

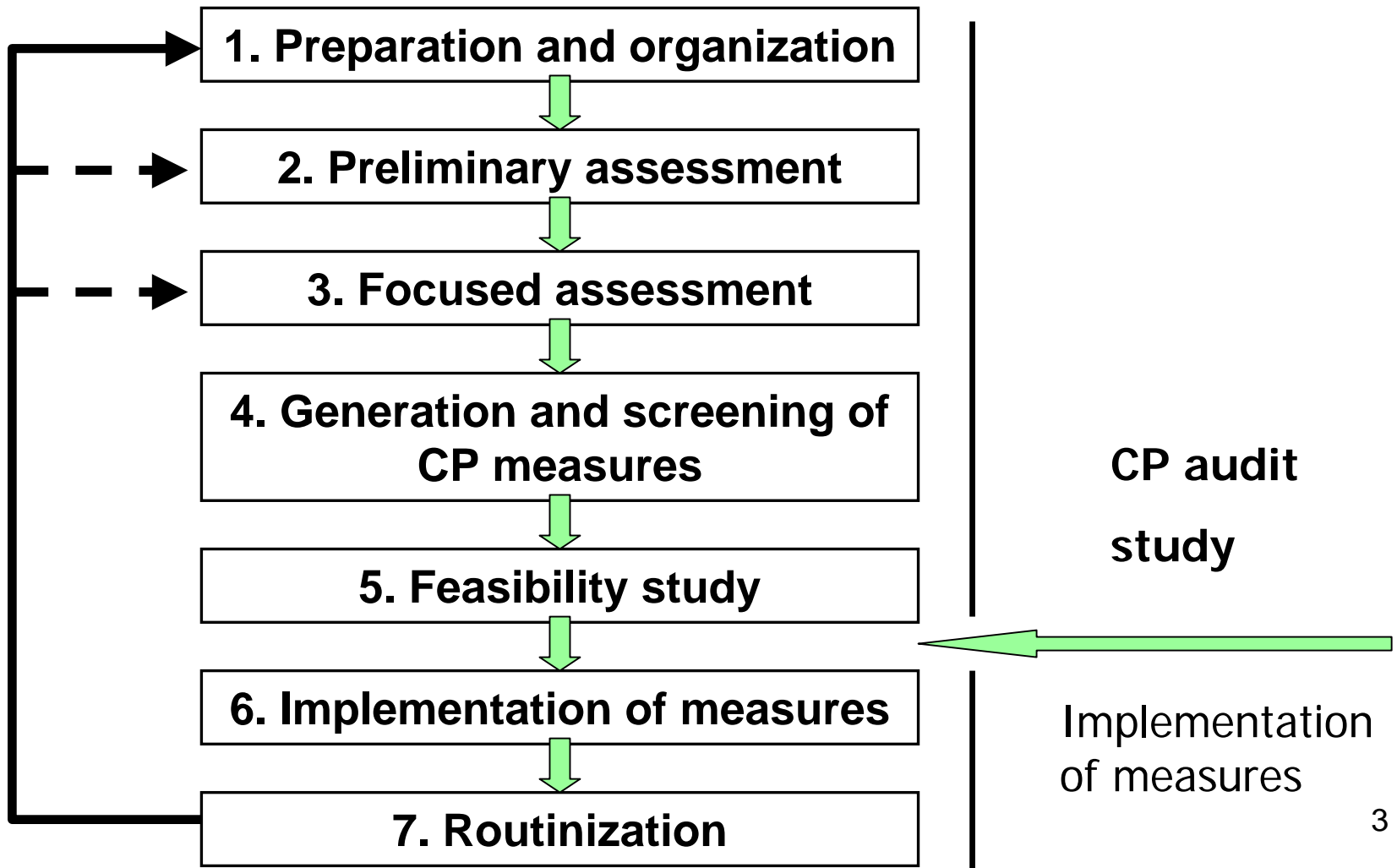
Promoting Cleaner Production at Industries in Jiangsu, China

**Hongyan H. Oliver & Leonard Ortolano
Civil and Environmental Engineering
Stanford University
Stanford, California**

Cleaner Production

- Cleaner Production (CP)
 - CP vs. End-of-pipe
 - *CP is a strategy to reduce waste generation through preventive approaches such as process modification, product redesign, raw material substitution and good housekeeping.*
 - CP tools
 - **CP audit**, life-cycle analysis, eco-design, eco-labeling, environmental management systems (ISO 14001)

