

The Economic Benefits of the Use of Air Quality Information & Forecasts: *Explorations in New England*

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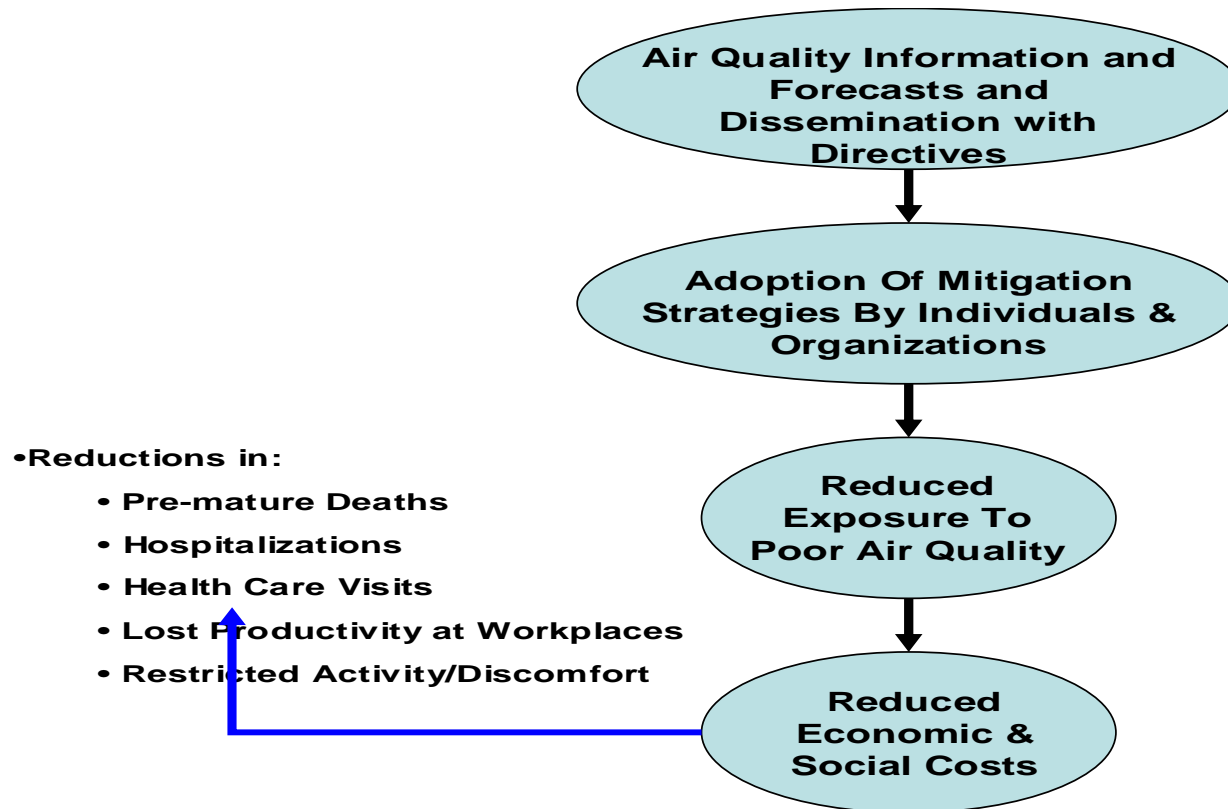
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Trying to gain insight about the economic value of air quality information and forecasts

- As air quality information and forecasts (AQIF) increase in quantity and quality, a greater number of organizations and individuals are accessing and using the information.
- This would not happen if AQIF had no economic value.
- Yet, relatively little assessment of the uses of air quality information and forecasts and on the economic value of AQIF has occurred.
- This is in contrast to:
 - documentation and awareness of the economic benefits of hurricane and weather information and forecasts
 - documentation of the economic costs, particularly health care related costs, associated with poor air quality.
- Our research working with stakeholders and potential users of AQIF attempts to help fill the gap in understanding about the value – current, and prospective -- of air quality information and forecasts.

