CAIR+ and Public Health

Monetized public health benefits of additional EGU controls

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What did we do?

- Benefits Analysis of Clean Air Interstate Rule Plus (CAIR+) Program
- MARAMA retained ICF consulting to model the April CAIR+ proposal of the Collaborative (*Not the most recent OTC position!*)
  - 18% reduction in SO_2 beyond current CAIR
  - 23% reduction in NO_X beyond current CAIR
- NH DES modeled this scenario in CALGRID
- NESCAUM Calculated Ozone and PM2.5 benefits in BenMAP

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Health Studies-Ozone

Health Endpoint	Studies
Mortality	Five studies, all ages, nationwide.
Hospital Admissions, Respiratory	Five studies in the elderly, one in infants. Performed in four US cities, one Canadian city.
Asthma Related ER Visits	Four studies, all ages, US and Canadian cities.
School Absence Days	Two studes in children, US cities.
Worker Productivity	One study, adults, nationwide.

Choices were made to be consistent with EPA CAIR RIA (Same studies used in NAAQS analysis)
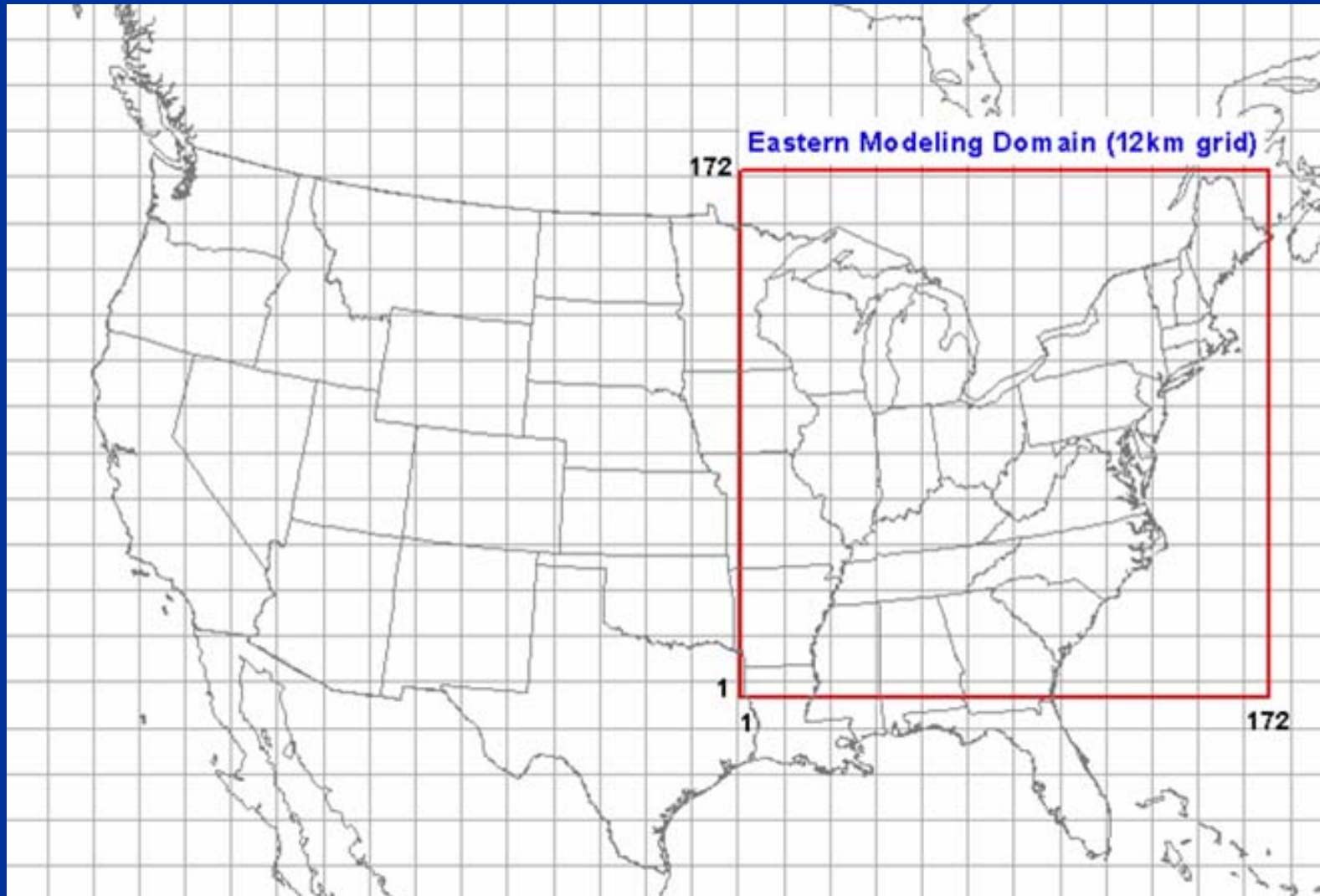
Health Studies- PM$_{2.5}$

