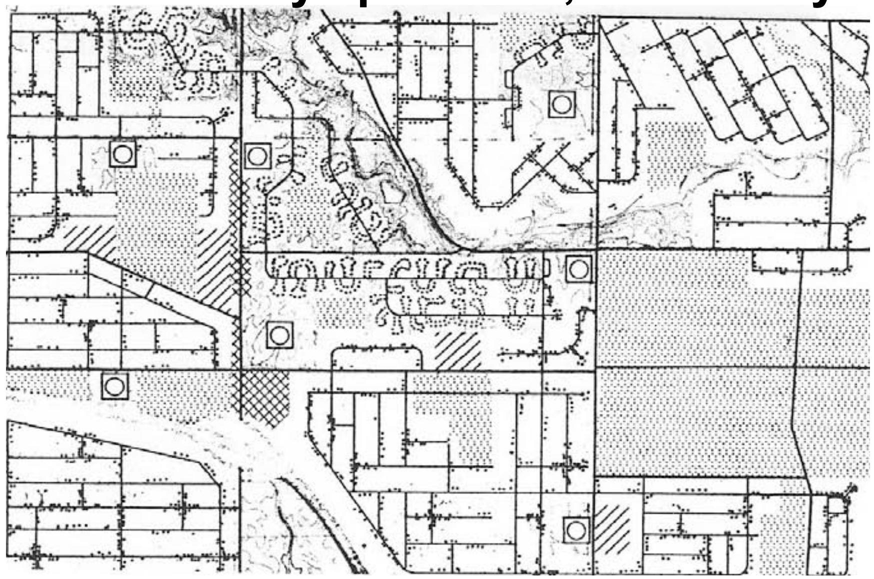


Gasoline Use per Capita versus Population Density

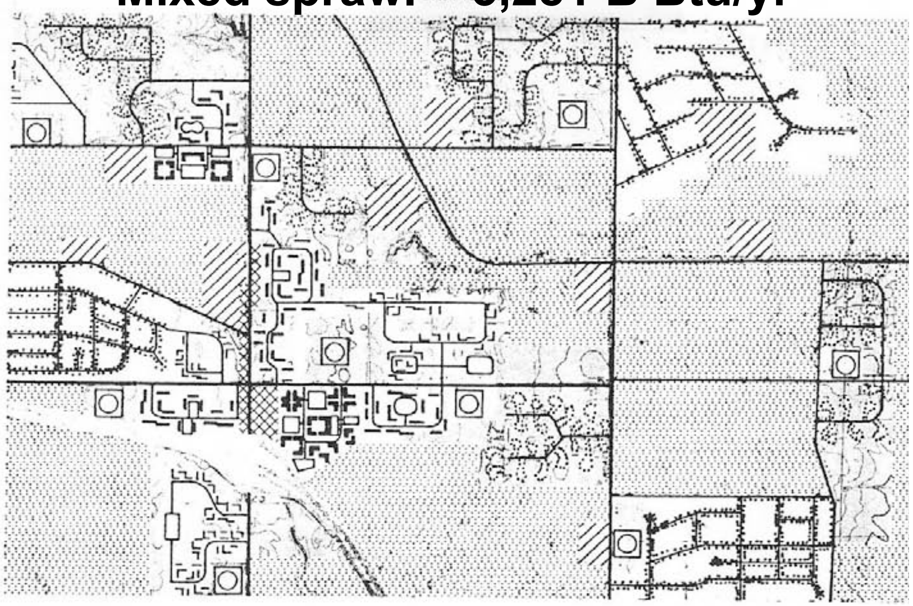


Source: Newman & Kenworthy, 1999

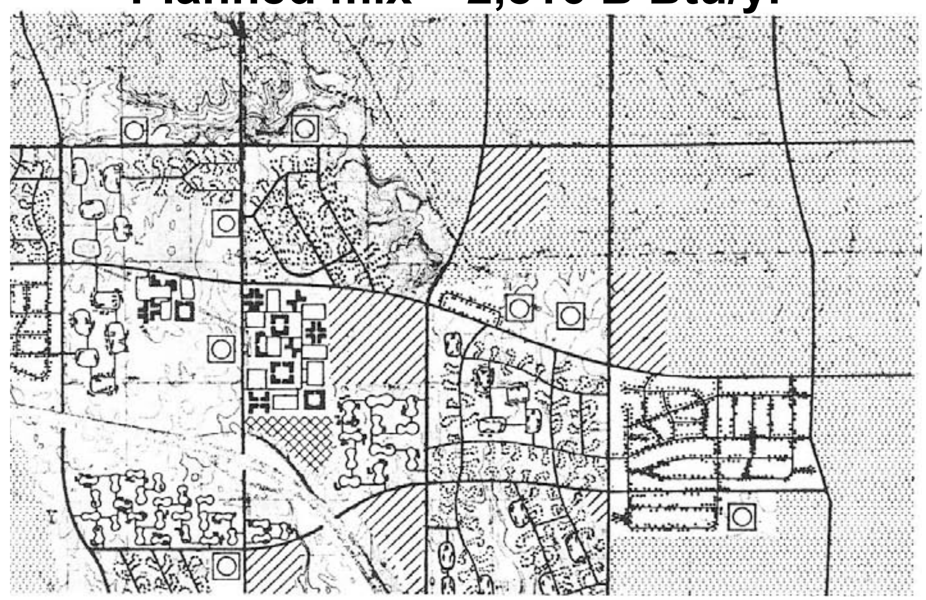
Low-density sprawl – 4,060 B Btu/yr



Mixed sprawl – 3,281 B Btu/yr



Planned mix – 2,816 B Btu/yr



Consumption of Natural Gas, Electricity, and Gasoline by Community Type

Community Type	Description	Energy Consumed	
		(B Btu/yr)	% saved
Low-density sprawl	75% of units are single-family dwelling units (SFDU), 25% are clustered SFDU. No vacant land.	4,060	baseline
Mixed sprawl	20% each of conventional and clustered SFDU, townhouses, walk-up apartments, and high-rise apartments with random development in "leapfrog" pattern.	3,281	19.2%
Planned mix	Neighborhoods are contiguous and large areas of open space are preserved. Housing mix is same as "mixed sprawl."	2,816	30.6%

Source: Real Estate Research Corp., 1974

This study compared 6 community prototypes.