CP Audit Process Steps



Research Questions

- *What effects have government-initiated CP programs had on CP activities at enterprises?*
- *What factors motivate the CP-related actions of enterprises?*

Research Location



Jiangsu



City N

City C

City S



**Wastewater discharged
into the Yangtze River**



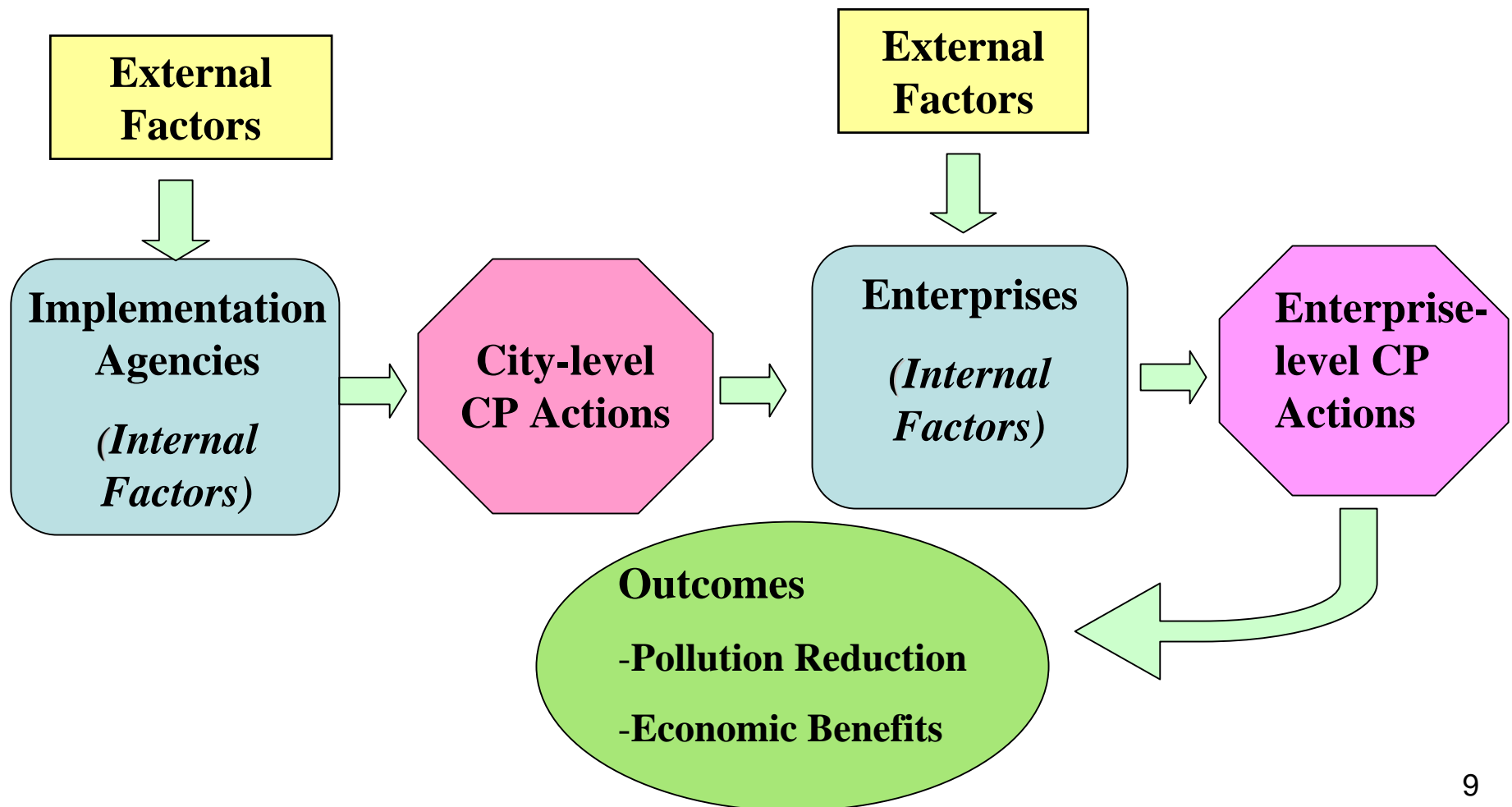
**Cyan bacterial Bloom in
the Lake Tai**

Basic Statistics of City C, N and S (in 2002)

	Population (million)	Area (1,000 km ²)	GDP per capita (\$)	Number of enterprises	Total industrial output (billion \$)
City C	3.4	4.4	2,676	2,474	14.1
City N	7.8	8.0	1,368	1,933	10.6
City S	5.8	8.5	4,035	4,122	41.7

Source: Jiangsu Statistics Yearbook 2003.