Health Endpoint	Studies
Mortality	One study in adults, one study in infants, nationwide.
Chronic Bronchitis	One study in adults, California cities.
Acute Myocardial Infarctions	One study in adults, Boston, MA.
Hospital Admissions, Respiratory	Five studies, all ages, US cities.
Hospital Admissions, Cardiovascular	Three studies in adults, US cities.
Asthma Related ER Visits	One study in children and adolescents, Seattle, WA.
Acute Bronchitis	One study in children, US cities.
Lower Respiratory Symptoms	One study in children, US cities.
Asthma Exacerbation	One study in children and adolescents, two US cities.
Work Loss Days	One study in adults, US cities

Choices were made to be consistent with EPA CAIR RIA

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Value of Avoided Incidence

Endpoint Group	Unit Value of Avoided Incidence (2000$)
Mortality	$6,324,101
Hospital Admissions, Respiratory	$7,759-$25,876 depending on endpoint
Emergency Room Visits	$261-$312
School Loss Days	$75
Work Loss Days	Based on county specific median daily wage
Chronic Bronchitis	$340,482
Acute Bronchitis	$374
Myocardial Infarctions	$66,000-$143,000, depending on age
Lower Respiratory Symptoms	$187
Asthma Exacerbations	$74

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Modeling Domain

Eastern Modeling Domain (12km grid)

CAIR+ Ozone Benefits

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BenMAP Method – Broad Strokes