Each prototype had 10,000 dwelling units built on 6,000 acres.

Communities varied in terms of housing mix (e.g., single-family dwelling units, apartments, etc.) and degree of community planning (e.g., "leapfrog" development versus contiguous neighborhoods, etc).

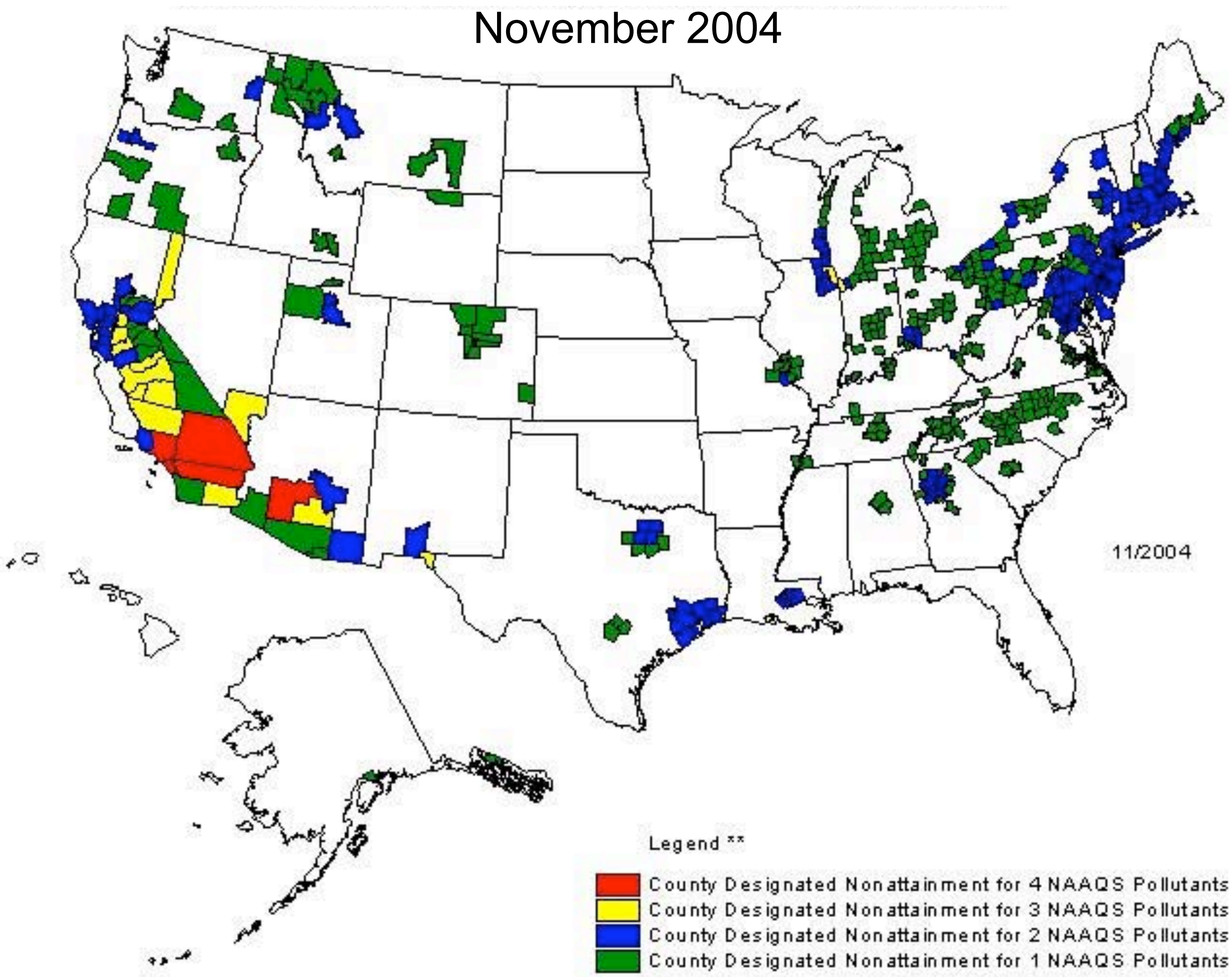
Evaluation of cost of infrastructure (e.g., roads, sewers and water supply systems), environmental impacts (e.g., air pollution) and consumption of natural resources (e.g., energy and water).

