Massachusetts Toxics Use Reduction — Celebrating 25 Years

Reporting Training
Toxics Use Reduction Act (TURA): Production Ratios and Unit of Product

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Heather Tenney & Suzi Peck

OTA Office of Technical Assistance & Technology

MassDEP Commonwealth of Massachusetts Department of Environmental Protection

TURI Toxics Use Reduction Institute UMass Lowell

Production Ratio

- A ratio of reporting year production to the prior year production
- An "activity index" other than production that is the primary influence on the individual chemical use or byproduct generated may be used

$$\text{Production Ratio} = \frac{\text{This Year's Production Level}}{\text{Last Year's Production Level}}$$

Production Ratio

- Ratio reported to nearest 0.1 or 0.01
- *Example:*
  - report 1.09 for a 9% increase in production
- Report 1 for the initial reporting year
- The ratio may vary for each individual chemical

Group discussion:

What do these production ratios mean?

- Production ratio = 1 ?
- Production ratio = 0 ?
- Production ratio = N/A ?
- Production ratio > 1 ?
- Production ratio is negative ?

Group discussion:

What do these production ratios mean?

- Production ratio < 1 ?
- Production ratio > 2 ?
- Production ratio < 0.4 ?

Example 1:
What do I do if I use the same chemical in two production units?

- In Production Unit 1, 100,000 lbs of methylene chloride is used as a component of adhesive. Production of this product has increased 50% over the last year.
- In Production Unit 2, 10,000 lbs of methylene chloride is used in cleaning parts. Production of this product is down 10% since last year.

2 Production Units

Example 1 calculation

Weighted production ratio:

Prod. Unit 1 + Prod. Unit 2 / Total Use

(1.5 x 100,000 + .9 x 10,000) / 110,000

= (150,000 + 9000) / 110,000

= 159,000 / 110,000

= 1.45

Example 2

- Facility reports 23,000 pounds of chromic acid and 74,000 pounds of nickel in 2009
- Facility reported 10,000 pounds of chromic acid and 50,000 pounds of nickel in 2008
- Production ratio is 1.24 for both chemicals
- Company does not report any TUR implemented

Question: *Is this accurate?*

Example 3

- Facility reports 40,000 pounds phenol in 2009
- Facility reported 50,000 pounds phenol in 2008
- Company does not believe any TUR implemented
- Production ratio =.95

Question: *Is this accurate?*

Example 4

- Facility reports 170,000 pounds of nickel in 2009
- Facility reported 200,000 pounds of nickel in 2008
- Company does not report any TUR implemented
- Production ratio is 1.15

***Question**: Is this accurate?*

How do facilities use Production Ratios?

- **Section 4 reporting**
  - Calculating the impact of TUR on use and byproduct
- **Plan summary:**
  - Projected change in use and byproduct
- **Evaluation of effectiveness** of TUR strategies that were implemented

How does the program use Production Ratios?

- Measurement of **overall program effectiveness**
  - **Change in statewide** use, byproduct, and transfer and release totals
  - **Proportion of facilities** doing TUR statewide or for individual chemicals or sectors

Measurement of overall program effectiveness

Average weighted production ratio:

- Reported totals are divided by the average weighted production ratio to calculate production adjusted totals
- These totals are calculated for "core" records – those facility chemical pairs that were subject to reporting the first year and are still subject to reporting.