- Used 2018 and 2002 CALGRID model results provided by NHDES for BOTW and CAIR+

- Modeled May 1st-September 30th

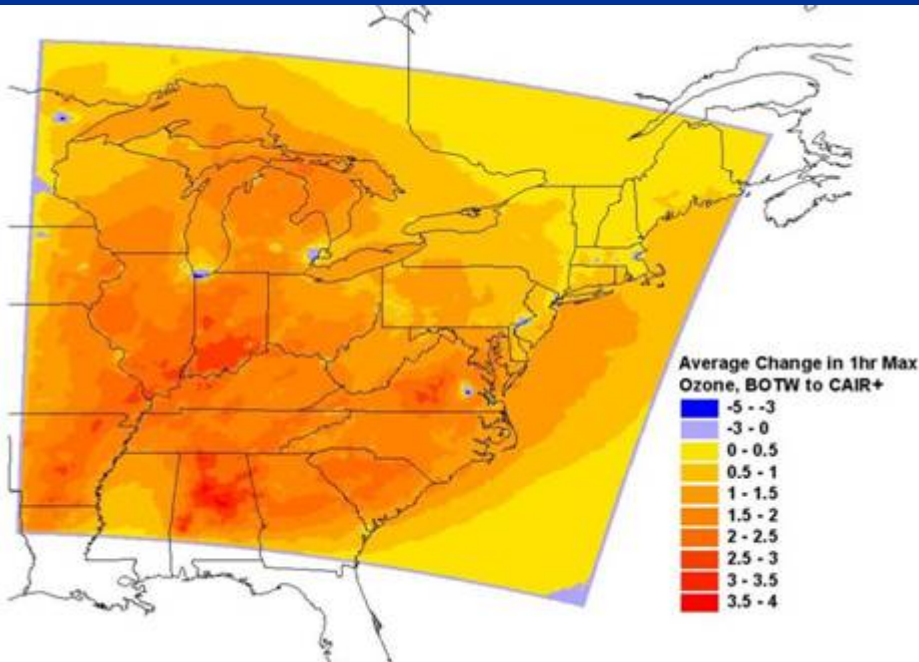- Used model data to scale 2002 AIRS monitor data available within BenMAP
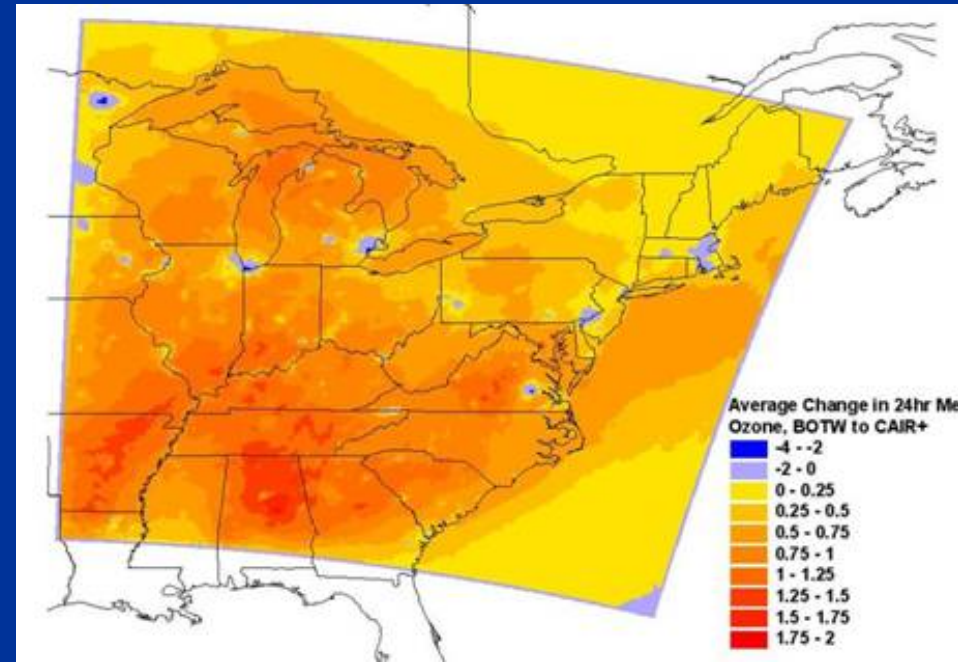
BenMAP Method – Step by Step

- CALGRID data was supplied in an hourly format and used within BenMAP to develop a variety of air quality metrics including 24hr average, 1hr max, and 8hr max

- 2002 AIRS monitor data was interpolated to 172 x 172 grid definition used in CALGRID

- 2002 AIRS monitors were scaled using 2002 and both sets of 2018 CALGRID modeling data to develop two future year air quality projections

- Calculated change in concentrations at each grid cell between BOTW scenario and CAIR+ scenario

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Reduced Ozone Levels in 2018 Modeled by BenMAP

Average change in 1-hr Max

Average change in 24-hr Mean

Average Change in 1hr Max Ozone, BOTW to CAIR+
- -5 - -3
- -3 - 0
- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4

Average Change in 24hr Me Ozone, BOTW to CAIR+
- -4 - -2
- -2 - 0
- 0 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2