Three Major Periods of AQM

PERIOD	AQM DEVELOPMENT	FOCUSES
1^{st}	Industrial source pollution control	• Local and regional scale • SO_2, SPM/TSP, heavy metals • Cleaning at stack/improving technologies/moving sources
2^{nd}	Urbanization and pollution control	• Traffic/urban population exposure • Households (space heating, cooking practices)
3^{rd}	Co-management of air quality and climate change issues	• Benefits on air quality of climate change-driven policies • Local emissions control options with a view to their effect on climate

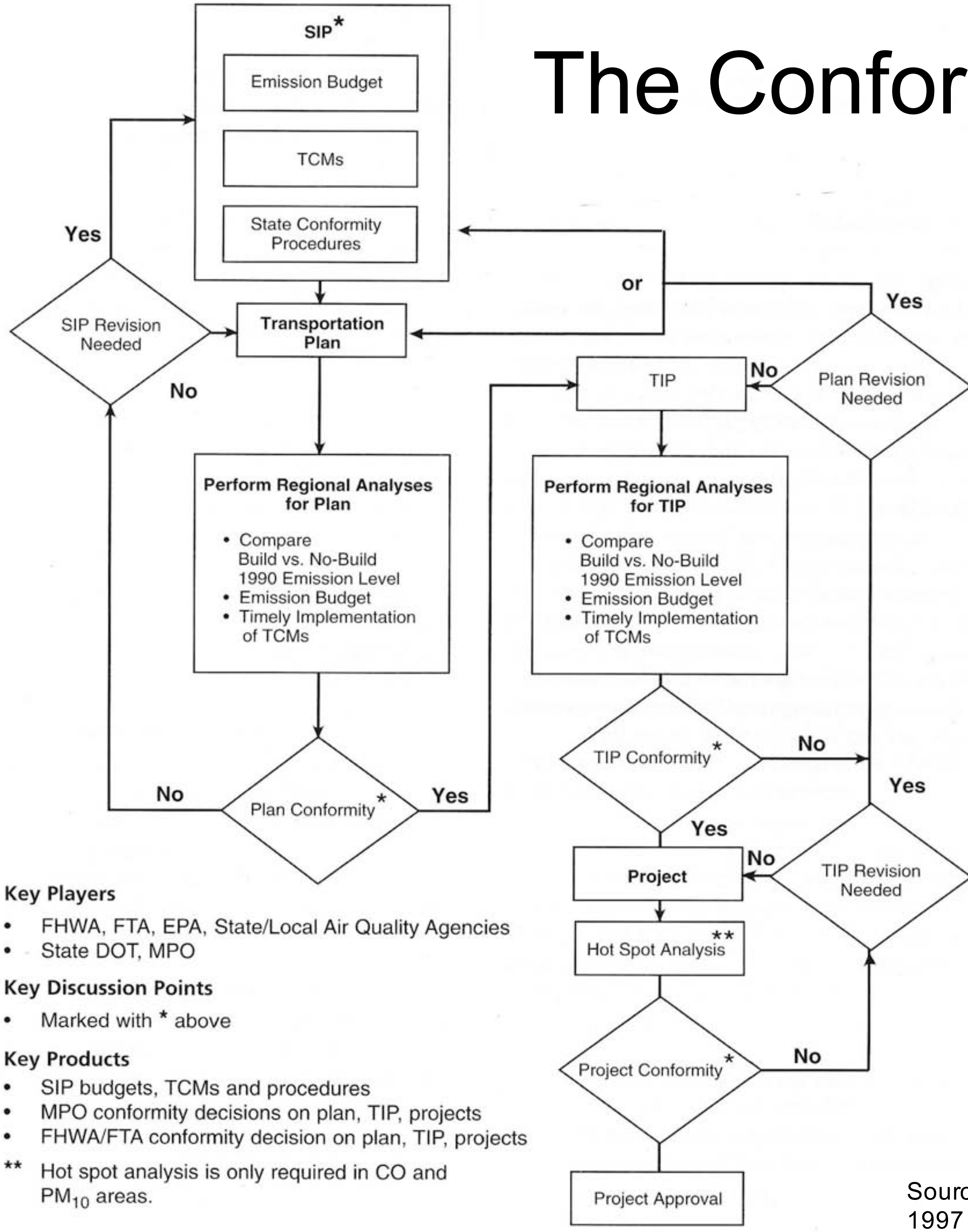