AQIF Economic Valuation Conceptual Framework



Vulnerability = Sensitivity - Adaptation

AQIF Value & Challenges

- **Value:**

- Air quality information and forecast's greatest value will most likely be in helping individuals and organizations **avoid the costs of poor air quality**
- Hurricane and weather information and forecasts do not prevent hurricanes or bad weather -- they help individuals and organizations avoid some of their costs.
- AQIF can not prevent poor air quality (at least not directly) but some of its greatest benefits could be in helping individuals and organizations avoid some of the costs of poor air quality.

- **Challenges:**

- Realization of the economic value of AQIF will require stimulating interest and suggesting --with specific examples- the potential uses and value of AQIF.
- Putting this in perspective ... 50 or so years ago not many people would have anticipated the high public interest and industry and public use and economic benefits of weather and hurricane information and forecasts.



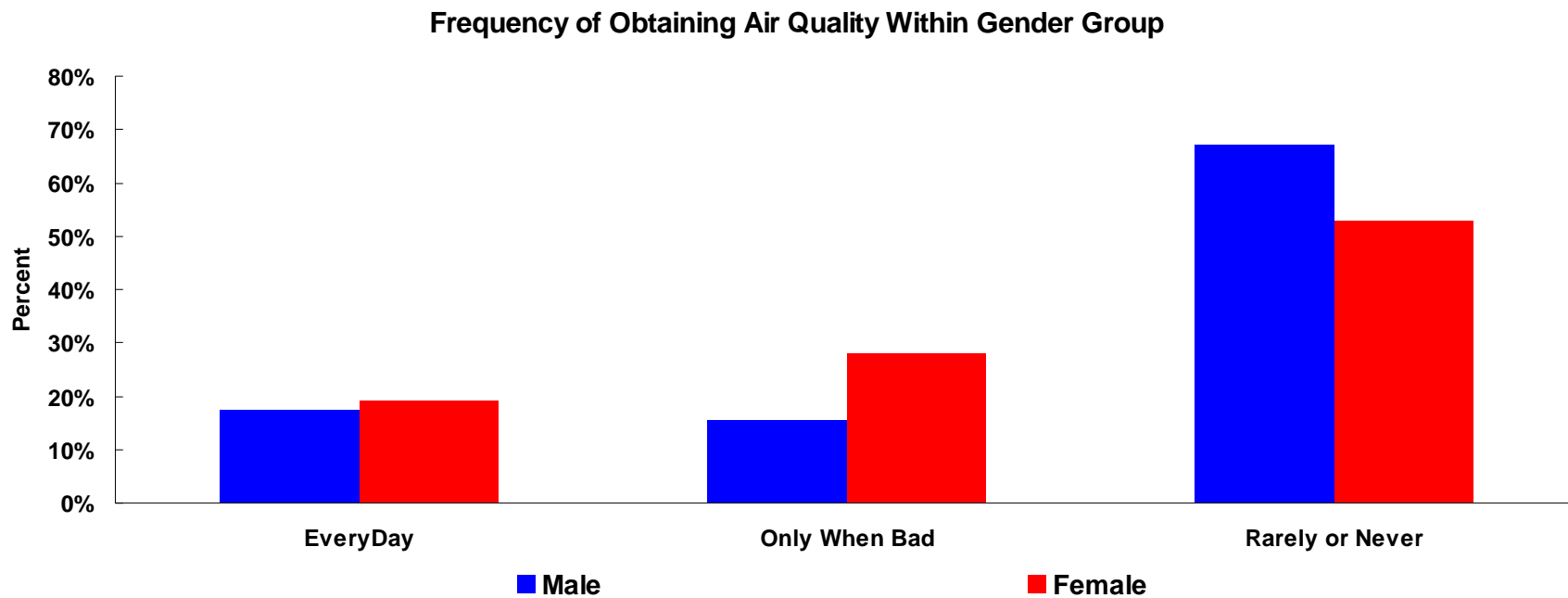
Summary of findings...Use of AQIF

- ***The majority of New England residents never access AQIF.***
- Well over one-half of respondents in a representative New England sample **never** access air quality information and forecasts.
- The respondents most likely to access AQIF regularly were asthmatics and others who suffer from conditions most affected by poor air quality. Still, only about one-half of individuals in this category access AQIF on a regular basis.
