

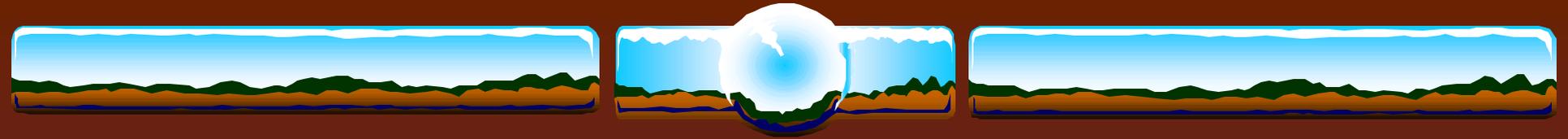
METHOD FOR QUANTIFYING EMISSION REDUCTIONS RESULTING FROM EPISODIC PUBLIC EDUCATION PROGRAMS

Chairman's Air Pollution Seminar Series

California Air Resources Board

March 17, 2003

Eric N. Schreffler, ESTC

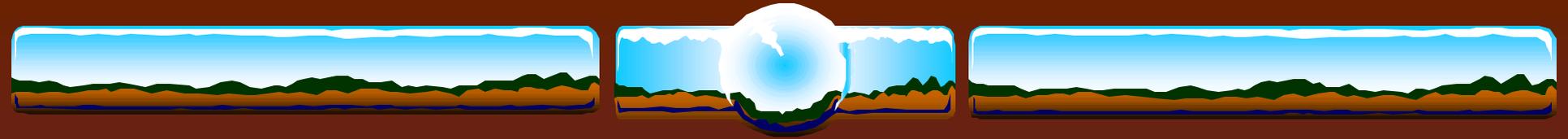


INTRODUCTION

What are Episodic Public Education Programs?

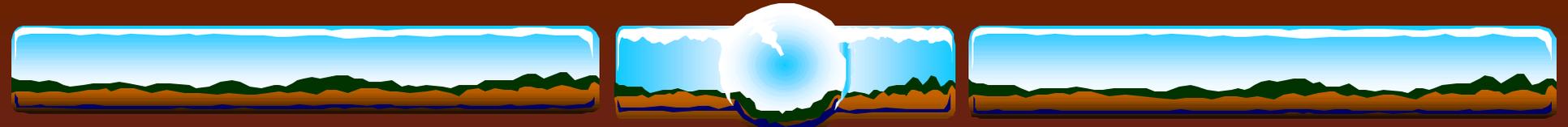
Do People Really Change Travel Behavior in
Response to Public Education Campaigns?

How Do You Measure These Changes?



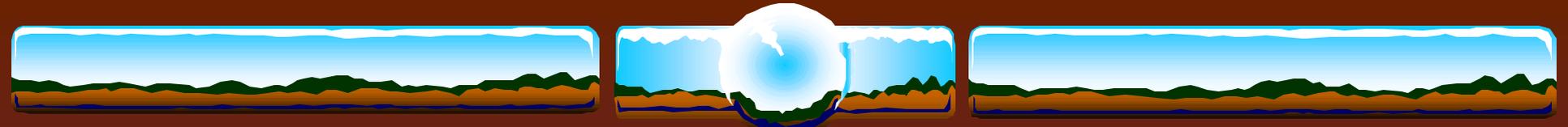
TOPICS

- ❖ General Evaluation Issues
- ❖ CARB Research and Findings
- ❖ Quantification Method
- ❖ General Guidance and Tools



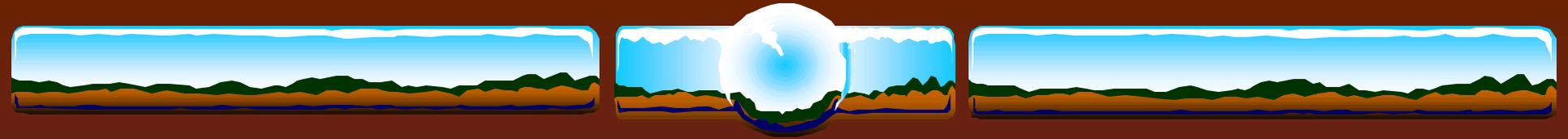
Evaluation Issues

- ❖ Projections focus on intended outcome vs. impact of trip reduction strategies
- ❖ Methods used to project results differ from those used to measure impacts
- ❖ Surveys focus on awareness, not behavior
- ❖ Too many assumptions...not empirical



Public Education Programs

- ❖ Most common are ozone alert or seasonal clean air programs
- ❖ Often under control of public information
- ❖ Rely on mass media and outreach
- ❖ Use marketing and advertising specialists
- ❖ Little experience with impact quantification



Public Education Programs

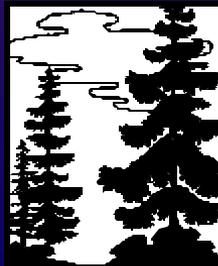
So, how do you make leap from marketing and education...