Source: Larssen et al., 2003

Counties in U.S. Designated in Nonattainment of NAAQS



Source: US EPA, 2004

The Conformity Process



Key Players

- FHWA, FTA, EPA, State/Local Air Quality Agencies
- State DOT, MPO

Key Discussion Points

- Marked with * above

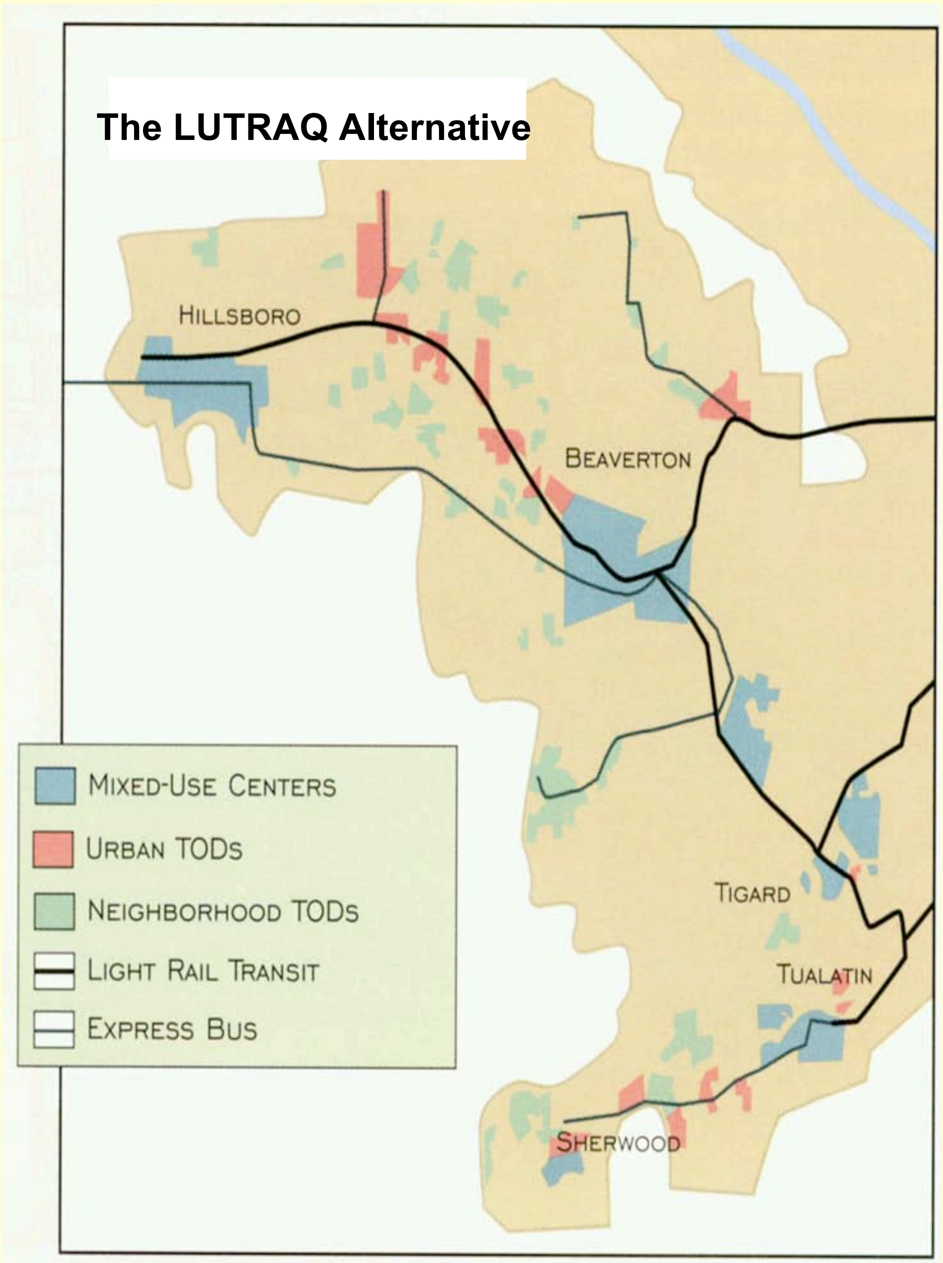
Key Products

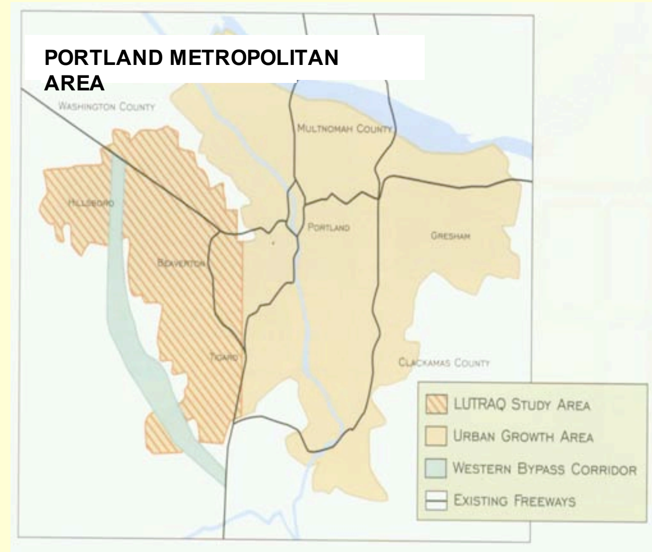
- SIP budgets, TCMs and procedures
- MPO conformity decisions on plan, TIP, projects
- FHWA/FTA conformity decision on plan, TIP, projects

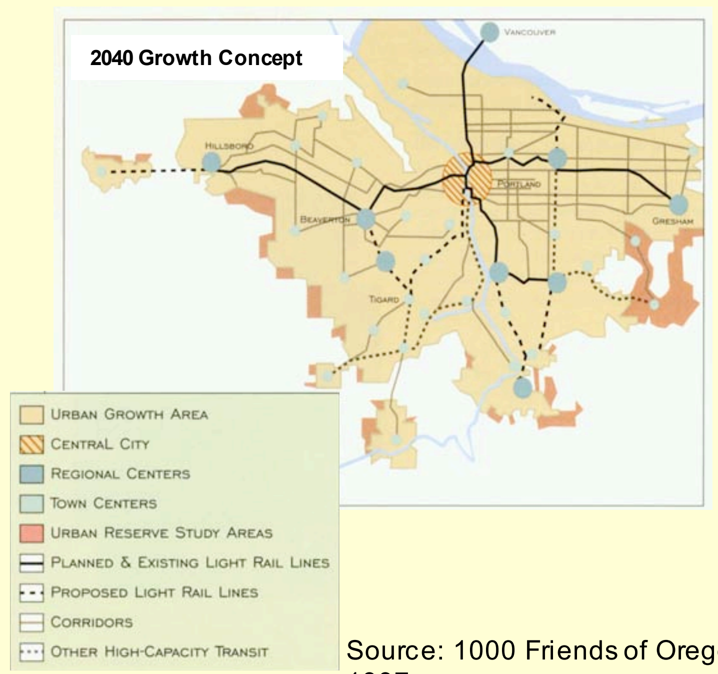
** Hot spot analysis is only required in CO and PM_{10} areas.