- A slightly but significantly higher percentage of women than men access AQIF. This may be indicative of females being responsible (more so than males) for child and elderly care and these groups' relatively high vulnerability to poor air quality.
- The use of AQIF is not significantly higher in the more urban states in the New England region with higher incidence of poor air quality (Connecticut and Massachusetts) than in the more rural states with lower incidence of poor air quality (such as New Hampshire).

Results from a Phone Survey to a Representative Sample of New Englanders

	MA	ME	RI	NH	CT	Total Survey
Table 1: Respondent Frequency of Accessing AQIF						
Percentage of Respondents by State Who Received Air Quality Information <u>Every Day</u>	19%	18%	15%	14%	11%	16%
Percentage of Respondents by State Who <u>Rarely or Never</u> Receive Air Quality Information	59%	63%	61%	65%	52%	59%

Frequency of Obtaining Air Quality Information Within Gender Group



Health and Productivity Outcomes

- Employee Survey
- NE Population Phone Survey
- Hospital & Health Clinic Data Analysis



New England Population, Phone Survey, Summer 2005 Large Employer, Internet Survey, Summers 2004-2005

	Phone Survey	S04 Surv	S05 Surv
Initial # of Respondents	437	470	280
Male	39.6%	30.7%	30.0%
Female	59.3%	68.4%	68.0%
Mean Age	50	43	43

–Summer 2004 large employers: Cisco Systems, UNH ,Exeter, W-D and Portsmouth Hospitals

–Summer 2005 large employers also included: Bottomline Technologies and Timberland



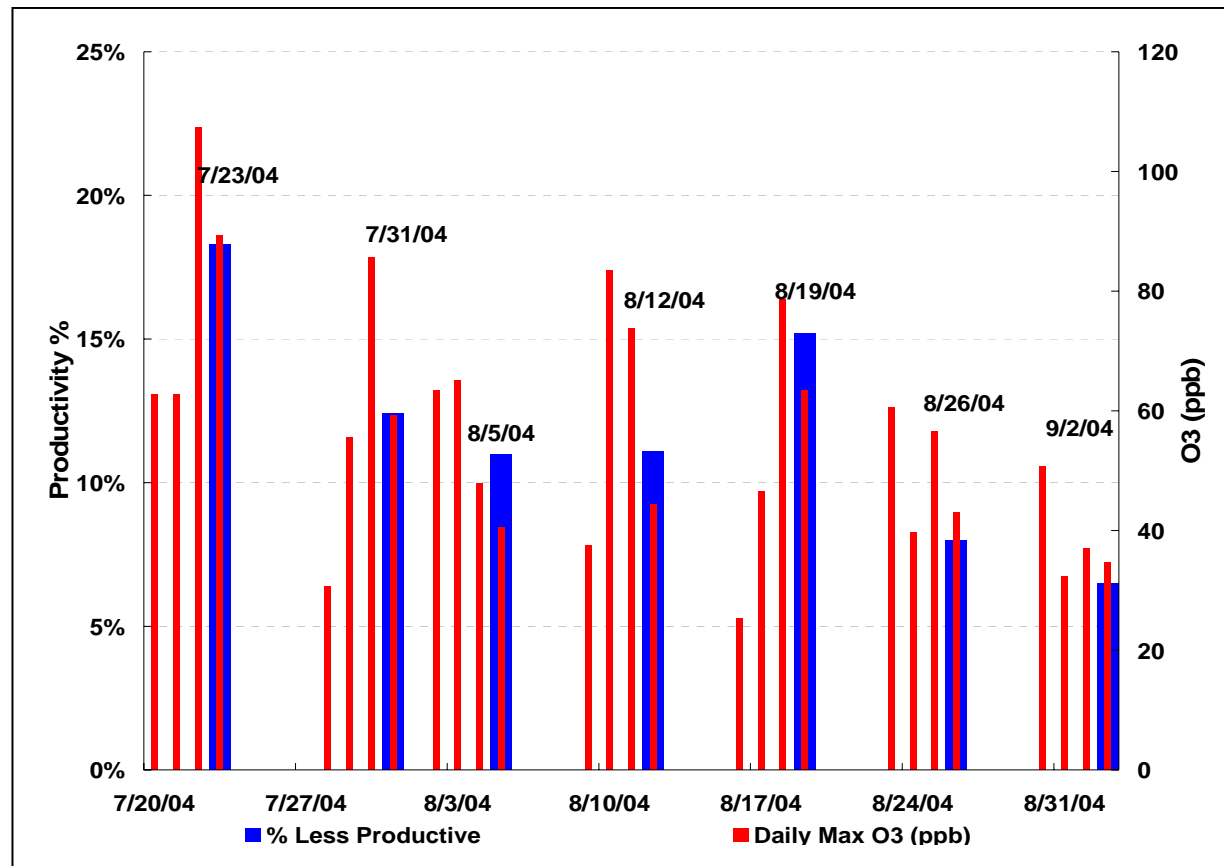
Findings...