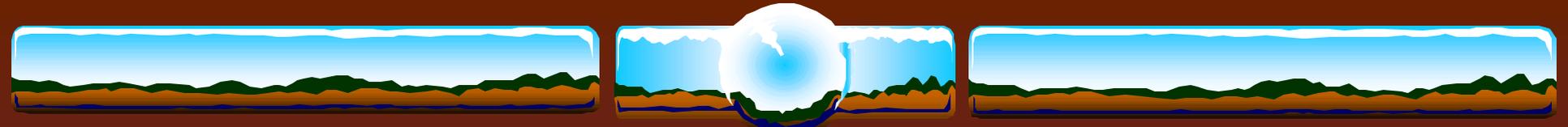


to travel behavior and trip reduction..



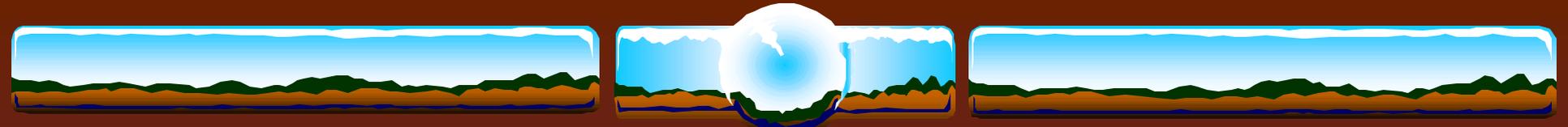
to emission reduction?





What Do You Need to Know?

- ❖ Proportion of drivers who reduce travel
- ❖ Self-reported number of trips reduced
- ❖ Proportion of work and non-work trips
- ❖ Knowledge of ozone message
- ❖ Average trip lengths
- ❖ Emission factors



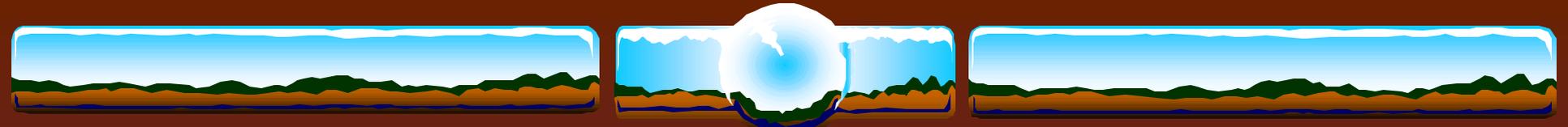
CARB METHOD

Original Title of Research:

“Quantification Methods for Identifying Emission Reductions Resulting from Episodic and Seasonal Public Education Programs”

Working Title:

“Spare the Air Quantification Method”



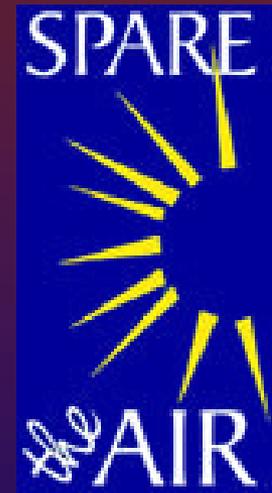
Research Sponsors

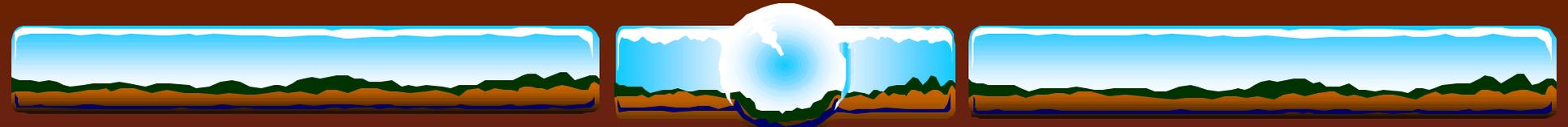
Funders:

- ❖ California Air Resources Board
- ❖ US Environmental Protection Agency
- ❖ Federal Highway Administration
- ❖ Sacramento Metro AQMD

Also:

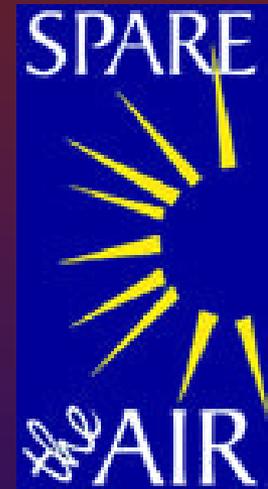
- ❖ Caltrans
- ❖ Bay Area AQMD
- ❖ San Joaquin Valley AQMD

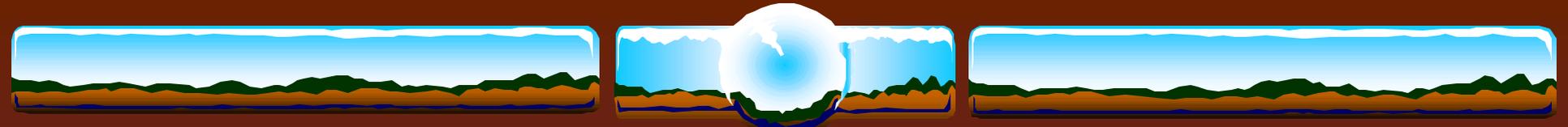




Research Team

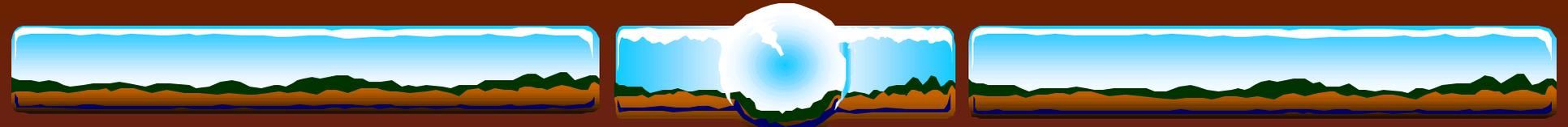
- ❖ Joann Lu, CARB
- ❖ Jeff Weir, CARB
- ❖ Eric N. Schreffler, ESTC
- ❖ Godbe Research and Analysis
- ❖ K.T. Analytics
- ❖ ENVIRON (EarthMatters, Kenneth Train, Phd)
- ❖ Gary Hawthorn Associates





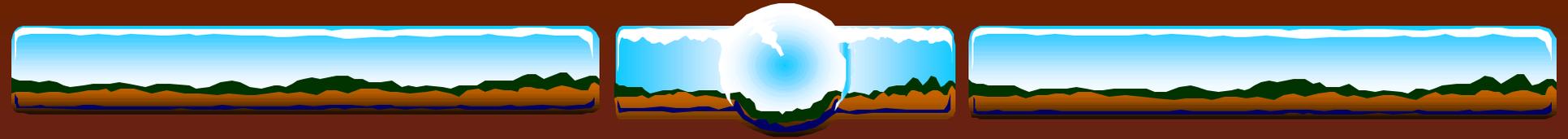
ESTC Evaluation Background

- ❖ Evaluated federal TDM demo projects
- ❖ Projected impacts of employer programs
- ❖ Helped develop Employee Trip Reduction models
- ❖ Evaluated impacts of TCM projects in California
- ❖ Developed standardized methods
- ❖ Developed regional evaluation approaches



Research Objectives

- ❖ Method to Quantify Trip and Emission Reductions
- ❖ Affordable for Use by Air Districts
- ❖ Accurate and Rigorous
- ❖ Develop Correction Factor to Adjust Survey Findings
- ❖ Acceptable to ARB and EPA for SIP Credit

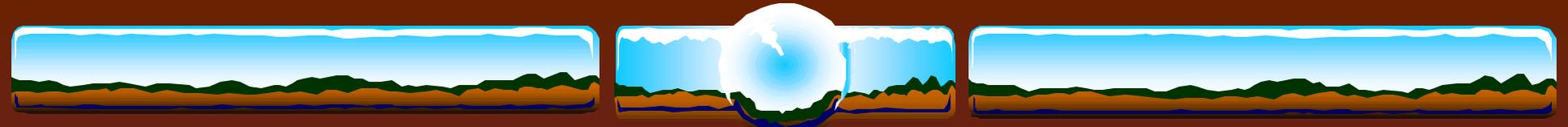


Research Definitions

STA = Spare the Air

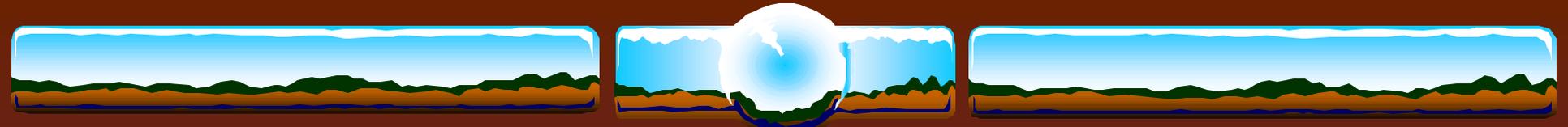
Reducer = Driver who purposely reduces trips because of STA