Source: FHA, 1997

Portland Metropolitan Area and The LUTRAQ Alternative

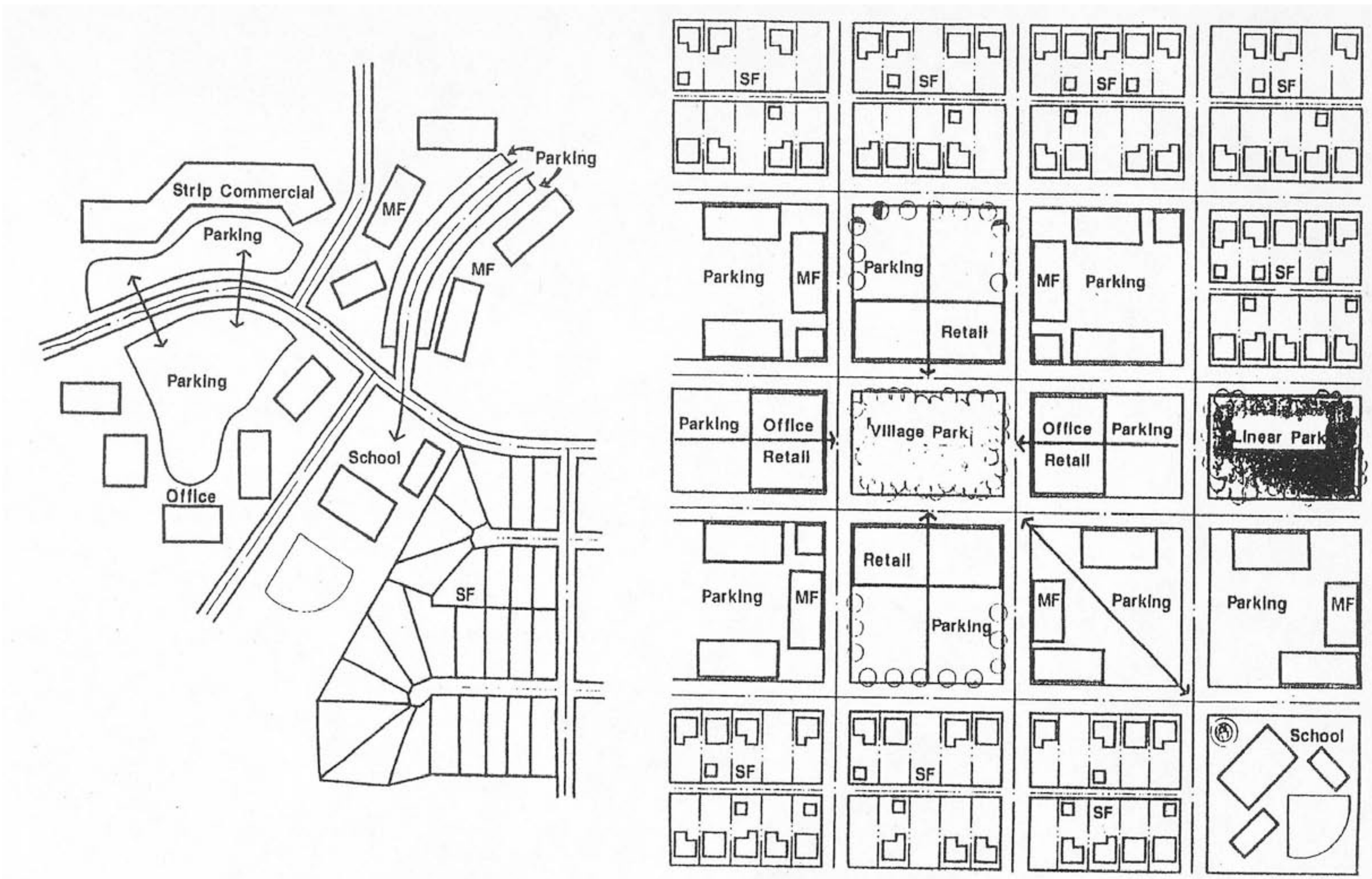






Source: 1000 Friends of Oregon, 1997

Conventional Suburbs *versus* Traditional Neighborhoods



Source: Boarnet & Crane, 2001

LUTRAQ Study Alternatives

No build	Base case includes building a new LRT line with feeder buses.
Highways only	Includes the construction of a new four-lane, limited access highway, only commonly called the Western Bypass, between I-5 and Highway 26, from Tualatin to Hillsboro at a cost of $200 million.
Highways + parking fee	Same as above plus a parking fee of $3/day for commuters who parking fee drive alone to work sites in the study area. Fee revenue pays for free transit passes for everyone working within study area.
LUTRAQ	Modify existing land use plans so that 65% of new residential units and 78% of future jobs are located in transit-oriented development. Also includes $3 parking fee, free transit passes, and sidewalk and bikeway improvements.
LUTRAQ + congestion pricing	Same as above plus improvements in bus corridors and a peak travel period charge of 15¢ per mile for work trips.