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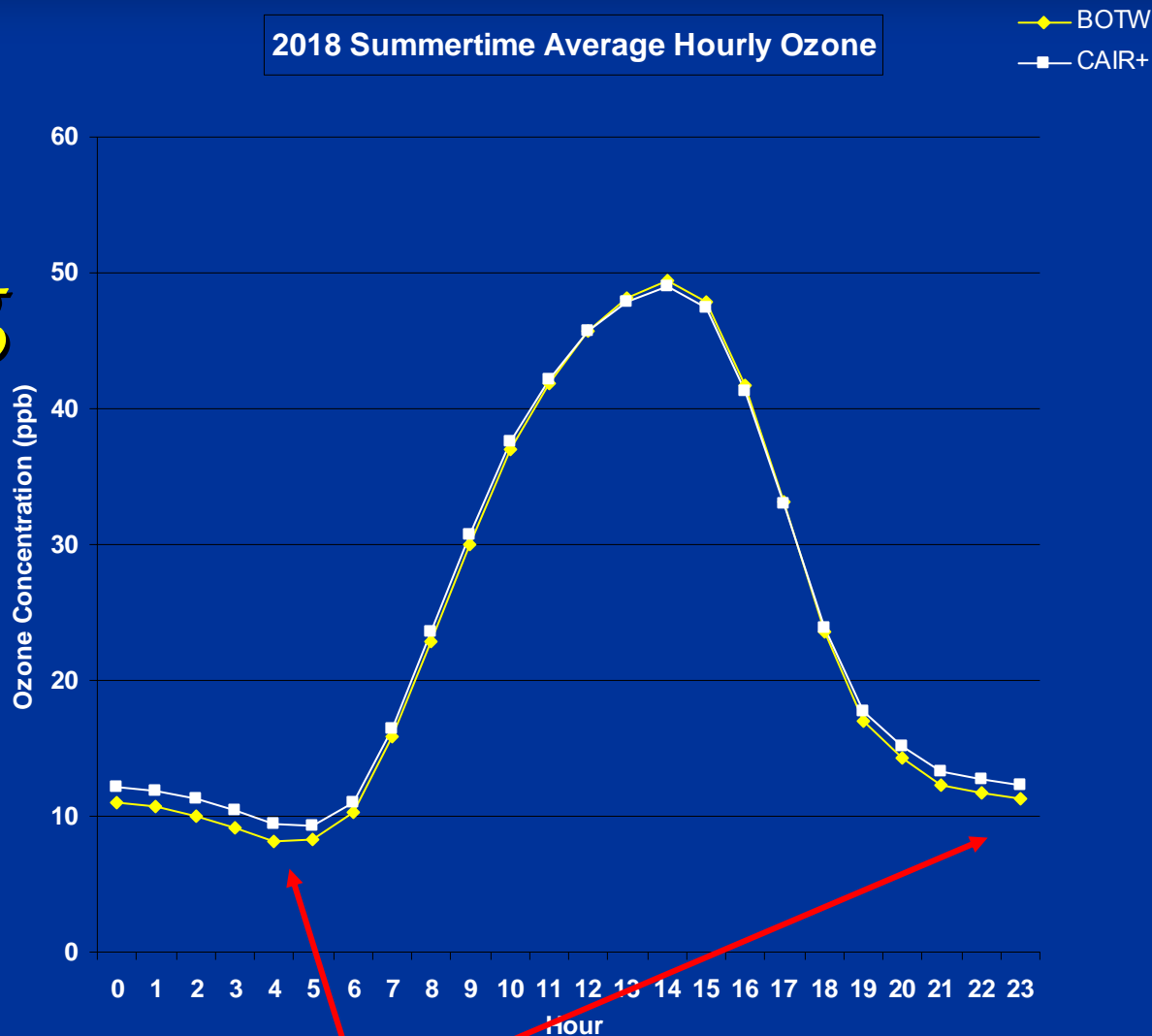
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Reduced NOx Scavenging