Ozone and Worker Productivity

- In the Summer of 2004 a significant negative correlation between ozone levels and self-reported indoor worker productivity (among workers at large employers in Seacoast) was strongly indicated. Higher ozone levels were associated with lowered indoor worker productivity.
 - About **one of every eight workers** that participated in an Internet-based employee survey at large employers reported experiencing productivity decline when there were high levels of ozone.
 - The total worker product lost in New England to bad air quality is estimated at almost \$120 million in the Summer of 2004.
 - If 20 percent of that worker product loss could be avoided by the adoption of mitigation strategies based on air quality forecasts, the economic value (of the forecasts) would have been more than \$23 million in one summer in New England.
 - *This estimate of economic benefits from AQIF is only for short-term annual improvements in worker productivity in New England. It does not take into account any of the potential benefits to employers and employees from avoiding medical costs and lost days at work.*

Relationship Between Productivity and Ozone.

Peaks in Ozone and Lost Productivity on 7/23, Employee Survey 2004



Summer of 2005 mixed findings regarding Ozone levels and Lost Productivity

- The confounding effects of warm and humid weather (in the Summer of 2005 the Seacoast of New Hampshire had average temperature 3.3 degrees warmer than in the Summer of 2004) made it difficult to separate out the impact of poor air quality on worker productivity in the survey of workers at large employers.
- However, in a separate representative population phone survey of New England residents in the Summer of 2005, maximum daily ozone had a correlation with self-reported days of lowered productivity.

Economic Value Findings... The potential Economic Value of Low Cost Ozone Sensor

- There appears to be market potential for low cost ozone sensor. *This was the main conclusion from a market assessment done by an MBA student at the Whittemore School of Business and Economics under the guidance of a faculty member.*
 - A significant portion of the market potential for the low cost ozone monitor is in its use for compliance -- the monitoring and enforcement of air quality regulations, rules and norms – in both the United States and abroad, and in general use outside the United States.
- The market value of other (e.g., other than the low cost ozone monitor) economically beneficial air quality products and services should be considered and business development fostered, where applicable.
 - Relatively low cost and locally-based pollen monitors and forecasts could be economically beneficial.

Hospitals and Health Clinics

Potential Uses of AQIF in New England

- Exeter Hospital, Portsmouth Regional Hospital and Wentworth-Douglass Hospital
 - Admission and visit records including admission date, zip code and diagnostic codes for 2002, 2003 and 2004
- Community Health Access Network (CHAN)
 - 6 clinics provided data from 131,125 respiratory and cardiovascular visits (8,000 asthma visits) from January 1996 through September 2004

The research team presented preliminary results to each hospital and health clinic and engaged in a two-way dialogue about the findings and how the partners could use them going forward to benefit their patients.