Adjusting raw data for year-to-year changes in production

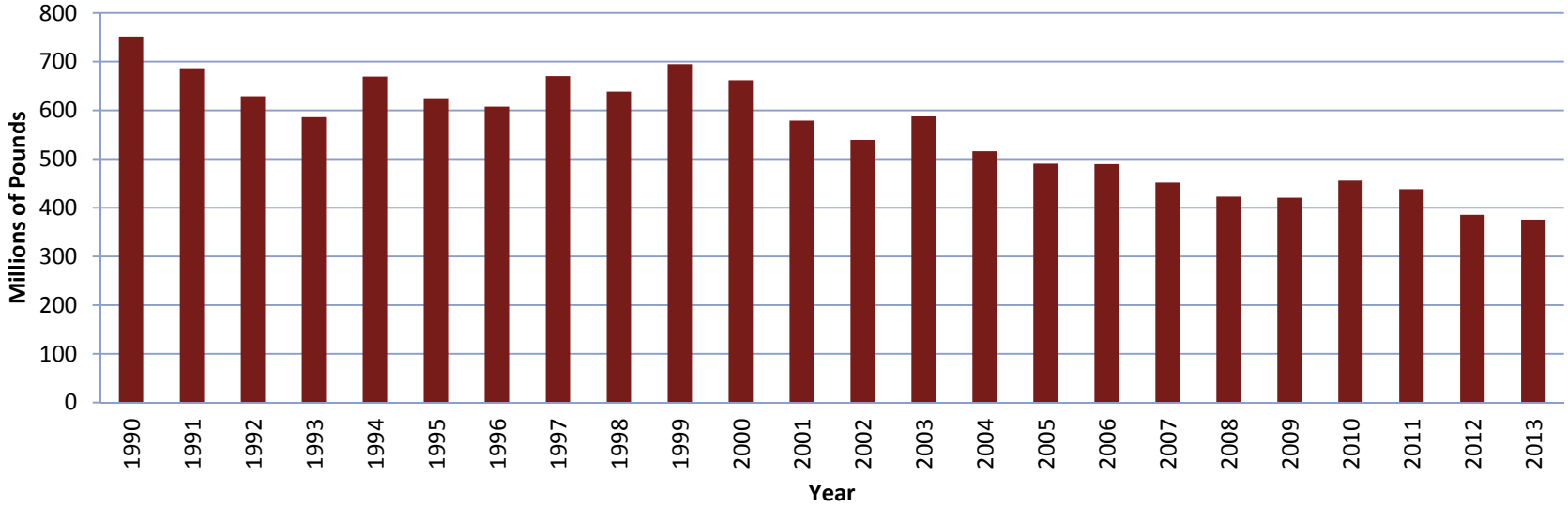
Example:

- In year 1, a facility produces 1,000 machine parts, and generates 100 lbs of byproduct.
- In year 2, the facility produces 10% fewer machine parts (900). Therefore, the production ratio is 0.90. However, the facility only generates 80 lbs of byproduct.
- The production adjusted byproduct for year 2 is 80 lbs / 0.90 = 89 lbs.

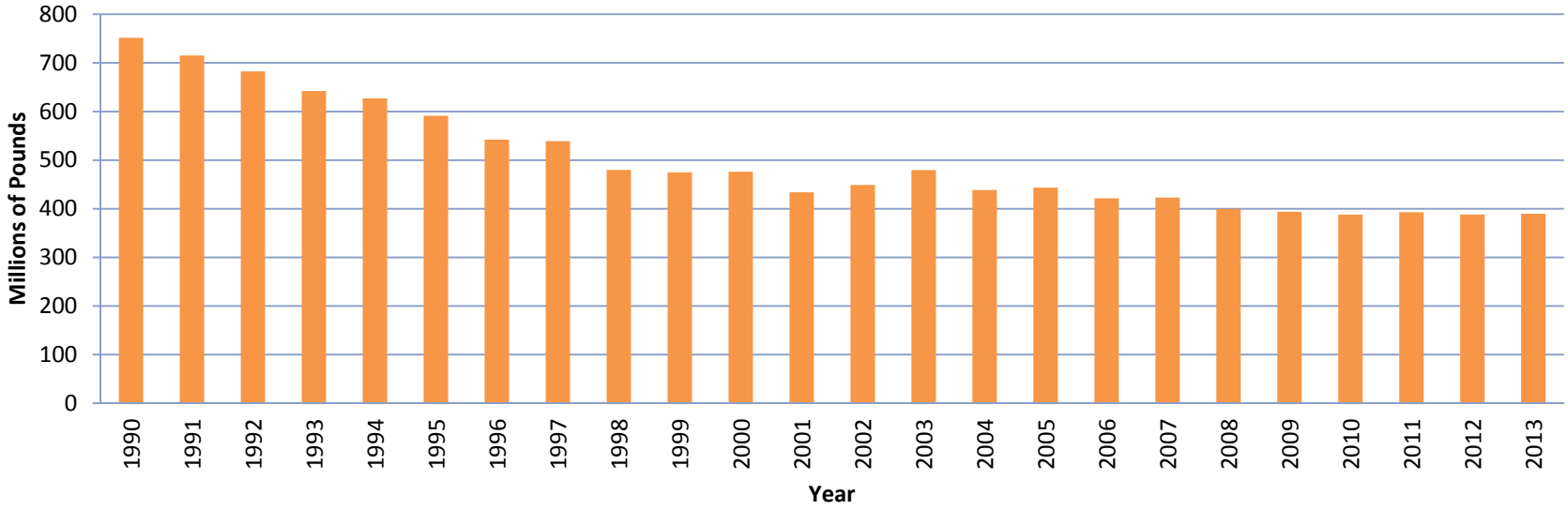
Example continued:

- The production adjusted percent change from year 1 to year 2 is (100-89) / 100 = 0.11, or an 11% reduction, while its actual byproduct reduction is 20%.

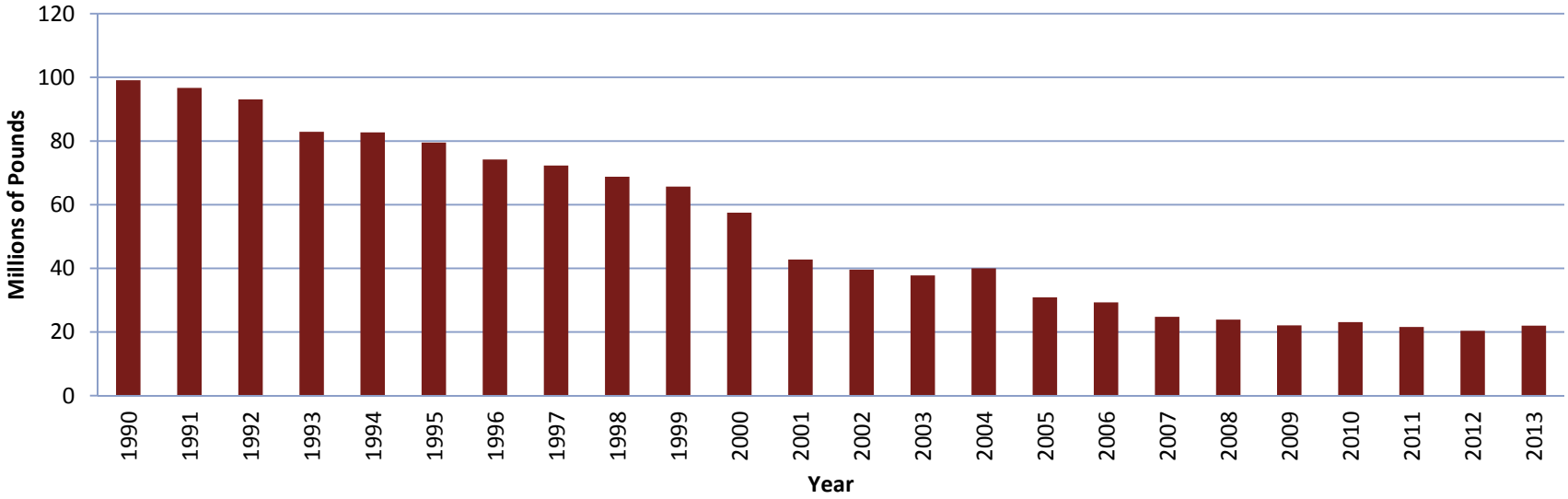
Total Use



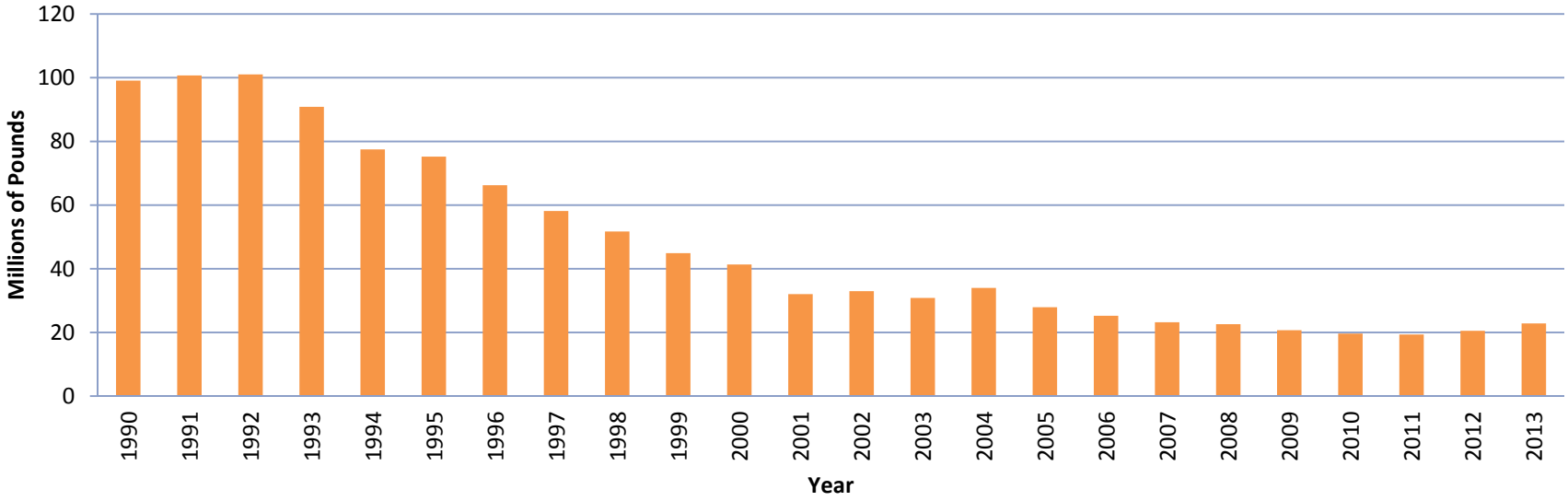
Production Adjusted Total Use



Byproduct



Production Adjusted Byproduct



Calculating Individual Facility TUR Progress

Pounds of use or byproduct in the first year

Multiplied by

The "Cumulative Production Ratio" (the product of each year's production ratios: $(1 \times PR_{yr\ 2} \times PR_{yr\ 3} \times \ldots PR_{current\ yr})$)

Equals

The pounds that *would have been* used or generated in the first year *if* the first year's level of production had been the same as the current year's

Subtracting

Current year use or byproduct

Results in

The change in pounds used or generated per year due to changes in manufacturing processes

Is the result positive or negative if TUR had been implemented?

So … What Could Go Wrong?

- Mathematical errors in the calculation
  - Decimal points
  - Negative numbers (shouldn't have them!)
  - Ratio Reversed
  - Wrong production numbers

- Poorly chosen unit of product

Glorious Paint Company

- 6 million pounds of paint per year
- 4 types
  - 2 colors: Red and Blue
  - 2 classes: Super and Best
- 3 listed chemicals
  - Pigment A used in all red paint
  - Solvent B used in different amounts in Super and Best Paint and for between batch equipment cleaning
  - Solvent C used in end of day equipment clean up

	Lbs Paint/Yr	Lbs Pigment A Used/Yr		Lbs Byproduct /Yr
Red	3,000,000	2% of paint	60,000	3000
Blue	3,000,000	0% of paint	0	0

-Company reduces Pigment A 25% to 1.5%

-The design mavins declare blue "out" and red "in". Red sales rise by a third to 4 million, blue sales drop by a third to 2 million

*5% of paint ends up in the processing equipment

Did the company do TUR?

Should the unit of product be total pounds of paint or total pounds of red paint?