June 15th-June 18th Hourly Ozone
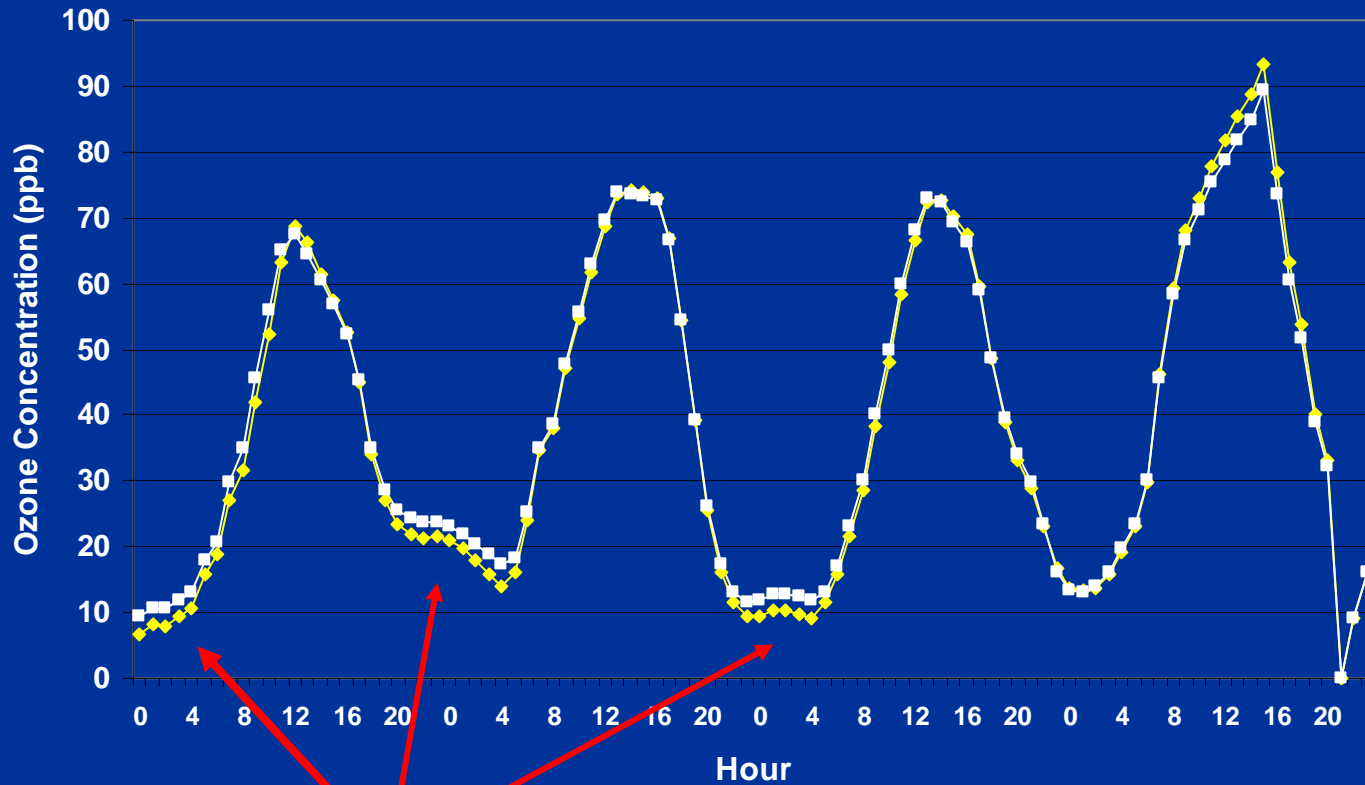
Nighttime NOx Scavenging

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Estimates of Avoided Incidences

due to reductions in ozone through CAIR+

Endpoint	Reduced Incidences in OTR
ER Visits, Asthma	47
Hospital Admissions, All Respiratory Endpoints, >64 Years and <2 Years	407
School Loss Days	77,191
Loss of Income Due to Decreased Worker Productivity	1,707,240
Mortality (Range of Five Studies)	24.4 - 76