Asthma and Air Quality ..summary

- No significant correlation between asthma admissions and services at Seacoast Hospitals and Community Health Clinics and ozone and particulate matter levels in the Seacoast area appears to exist.
- A correlation of asthma services at Seacoast Hospitals and Community Health Clinics to pollen, specifically ragweed and sage, does appear to exist.
 - A quantitative assessment revealed that if a modest one-fourth of the increased asthma services and treatments due to pollen could be avoided with pollen information and forecasts and effective dissemination (e.g., through health care providers) the savings in hospital costs in the Seacoast of New Hampshire would be about \$75,000.
 - Extrapolating this to the nation as a whole (from the Seacoast's 150,000 population to the approximately 296 million U.S. population) this could potentially result in over \$140 million in avoided health care costs nationally.
- Some relatively low cost pollen forecasts along with effective dissemination could have significant net economic value. They could help inform health care professionals and vulnerable populations and foster preventative measures that could result in avoiding some of the costs and negative consequences of high pollen.

Organizations that will be most likely to profit from and pay for air quality information and forecasts

- Firms whose corporate objectives emphasize reliable service or employee well being
- Risk-averse firms will attach a greater value to forecast accuracy than do risk neutral firms.
- Most likely ...an intermediate level of forecast accuracy will be optimal
- The actual optimal forecast accuracy and expenditure level can be determined with experience, as private firms and forecasters provide air quality forecasts and real data can be used in the model's payoff cells and analysis.

Next Steps..

- A pilot intervention program that includes the strategic use of air quality information and forecasts together with health directives from physicians with Exeter Health Resources in New Hampshire
- This initiative will be documented and evaluated.



Research Partnership with Exeter Health Services

- **We will evaluate the effectiveness of customized air quality information and health directives delivered directly --via e-mail or via automated phone calls -- to patients who suffer from asthma and other respiratory ailments.**
- The approach is consistent with research suggesting that the dissemination of air quality information along with health directives coming from health care providers might be the most effective way to inform and affect patient behavior and to avoid some of the costs associated with poor air quality.
- Public health clinics in New Hampshire also have interest in working with the research team on a similar initiative targeted to low income families if resources are available.



“Follow-up” Research ..*Some Ideas*

- The framework and analysis can provide further insight into the economic value of AQIF if it is used to consider:
 - **Other public health treatments and admissions (other than asthma-related)**. This includes other respiratory ailments caused by poor air quality and cardiovascular ailments suggested by previous research as related to poor air quality.
 - **A fuller range of air quality conditions and factors**, other than ozone and PM2.5, and their affect on worker productivity.
 - **Outdoor workers’ productivity** and how it is affected by air quality.
 - **Locations in other regions of the United States** and in areas with higher incidence of poor air quality, such as central cities.
- Future research of the economic benefits of AQIF should also consider the “feedback” benefits from AQIF identified among the currently most sophisticated users (in the EPA Region 1 survey). This involves motivating -- through raising consciousness and awareness of air quality conditions -- changes in individual behavior and organizational practices that reduce pollution and that can contribute to improved air quality, and thereby reduce the costs of poor air quality.

Conclusion and Looking Forward...

- Inquiry's main contribution is in presenting the case and outlining a path for future inquiry of the economic value of AQIF.
- The suggested path should be:
 - *descriptive*, documenting the current uses and economic value of AQIF;
 - *prescriptive*, suggesting potential future uses of AQIF and formally testing and evaluating those uses;
 - *collaborative*, partnering and engaging with for-profit and non-profit stakeholder and partner organizations; and
 - *multidisciplinary*, engaging business and health policy faculty with atmospheric scientists to help foster economically beneficial applications of air quality information and forecasts.