Source: 1000 Friends of Oregon, 1997

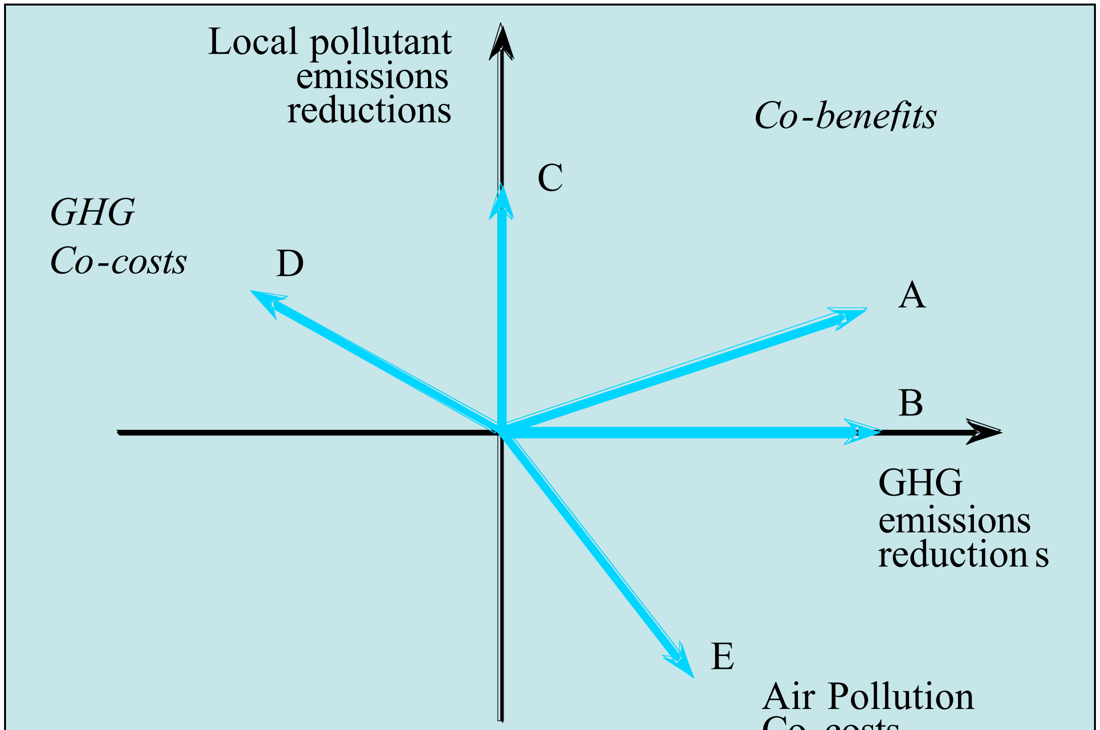
Air Pollutant & GHG Emissions & Energy Consumption of LUTRAQ Study Alternatives Relative to No Build Alternative

	No Build	Highways Only		Highways + Parking Fee		LUTRAQ		LUTRAQ + Congestion Pricing	
			Diff*		Diff*		Diff*		Diff*
Air Pollutant Emissions (kg/day)									
HC	9,988	9,965	-0.2%	9,626	-3.6%	9,366	-6.2%	8,840	-11.5%
NO_x	14,104	15,054	6.7%	14,620	3.6%	13,744	-2.6%	12,914	-8.4%
CO	94,605	94,057	-0.6%	90,813	-4.0%	88,262	-6.7%	83,296	-12.0%
Greenhouse Gas Emissions (kg/day)									
CH_4	786	799	1.6%	783	-0.4%	736	-6.4%	683	-13.2%
N_2O	526	534	1.6%	524	-0.4%	492	-6.4%	457	-13.2%
CO_2	4,814,705	4,893,061	1.6%	4,795,466	-0.4%	4,505,841	-6.4%	4,179,806	-13.2%
Energy Consumption (million of BTUs/day)									
	35,089	35,660	1.6%	34,949	-0.4%5	32,838	-6.4%	30,462	-13.2%