Analytic Framework for a City-Level CP Program



Focus 1: Implementing Agencies

External Factors

*Content of a CP policy
Authority of a CP policy
Policy pressure from Jiangsu ETC & EPB
Political attention
Interagency cooperation*

Municipal ETC and EPB

City-level CP Actions

*Technical capacity
Resource availability
Organizational mission, S.O.P.
Implementers' incentives and capability*

*Creating a list of CP enterprises
Visiting factories
Providing CP training
Providing technical support
Providing financial support*

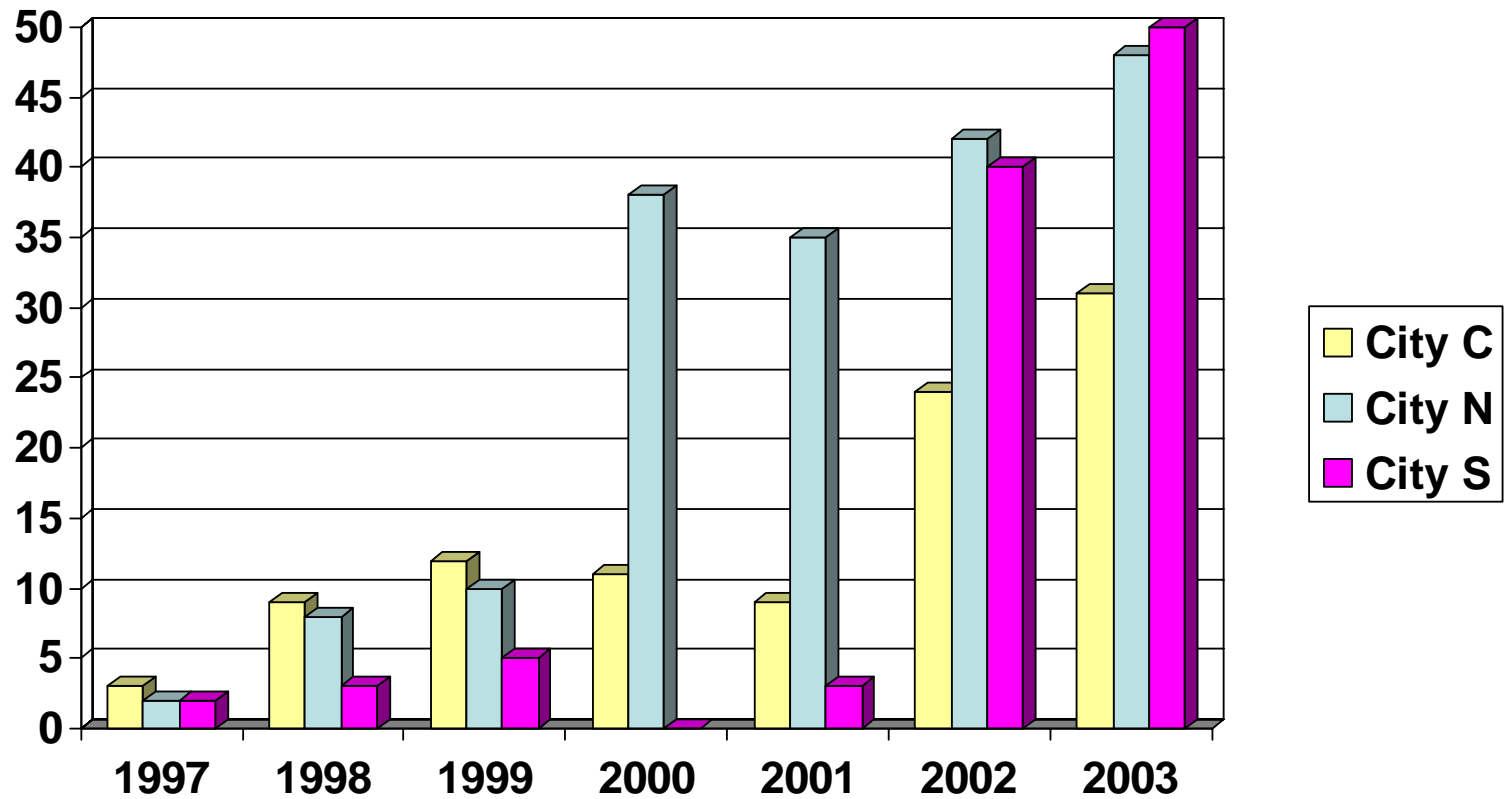
Jiangsu CP Framework: Before 2001

- Administrative rules shaped the framework
 - 1996 Notice on Implementing CP Audits
 - **All large and medium-sized enterprises shall implement CP audits by the end of 2000**
 - 1999 Notice on Accelerating CP Implementation
 - Ten measures aim at providing incentives for industries to adopt CP
- Municipal agencies responsible for implementing the rules include
 - **Environmental Protection Bureaus (EPBs)**
 - Economic and Trade Commissions (ETCs)