Non-Reducer = Driver who did not respond to STA message



Research Design

- ❖ Track Behavior of Reducers and Control Group
- ❖ Compare STA Day Behavior to Other Days
- ❖ Compare Reducer Behavior to Non-reducers
- ❖ Develop Estimate of Actual Trip Reduction
- ❖ Compare Actual to Reported Trip Reduction
- ❖ Produce Correction Factor for Trip Reduction

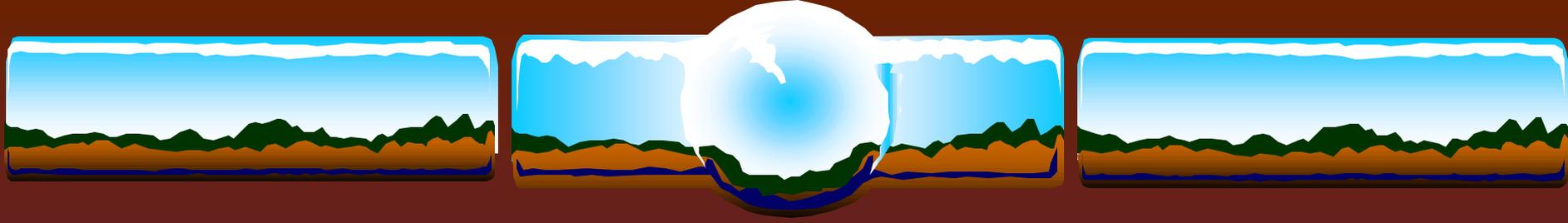


Key Comparisons

Travel behavior of respondents who “purposely reduced” driver trips on STA days versus non-STA days (Treatment)

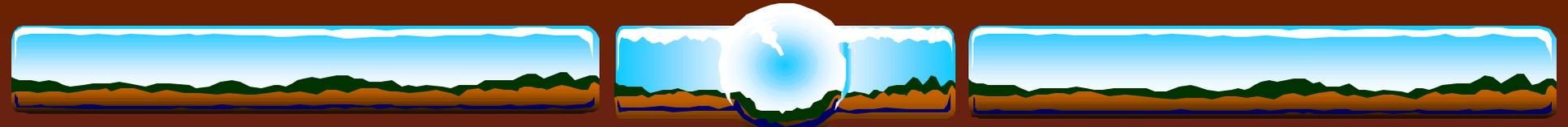
and

Travel behavior of all other drivers on STA days versus non-STA days (Control)



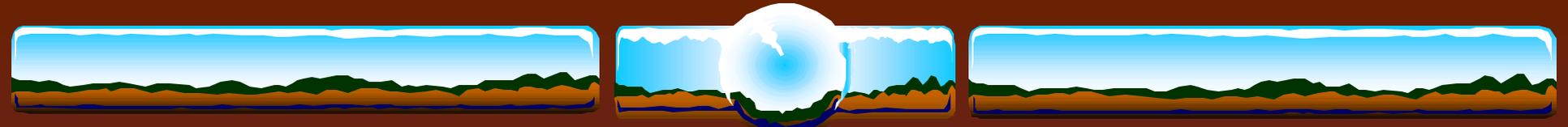
RESEARCH ON EPISODIC PROGRAM

Spare the Air Program
Sacramento, California
Summer 1999 and 2000



Sacramento Surveys

- ❖ Developed “Reducer” and “Standard” Surveys
- ❖ Fielded Surveys Evening After STA Alert
- ❖ Followed-up on Non-STA Day
- ❖ Surveyed Summer of 1999 and 2000 in Sacramento
- ❖ Called Almost 4,000 People
- ❖ Resulted in 134 Reducers and 177 Non-reducers with Paired Surveys