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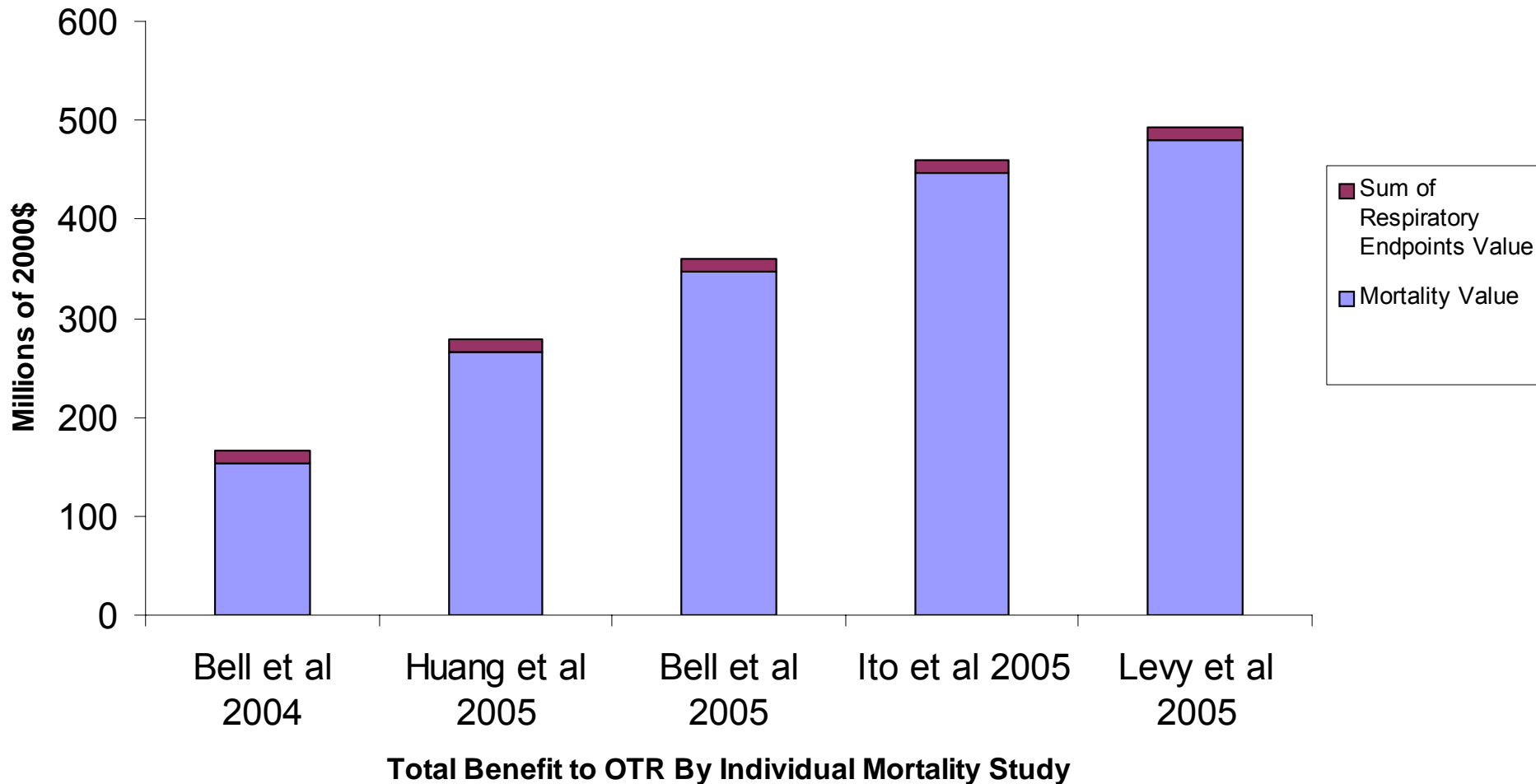
CAIR+ PM$_{2.5}$ Benefits

BenMAP Method – Broad Strokes

- Used 2018 and 2002 CALGRID model results provided by NHDES for BOTW and CAIR+

- Modeled full year in 2018

- Used model data to scale 2002 AIRS monitor data available within BenMAP

BenMAP Method – Step by Step

- Hourly CALGRID data was converted to a daily 24-hr mean input.

- 2002 AIRS monitor data was interpolated to 172 x 172 grid definition.

- 2002 AIRS monitors were scaled using 2002 and both sets of 2018 CALGRID modeling data to develop two future year air quality projections

- Calculated change in concentrations at each grid cell between BOTW scenario and CAIR+ scenario. Used this difference to estimate benefits within each grid cell to estimate avoided incidences.