Jiangsu CP Framework: Recent Additions

- Jiangsu Lake Tai Clean-up Plan (2002) requires:
 - City C – implement CP audits at **95** major polluters by 2006;
 - City S – implement CP audits at **253** major polluters.
- China Cleaner Production Promotion Law (Jan 2003)
 - Local governments have authority to mandate certain enterprises to implement CP audits.
- **ETCs** have principal responsibility for implementing above two regulations.

Number of CP Audits Recorded in City C, N, and S



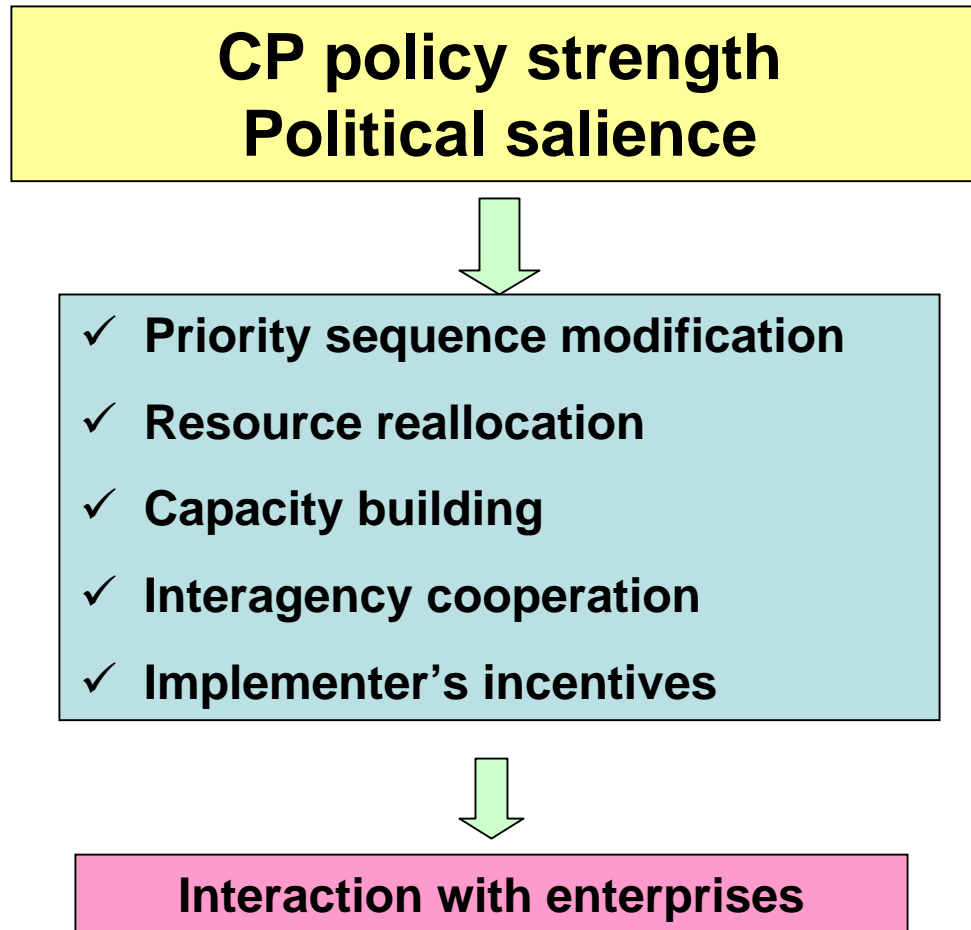
Fulfillment of the CP Goal by City C, N, and S as of the End of 2000

Number	City C	City N	City S
Total Large & Medium-sized enterprises	205	183	347
Audit reports	35	58	10
Enterprises submitting reports	33	46	10
Coverage	16%	25%	3%

Numbers of CP Audits Reported in City C, N and S (2001-2003)