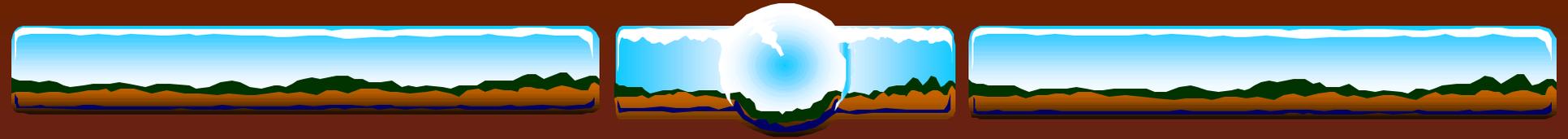


Net Average Trip Reduction

Reducers made *0.4478* fewer trips on STA days as compared to Non-STA days

Control group made *0.6497* MORE trips on STA days

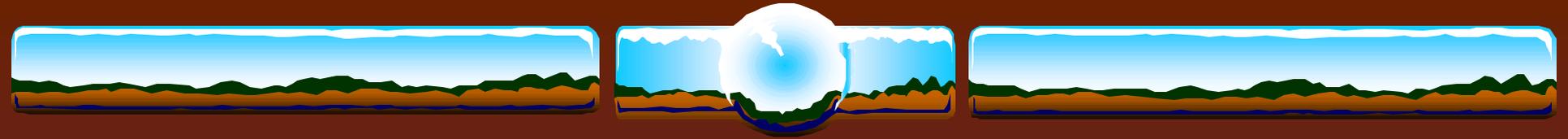
Net average trip reduction = $0.4478 - (-0.6497)$
= ***1.0975*** trips reduced by “reducers”



Self-Reported Trip Reduction

Summary question about how many trips reducers eliminated equaled:

2.2 fewer trips

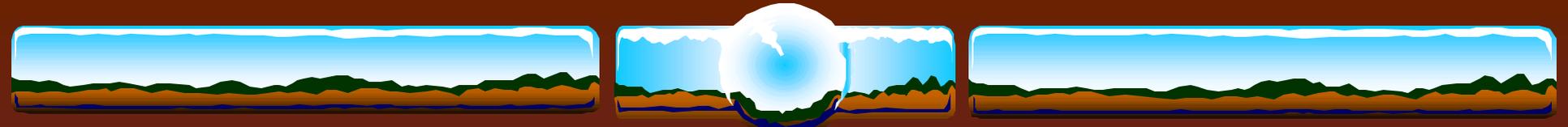


Correction Factor

$$\text{Correction Factor} = \frac{\text{Net Measured Average Trip Reduction}}{\text{Average Self-Reported Trip Reduction}}$$

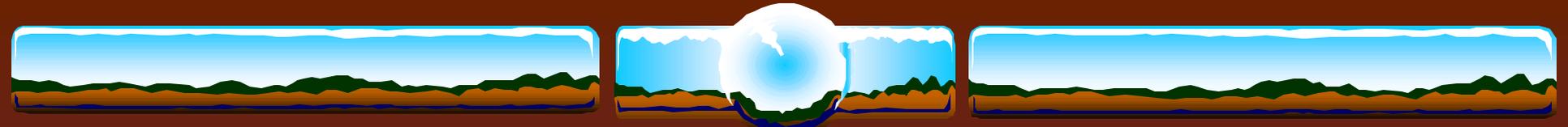
$$\text{Correction Factor} = \frac{1.0975}{2.2} = \mathbf{0.50}$$

People actually reduce $\frac{1}{2}$ of a trip for every reported trip reduced



Sacramento Results

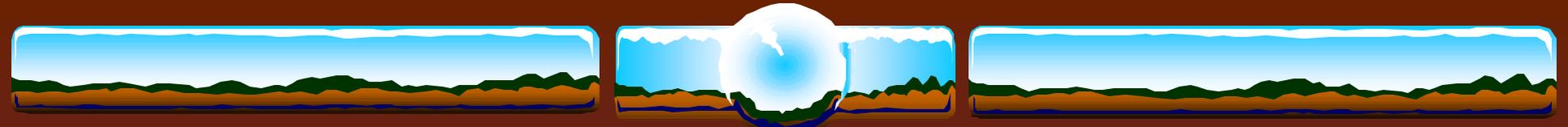
- ❖ About 5% of drivers reduce trips for STA
- ❖ They report reducing 2.2 trips
- ❖ They actually reduce 1.1 trips
- ❖ They eliminate or postpone trips
- ❖ They reduce non-work trips
- ❖ Reduced 0.35 tons/day NO_x; 0.37 tons/day ROG and 0.06 tons/day PM₁₀



Characteristics of Reducers

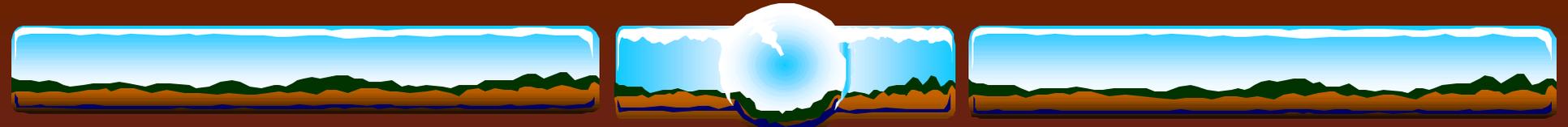
Multivariate Analysis of Following Variables:

1. Vehicles per household
2. Age
3. Children under 18
4. Drivers per household
5. Employment status
6. Parking \$ paid
7. Employer notification
8. Employer TDM program
9. Education level
10. Gender



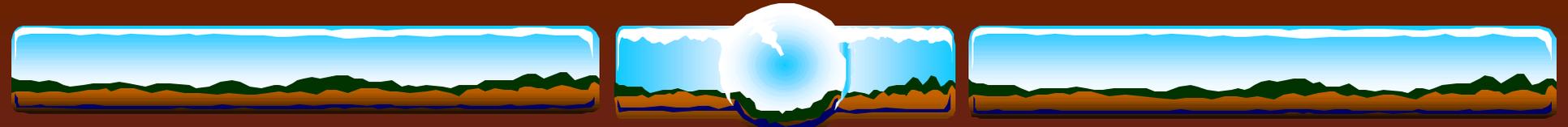
Logistic Regression Results

- ❖ Those working at employer sites that give air quality alerts about 1.6 x more likely to be reducers
- ❖ Women about 1.6 x more likely to be reducers than men
- ❖ Those with larger families (3 or more children) about $\frac{1}{4}$ as likely to be reducers



Summary of CARB Method

- ❖ Ask if they purposely reduced driving
- ❖ Ask how many trips they reduced
- ❖ Ask what kind of trips they reduced
- ❖ Ask why they reduced trips
- ❖ Ask if they knew it was an STA day
- ❖ Apply correction factor to reported reduction
- ❖ Apply reduction to population of reducers
- ❖ Calculate VMT and emission impacts

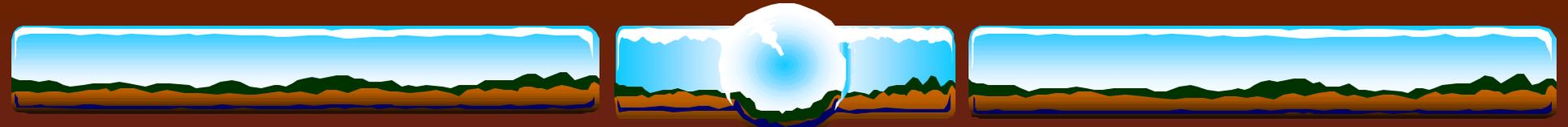


Recommended Method

Step 1 - Modify Survey and Sample Size

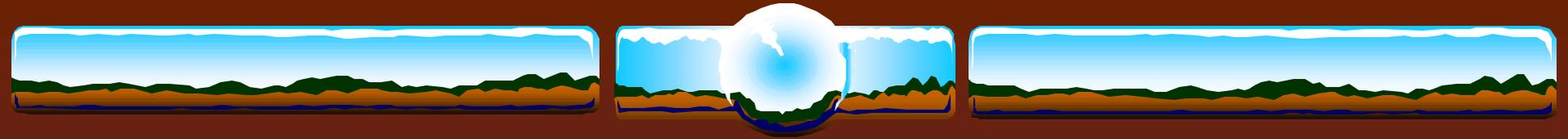
- ✓ Add questions for % of reducers, reported trip reduction, and type of trip reduced
- ✓ Sample size of about 1,000 to get acceptable error for estimate

Step 2 – Field Survey Right After STA Day



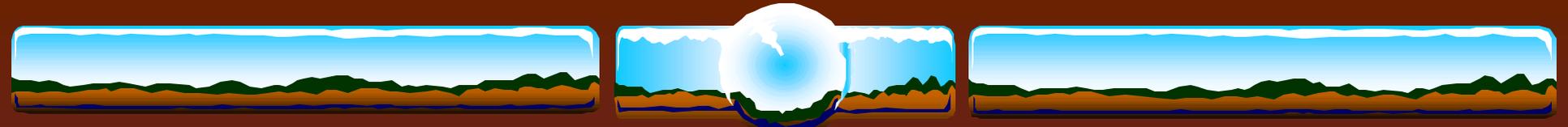
Survey Topics

1. Did you purposely increase or decrease the amount of driving you did today?
 - 2a. How many trips did you decrease?
 - 2b. How did you decrease each trip?
 - 2c. What kind of trip did you decrease?
 - 2d. Why did you reduce the trip?
3. Are you aware of Spare the Air or AQ ads?