* Differences compared to the No Build alternative

Source: 1000 Friends of Oregon, 1997

Classification of Mitigation Measures by Emission Reduction Potential



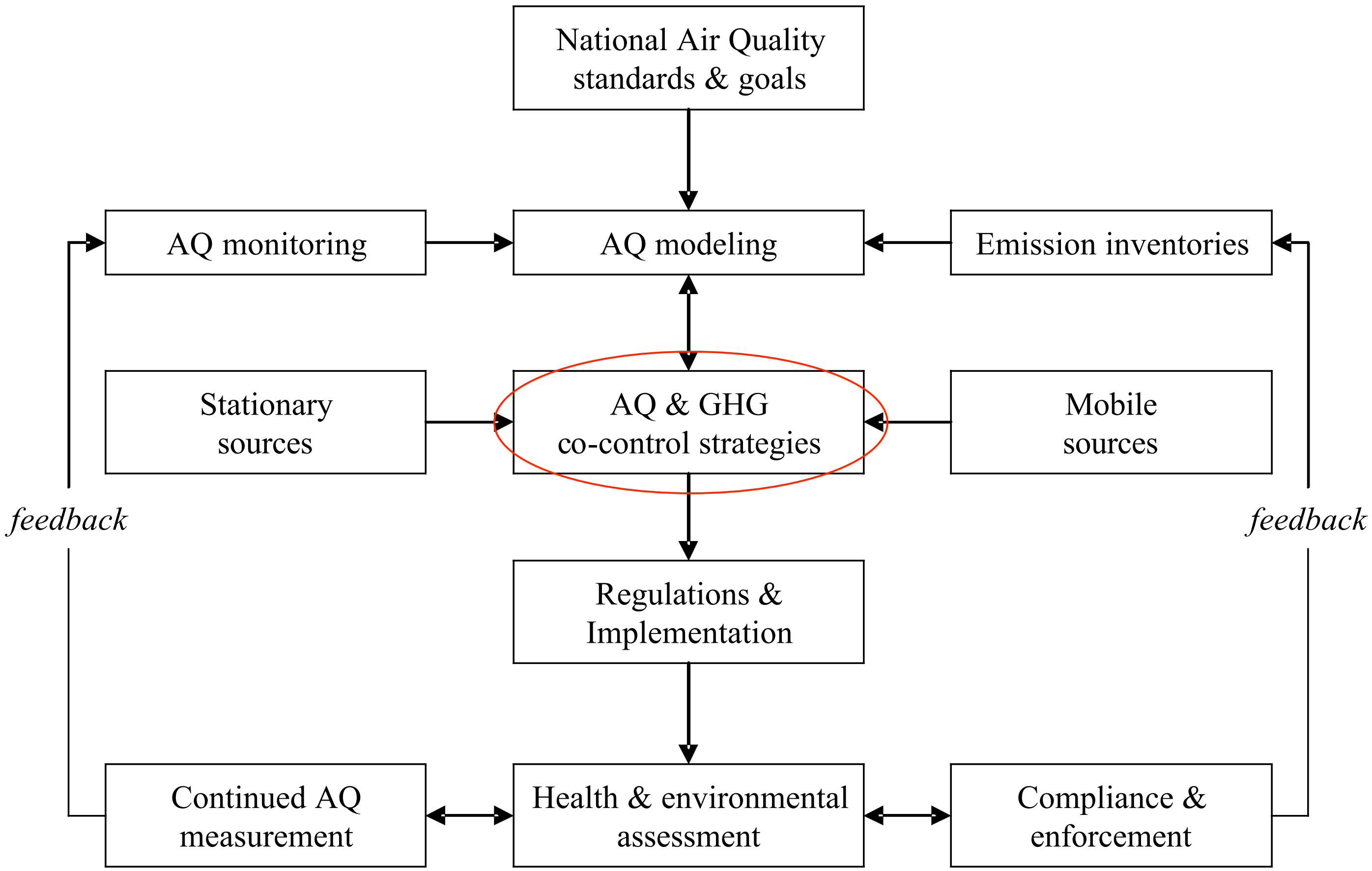
Source: Cifuentes et al., 2001

A : Measures simultaneously reduce both GHGs and UAPs.

B and **C** : Measures do not display any interaction between GHGs and UAPs.

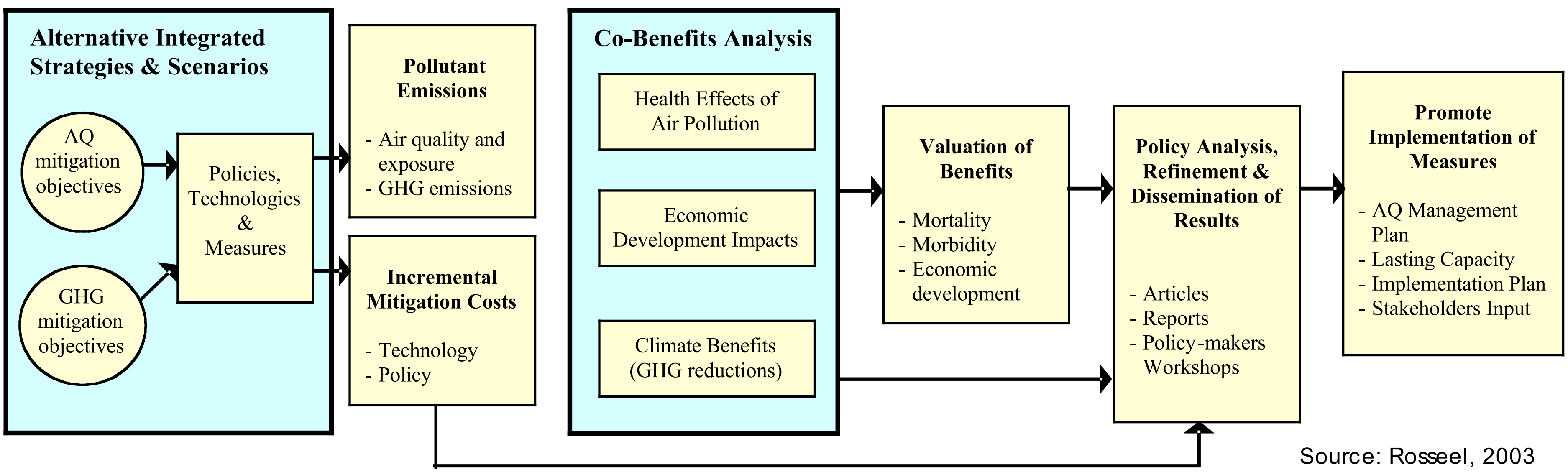
D and **E** : Measures that reduce UAPs result in increase in GHGs, or in reverse.

The U.S. Integrated Environmental Strategy (IES)