City		2001	2002	2003
C	Specified as in Lake Tai plan	5	15	30
	Completed	9	24	31
S	Specified as in Lake Tai plan	3	40	60
	Completed	3	40	50
N	Ten-five year CP plan	10-15	10-15	10-15
	Completed	35	42	44

Factors Influencing Implementing Agencies' CP Actions



Focus 2 – Enterprises

Market conditions
Environmental requirements
Energy, water conservation requirements

External Factors

Conducting CP audit study
Implementing CP measures
Writing CP reports
Continuing CP audit

**City-level
CP Actions**

Enterprises
*(Internal
Factors)*

**Company-
level CP
Actions**

- Audit requirement
- Training
- Factory visits
- Financial incentives
- Technical support

Leadership commitment
Resources (financial, technical)
Sectoral characteristics

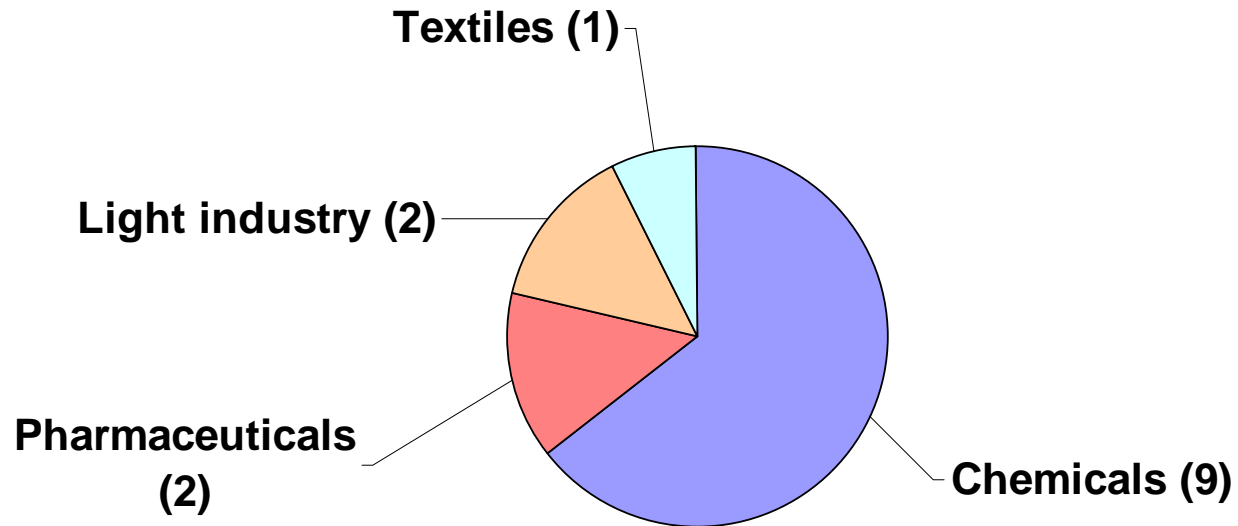
Selection Criteria for Case Study Enterprises

- Participation in city-level CP Programs
- Variation in
 - Sector
 - Size
 - Ownership type
- Recommendation of local ETC and EPB

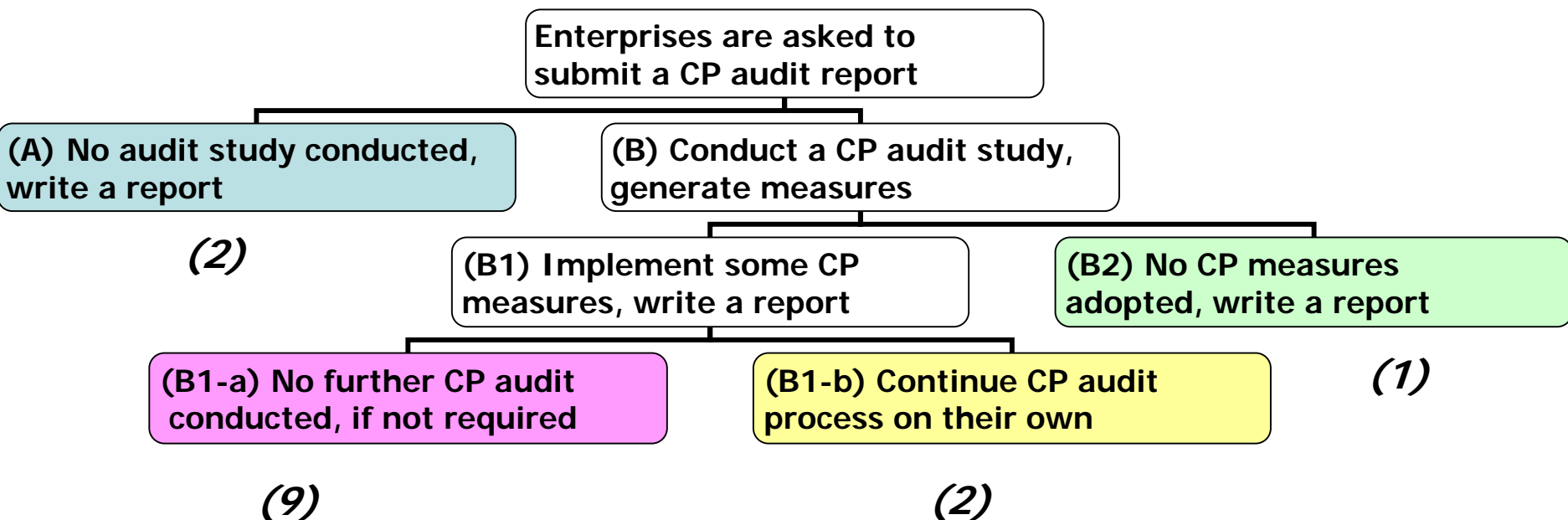
Enterprise Interviews Included in this Study