Survey Tips

- ❖ Need random sample of drivers
- ❖ Use Random Digital Dial telephone survey
- ❖ Avoid self-selection – e.g., alert recipients
- ❖ Sample size depends on “incidence” and trips reduced
- ❖ Don’t ask leading questions
- ❖ Ask about STA awareness at very end
- ❖ Be aware of survey biases



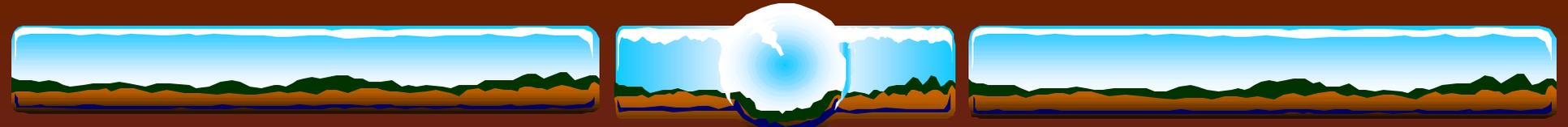
Recommended Method

Step 3 – Tabulate Results

- ✓ Proportion of reducers
- ✓ Reported average number of trips reduced
- ✓ Type of trip reduced (% work vs. non-work)

Step 4 – Estimate Total Reducers

- ✓ Apply proportion of reducers to driving population (equal to RDD sample)



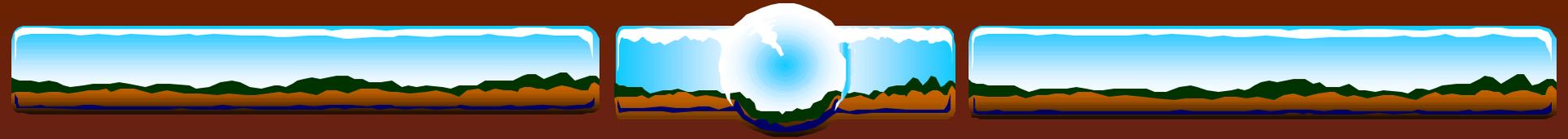
Recommended Method

Step 5 – Estimate Average Trip Reduction

- ✓ Derive self-reported trip reduction from survey

Step 6 – Apply Correction Factor

- ✓ Multiply correction factor (0.5) to average self-reported trip reduction from Step 5



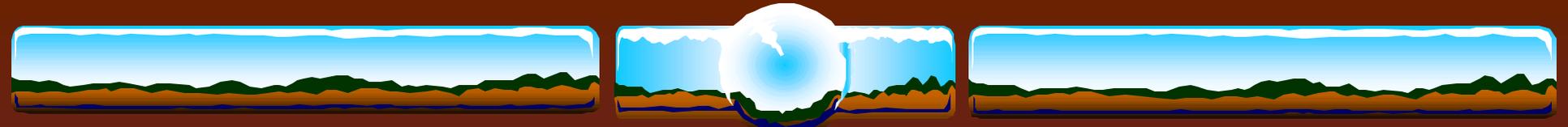
Recommended Method

Step 7 – Estimate Total Trip Reduction

- ✓ Multiply adjusted trip reduction (Step 6) by total reducers (Step 4)

Step 8 – Determine Proportion of Work and Non-work Trips Reduced

- ✓ Apply proportions of work and non-work trips reduced to adjusted total trip reduction



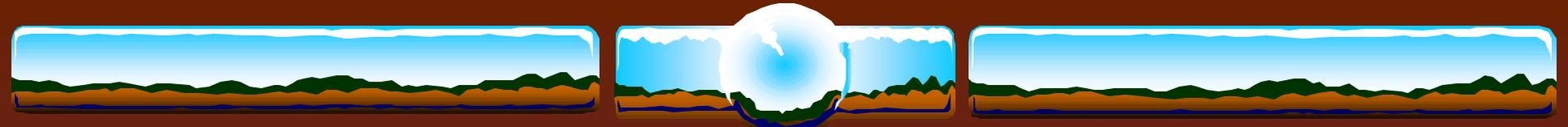
Recommended Method

Step 9 – Estimate VMT Reduction

- ✓ Multiply trips reduced by type (Step 8) by average trip length by type (work and non-work)