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Important difference between the two 2018 Scenarios

- BOTW: Used VISTAS IPM assumptions
  - Lower natural gas price
- CAIR+: Used MARAMA IPM assumptions
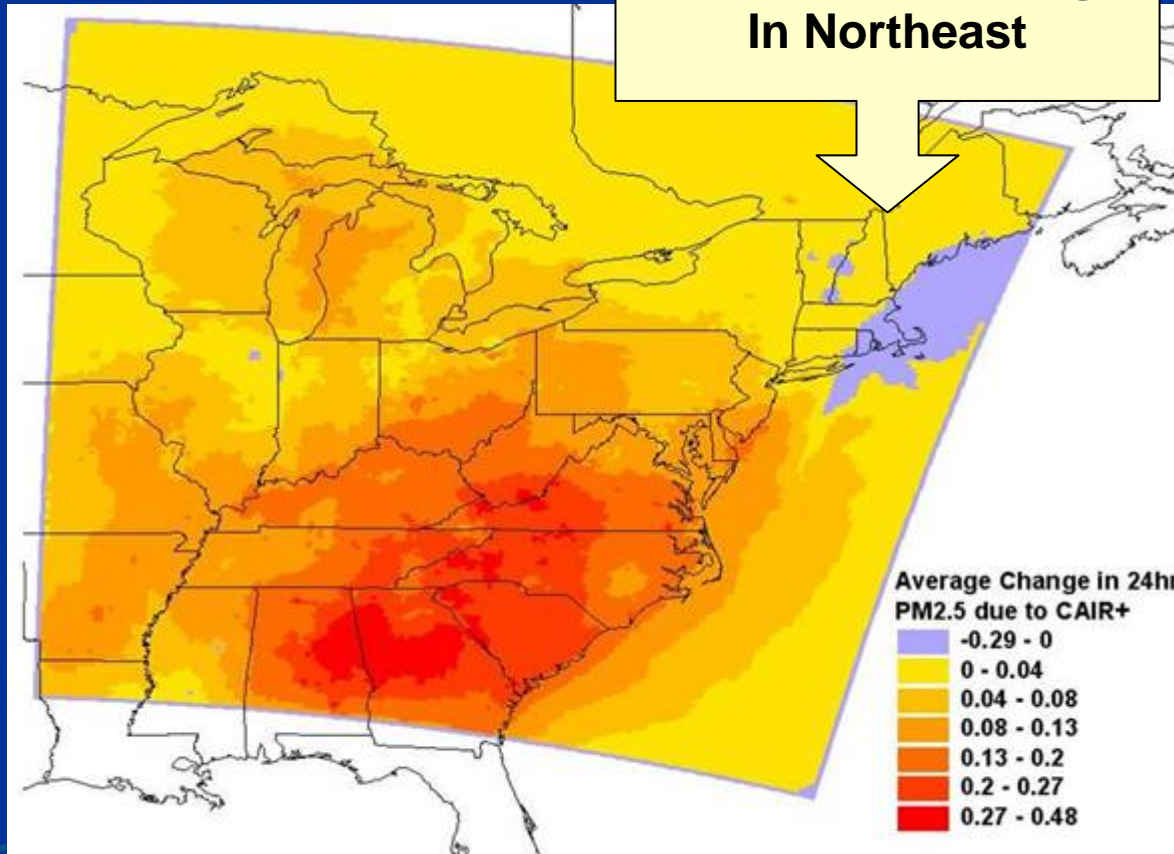 - Higher natural gas price

Bottom Line: Need to develop consistent scenarios to judge state-specific benefits

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Reduced PM$_{2.5}$ Levels in 2018 Modeled by ~~PacMAP~~

Average change

> **Different assumptions in base case lead to more coal and less gas In Northeast**

Average Change in 24hr
PM2.5 due to CAIR+

- ▨ -0.29 - 0
- ▨ 0 - 0.04
- ▨ 0.04 - 0.08
- ▨ 0.08 - 0.13
- ▨ 0.13 - 0.2
- ▨ 0.2 - 0.27
- ▨ 0.27 - 0.48

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Estimates of Avoided Incidences

due to reductions in $PM_{2.5}$ through CAIR+

Endpoint	Reduced Incidences in OTR
Mortality	230
Acute Bronchitis (Children, ages 8-12)	320
Acute Myocardial Infarctions (Adults ages 18 and older)	400
Asthma Exacerbation Symptoms	9400
Chronic Bronchitis (Adults 27 years and older)	150
Emergency Room Visits for Asthma (Children 17 years and younger)	170
Hospital Admissions, Cardiovascular Symptoms	130
Hospital Admissions, Respiratory Symptoms	100
Work Loss Days (Adults 18-65 years)	27000
Lower Respiratory Symptoms (Children, ages 7-14)	3800