- First set of interviews at 14 enterprises (2001-02)
- Second set of interviews at 16 enterprises (2004)

Sector Composition of First-set of Case-study Enterprises



Industrial Responses to CP Audit Requirements

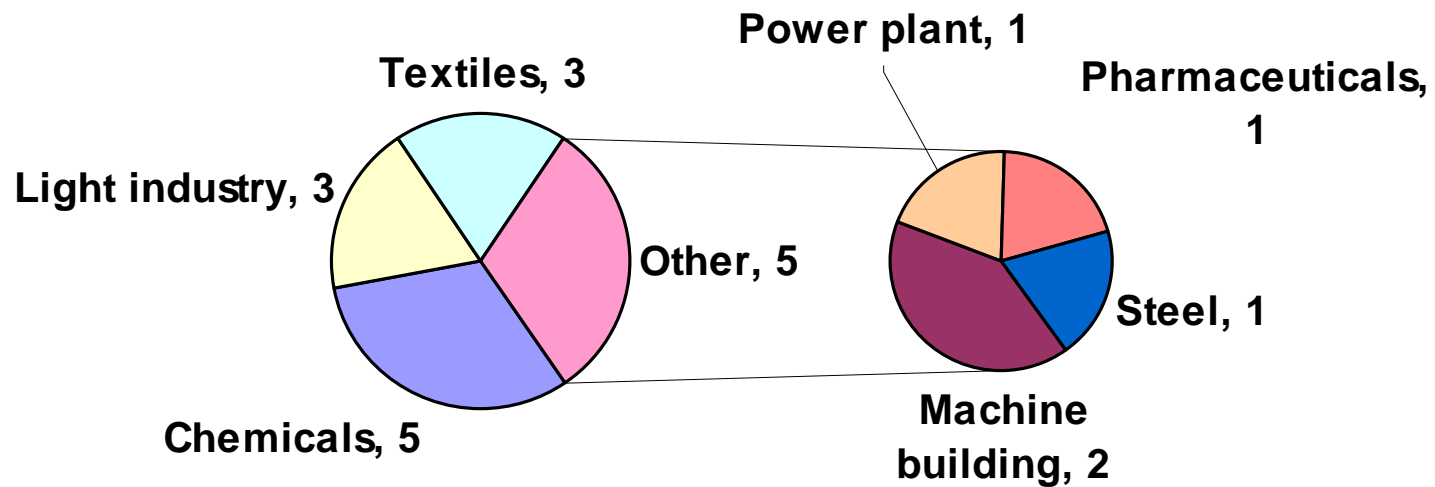


Note: data is for the 14 enterprises conducting CP audits before the end of 2001.