Pigment A Unit of Product con't

Did TUR IF: (Use $_{yr1}$ X PR) – Use $_{yr2}$ >0

$Use_{Yr2} = .015 \text{ X } 4 \text{ million} = .06 \text{ million pounds}$

$Use_{Yr1} = .02 \text{ X } 3 \text{ million} = .06 \text{ million pounds}$

Using Total Pounds of Paint

PR = 6 million lbs / 6 million lbs = 1

Reduced Use = (.06 million x 1) – .06 million = 0

Using Total Pounds of Red Paint

PR = 4 million lbs / 3 million lbs = 1.33

Reduced Use = (.06 million x 1.33) – .06 million = .02 million

Solvent A Unit of Product

	Lbs Paint/Yr	Lbs Solvent A Used/Yr		Lbs Byproduct/Yr (5% paint wasted)
Super	4,000,000	1% of paint	40,000	2,000
Best	2,000,000	2% of paint	40,000	2,000
Clng	750 batches	10 lbs/batch	7,500	7,500

-Company encourages clients to switch to Super Paint

-Super paint shipments increase by 25% to 5 million lbs, Best Paint shipments drop to by 50% to 1 million lbs.

TUR?

What Unit of Product?

Solvent A Unit of Product con't

Super Paint Use_{Yr2}	= .01 X 5 million lbs	= 50,000 lbs
Best Paint Use_{Yr2}	= .02 X 1 million lbs	= 20,000 lbs
Super Paint BP_{Yr2}	= .05 X 40,000 lbs use	= 2,000 lbs
Best Paint BP_{Yr2}	= .05 X 20,000 lbs use	= 1,000 lbs
Cleaning Use & BP $_{Yr2}$	= 750 X 10 lbs use	= 7,500 lbs

Using Super and Best as Separate Products

Super: PR = 5 million / 4 million = 1.25

Super Reduced Use = (40,000 X 1.25) - 50,000 = 0 lbs

Best: PR = 1 million / 2 million = 0.5

Best Reduced Use = (40,000 X 0.5) – 20,000 = 0 lbs

Solvent A Unit of Product con't

Super Paint Use_{Yr2} = .01 X 5 million lbs = 50,000 lbs
Best Paint Use_{Yr2} = .02 X 1 million lbs = 20,000 lbs

Super Paint BP_{Yr2} = .05 X 40,000 lbs use = 2,000 lbs
Best Paint BP_{Yr2} = .05 X 20,000 lbs use = 1,000 lbs

Cleaning Use & BP_{Yr2} = 750 X 10 lbs use = 7,500 lbs

Using Total Paint

PR = 6 million / 6 million = 1

Reduced BP = (11,500 X 1) - 10,500 = 1000 lbs
(9% reduction)
Reduced Use = (80,000 X 1) - 77,500 = 2,500 lbs
(3% reduction)

Solvent B Unit of Product

	Lbs Used/Yr			Lbs Byproduct /Yr*
Daily Clean Out	250 Days/Yr	100 pounds/ day	25,000	25,000

-Company installs integral recycling and recovers 20% of Solvent B

-Paint shipments decrease by a third from 6 to 4 million lbs

TUR?
What Unit of Product?

Solvent B Unit of Product cont

Use_{yr2} and BP_{yr2} = .08 X 25,000 = 20,000 lbs

Using Total Paint

PR = 4 million / 6 million =.67

Reduced Use = (25,000 X.67) – 20,000 = -3,250 lbs

Using Days Cleaned

PR = 250 days / 250 days = 1

Reduced Use = (25,000 X 1) – 20,000 = 5,000 lbs

Using Pounds of Chemical Used

PR 20,000/25,000 = .08

Reduced Use = (25,000 X 0.8) – 20,000 = 0

Other Potential Problems

- Using $ as unit of product
- Using volume a unit of product
- How to handle waste treatment chemicals
- How to handle coincidentally manufactured chemicals
- Other?

Characteristics of a "good" Production Ratio

Nothing is perfect. Good ones

- Are closely related to the amount of chemical used or wasted
- Are accurate, consistent from year to year, with a consistent relationship to use and byproduct
- Can "capture" all types of TUR – changing inputs, product reformulation, reducing byproduct
- Can be products or activities
- Should be different for different chemicals and products with different chemical concentrations