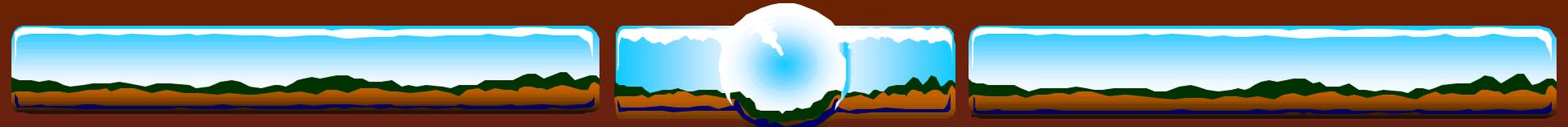
Step 10 – Estimate Emission Reduction

- ✓ Apply emission factors to total trip (by type) and VMT reduction



Summary of Method

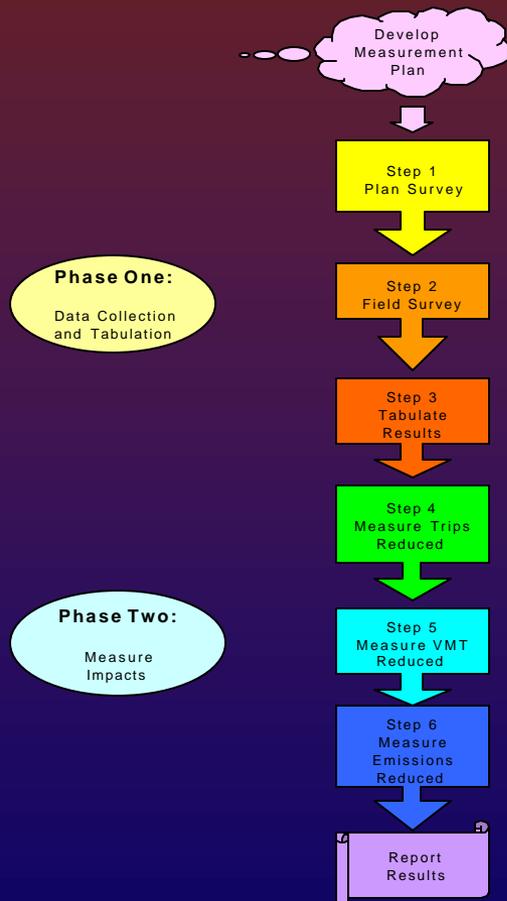
- ❖ Run measurement plan by USEPA
- ❖ Add three revised question strings to regional follow-up survey
- ❖ Adjust and readjust sample size
- ❖ Apply correction factor to self-reported trip reduction
- ❖ Calculate emission reductions



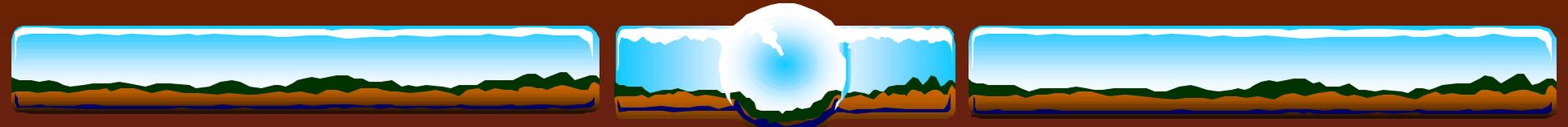
GENERAL GUIDANCE

- ❖ Think through forecasting and measurement issues when designing program
- ❖ Maintain consistency in approach/methods
- ❖ Develop measurement plan – get help
- ❖ Don't just do it for SIP
- ❖ Minimize assumptions and borrowed factors
- ❖ Minimize self-reporting bias

GUIDANCE DOCUMENT



- ❖ Developed Guidance Manual for Air Districts
- ❖ Reasons for Evaluating Program
- ❖ Steps for Using Method
- ❖ Tips on Planning Evaluation
- ❖ Case Study from Bay Area
- ❖ Sample Survey from Bay Area

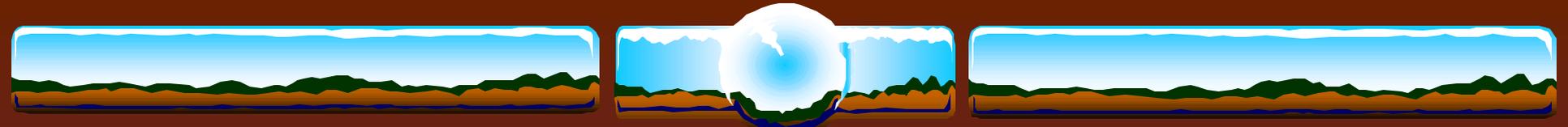


Report Available Soon

Research Report, including Guidance Manual,
available soon at:

www.calepa.ca.gov/library

under “ARB Collection”



ADDITIONAL CARB TOOLS

Automated Methods to Find the Cost
Effectiveness of Funding Air Quality Projects

Determining the Cost Effectiveness of Employer
TDM Programs

www.arb.ca.gov/planning/tsaq/eval/eval/htm