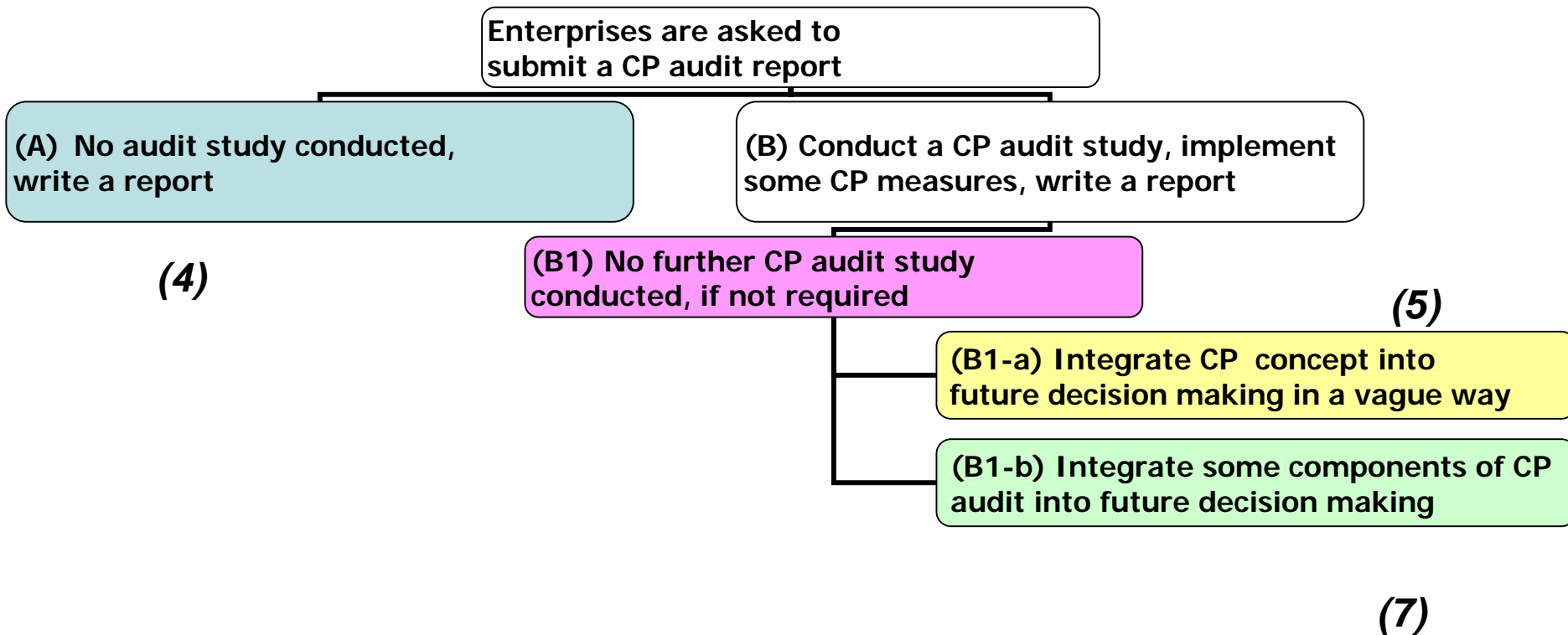
Enterprises Combine CP Audits with Existing Needs

- **Among 12 enterprises that conducted CP audit studies**
 - 7 – added CP audit to preexisting technology renovation plans
 - 4 – used audit to address known environmental violations

Sector Composition of 16 Case-study Enterprises



Industrial Responses to CP Audit Requirements



Note: data for 14 enterprises conducting CP audits during 2002-03.

Enterprises in Meeting CP audit Study Requirements

- 3 applied CP audit studies to preexisting technology renovation plans;
- 9 conducted CP audit studies without a preexisting technology plan as a platform.

CP Audits at Case-study enterprises

	Total cases	Enterprises implemented first audit genuinely	Enterprises continued CP audit
City C	9	7	1
City N	12	7	2
City S	6	6	4
Total	27	20	7

Commonalities of enterprises continuing CP audits:

- Leadership commitment
- External technical support during audit study

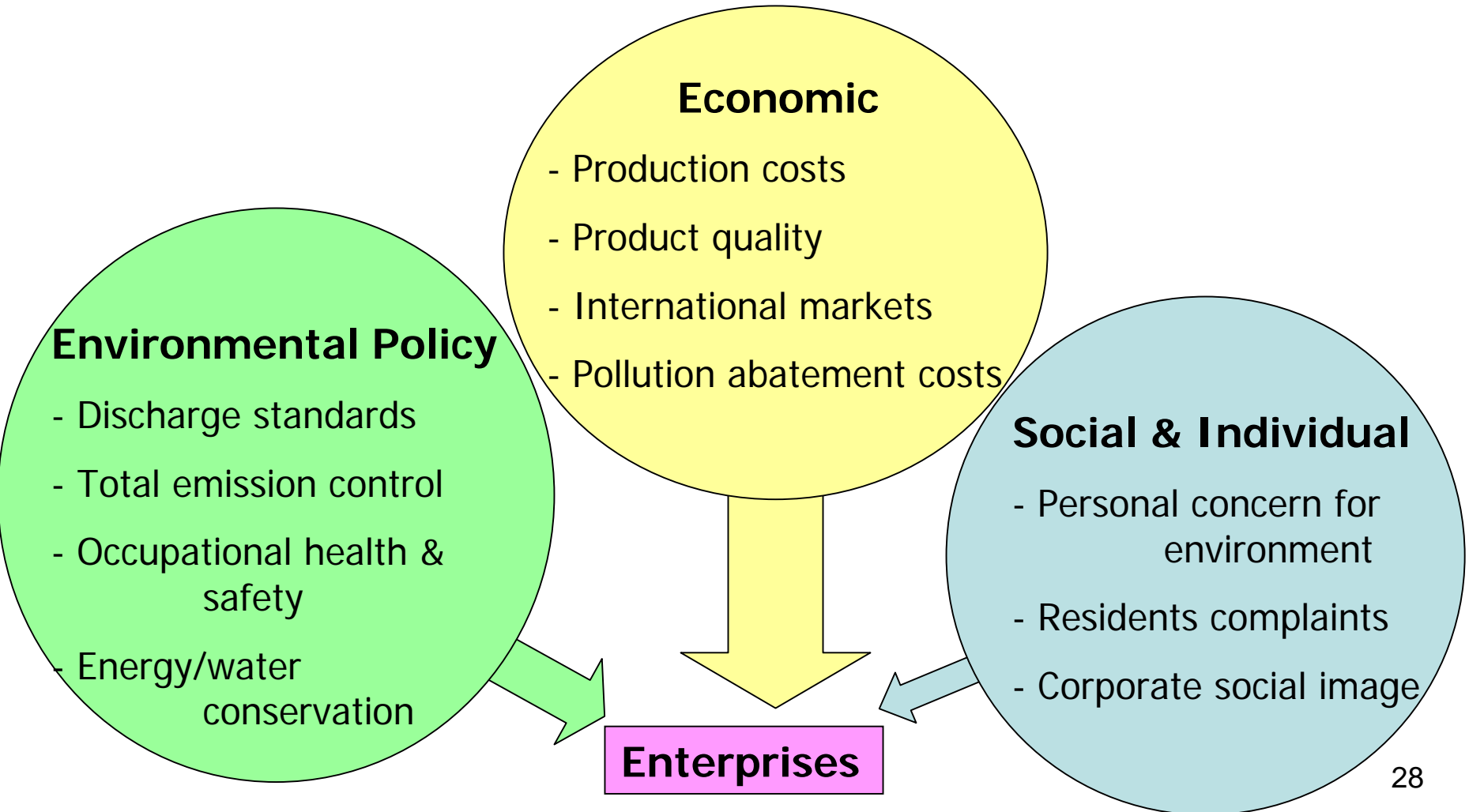
CP Measures at Enterprises

- Most enterprises in Category B had been engaged in CP-like measures to varying degrees long before CP audit requirement was imposed.

Examples of existing CP measures:

- Energy conservation
 - Process and product modification
 - Water recycling, etc.
- Enterprises in Category A have also implemented some CP-like measures; and some enterprises have long been quite advanced in applying CP principles in their decision making.

Enterprises' Incentives to Adopt CP Measures



Reasons Cited by Enterprises for Adopting CP measures

	Reason	Number of times cited
Economic benefits	Production cost reduction	23
	Product quality improvement	14
	International markets	17
	Abatement cost reductions	9
Environmental policy pressure	Discharge standards	19
	Total emission control	10
	Occupational health & safety	6
Social & Individual	Residents complaints	4
	Personal concern for environment	7

Conclusions (I)

- Municipal agencies have increased implementation actions because of increase in **policy strength** and **political salience**.
- **Goal displacement** occurred at municipal agencies (collecting audit reports, instead of inducing industrial behavior changes); which is exacerbated by the insufficient resources and inadequate capacity of agencies;
- **Token compliance** by some enterprises (writing reports summarizing CP-like actions that had occurred)

Conclusions (II)

- Many enterprises claimed that they would incorporate CP concept into their future decision making more consciously, but they were not willing to adopt CP audit procedures.
- A fraction of enterprises integrated some components of CP audit into their ongoing decision making processes.
- Enterprises are mainly motivated by economic factors to implement CP measures; environmental protection is considered a secondary benefit.
- End-of-pipe waste treatment approach is still the dominant approach for pollution control at most enterprises.

Thank you very much!