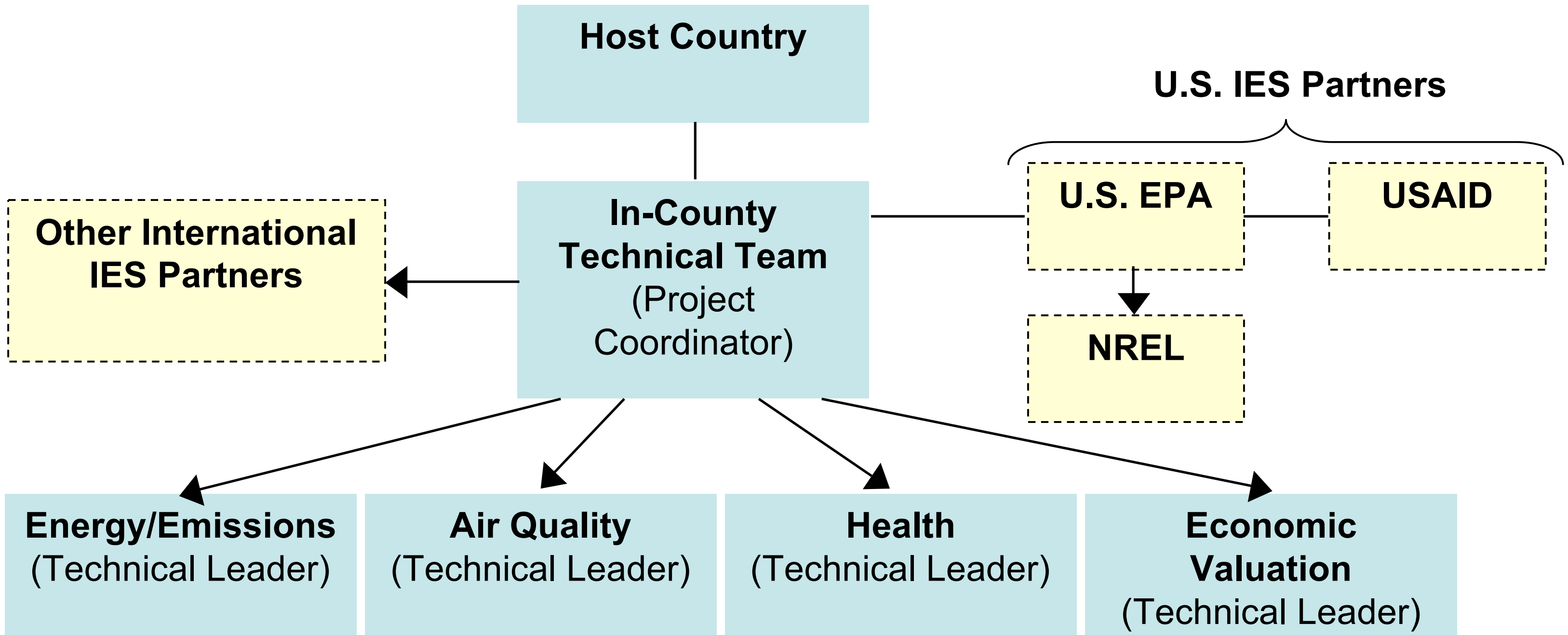
Source: Rosseel, 2003

Design and Analysis of Integrated Strategies



Source: Rosseel, 2003

Key IES Players and Stakeholders



Source: US EPA, 2004

Stakeholders

- Central or national government officials
- State or provincial government officials
- Municipal government officials
- Technical experts
- Non-government organizations (NGOs)
- Business network and trade association representatives

Mitigation Measures with Positive Benefits

Urban

? Low-sulfur coal
? Smokestack controls
? Catalytic converters
? Inspections and maintenance
? Diesel particle traps
? Evaporative controls

Integrated

? Clean fuels/renewables
? Energy efficiency program
? Carbon and energy taxes
? Public transport and land use
? Retirement of older vehicl
? Efficiency standards for new vehicles/appliances

Global

? Carbon sequestration
? Forest management
? Control of other GHGs (CH_4, N_2O, CFCs, SF_6)
? Geoengineering

Source: West et al., 2002

Sample IES Results

City	2010	2020	Cumulative 2010-2020*
Estimated Avoided Annual Mortality (Number of Avoided Premature Deaths Due to Change in PM10 Concentrations)			
Buenos Aires	1,463 – 3,957	N/A	N/A
Santiago	100	305	2,043
São Paulo	52 – 650	120 – 3,271	221 – 5,194
Seoul	22 – 98	40 – 120	400 – 1,195
Shanghai	647 – 5,472	1,265 – 11,130	10,177 – 88,025
Estimated Social Benefits of Annual PM_{10} Reductions (Millions of U.S. Dollars)			
Buenos Aires	88 – 895	N/A	N/A
Santiago	120	478	2,893
São Paulo	41 – 520	96 – 2,617	883 – 20, 782
Seoul	16 – 47	19 – 58	192 – 576
Shanghai	113 – 950	327 – 2,884	2,236 – 19,351
Reductions in Annual CO_2 Emissions (Millions of Metric Tons of CO_2)			
Buenos Aires	0.9 – 6.5	N/A	N/A
Santiago	5.4	14.3	101
São Paulo	0.2 – 1.9	0.3 – 8.5	2.6 – 57.2
Seoul	0.6 – 1.8	1.2 – 2.3	9.6 – 22.4
Shanghai	9 – 47	14 – 73	125 – 651

***Note:** Cumulative figures are estimated as linear extrapolations between the year 2010 and 2020 endpoints, except for those for São Paulo, which the IES-Brazil te am derived using a different approach

Source: US EPA, 2004

Sources of Variation in Results

- Stringency and enforcement of existing environmental regulations
- Economic conditions
- Energy/fuel mix and structure of the economy (e.g., shares of light/heavy industry, services)
- Geographic/air-shed conditions
- Land-use patterns (including transport systems and power facility siting)
- Population exposures
- Socio-economic status of population

Source: US EPA, 2004

Barriers to Implementation

- Insufficient local expertise and infrastructure for supporting new technologies and energy sources.
- Lack of capital for developing or investing in new technologies, energy sources, and infrastructure.
- Existing policies and regulations that favor current technologies and energy sources and discourage the development and implementation of new technologies and energy sources.
- Lack of data and methods for conducting comprehensive benefit-cost analyses of mitigation options.
- The need for general education to improve citizens' awareness and acceptance of new technologies and resource conservation opportunities and to change their choices and habits.

Source: US EPA, 2004

Final Comments

- Except in California and Oregon, land use planning has not been ranked highly among policies to improve air quality. Technological solutions (e.g., catalytic converters, diesel particle traps, evaporative controls, etc.) have received greater emphasis over the last 40 years.
- The LUTRAQ study in Portland, Oregon shows that modest reductions in urban air pollutants and GHGs may be achieved through a combination of light-rail transit, transit-oriented development (TOD), parking fees, free transit passes, and congestion pricing.

Final Comments (cont')

- Most air quality management (AQM) frameworks are not designed to produce optimal strategies to reduce both urban air pollutants and greenhouse gases (GHGs), even though a few frameworks consider both issues either directly or indirectly.

- Despite the absence of a legal mandate to reduce GHGs, the U.S. EPA has developed Integrated Environmental Strategies (IES) for "co-controlling" urban air pollutants and GHGs. In recent years, EPA and the Natural Energy Resource Laboratory (NERL) have partnered with key stakeholders in several foreign countries to perform IES studies. EPA claims that IES is compatible with "smart growth"measures.