Estimated Value of Avoided Incidences
due to reductions in $PM_{2.5}$ through CAIR+

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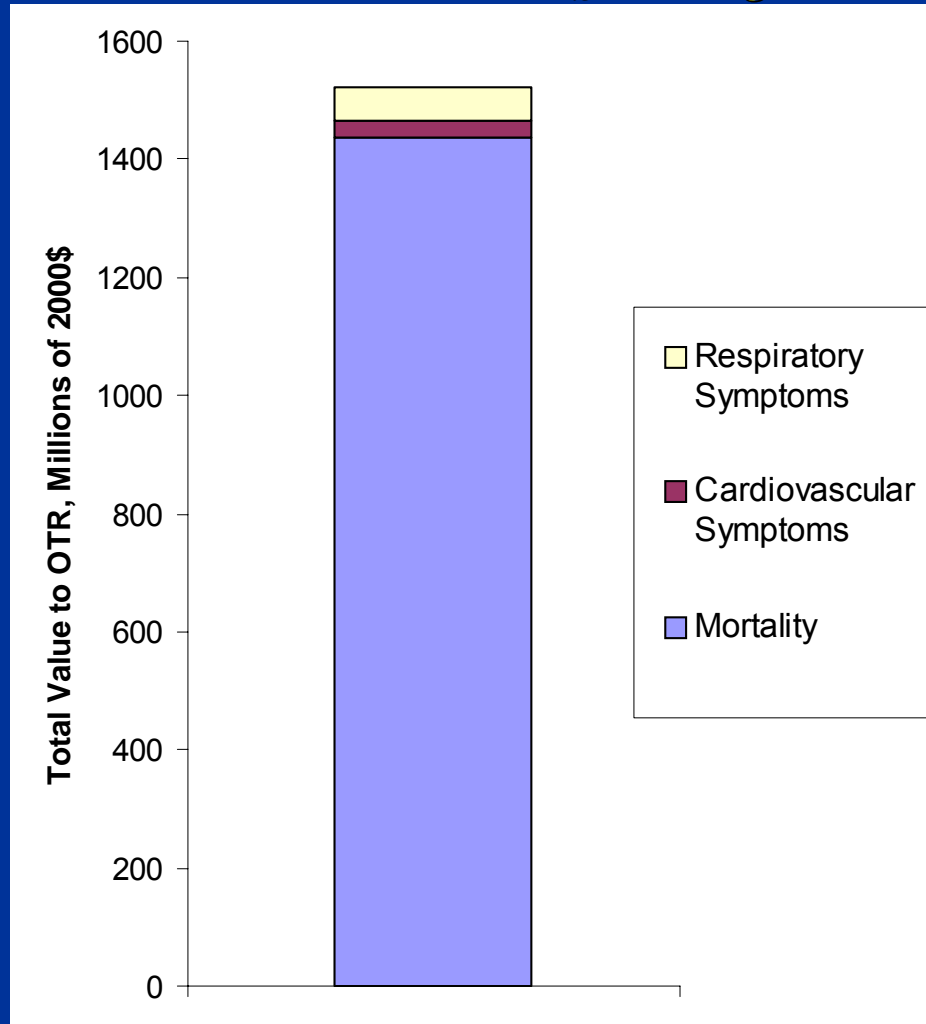
Summary of Benefits
CAIR+ in OTR

- $167 million to $493 million due to ozone reductions

- $1.5 billion due to $PM_{2.5}$ reductions

- $1.7 billion to $2.0 billion combined annual benefits

Summary of Benefits
CAIR+ *outside* OTR

- Additional $560 million to $1.4 billion due to ozone reductions

- Additional $4.4 billion due to $PM_{2.5}$ reductions

- Greater than $6.7 billion to $7.8 billion total annual benefit in the East!

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