Strategic Planning for Environmental Health Using UNC's United Arab Emirates Model

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Outline

- Origins and goals of UNC's project to develop an environmental health strategic plan for the United Arab Emirates (UAE)
- UAE background
- UNC's process for developing UAE strategic plan; other elements of UNC's UAE research
- Potential relevance to North Carolina

Project Originated from UAE-World Health Organization (WHO) Request

- Three individuals representing the UAE and WHO visited the Gillings School of Global Public Health on September 19, 2007.
  - Delegation leader: His Excellency Majid Al Mansouri, Secretary General, Environment Agency-Abu Dhabi (EAD)
- Delivered unanticipated request for proposals (RFP) entitled “National Strategy for Environment and Health, United Arab Emirates”
- Only the top three schools of public health in the United States were invited to apply:
  - UNC
  - Johns Hopkins
  - Harvard

Project Sponsor: H.E. Majid Al Mansouri, Secretary General, EAD

All Three Institutions Were Required to Present Proposals in Abu Dhabi

Michael Klag, Dean, Johns Hopkins Bloomberg School of Public Health

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Overarching Goal

"The aim is to enhance the understanding of environmental threats to human health . . . causing increased burden of disease to the people of the UAE."

Specific Products

- UAE National Strategy for Environmental Health
  - Recommended policies and other actions UAE can pursue over the next 10 years to reduce public health threats due to contaminants in the environment
  - To include action plan highlighting priorities for the next four years
- State of Environmental Health in the UAE Report
  - Detailed report of current scientific knowledge of environmental contamination and its effects on health in the UAE
  - To include new, quantitative estimates of the environmental burden of disease in the UAE, based on environmental models built at UNC
  - To include systematic ranking of environmental health threats
- Epidemiologic Study Results
  - New data on effects of indoor air quality on UAE public health
  - New data on diet, lifestyle effects on UAE public health

Broad Scope of Environmental Health Risks Considered

- Ambient air
- Indoor air
- Occupational environments (including agricultural, industrial, construction)
- Potable water
- Recreational water
- Soil
- Seafood, fruits, vegetables
- Electromagnetic fields
- Noise
- Global climate change

Project Presents a Unique Research Opportunity

- UAE can serve as test bed for emerging tools in environmental risk assessment, decision analysis
- Small size, government structure make such a test feasible
  - 4.3 million population (about half the NC population)
  - 83,600 km^2 total area (about 1.5 times the size of North Carolina)
  - Ruled by environmentally aware Sheikh
- Project also presents opportunities for collaborations with scientists in politically important part of the world
- In future, methods and results of this research could be applied to North Carolina, other states, other countries

Research Partners

- UNC is lead institution
- Key partners
  - UAE University
    - Primary research university in the UAE
  - RAND and Resources for the Future
    - Independent, U.S.-based nonprofit policy research organizations
    - RAND's offices in Doha, Qatar, facilitated quick start and regular in-country presence

UAE University, with 16,000 students, is the only federal university in the UAE.

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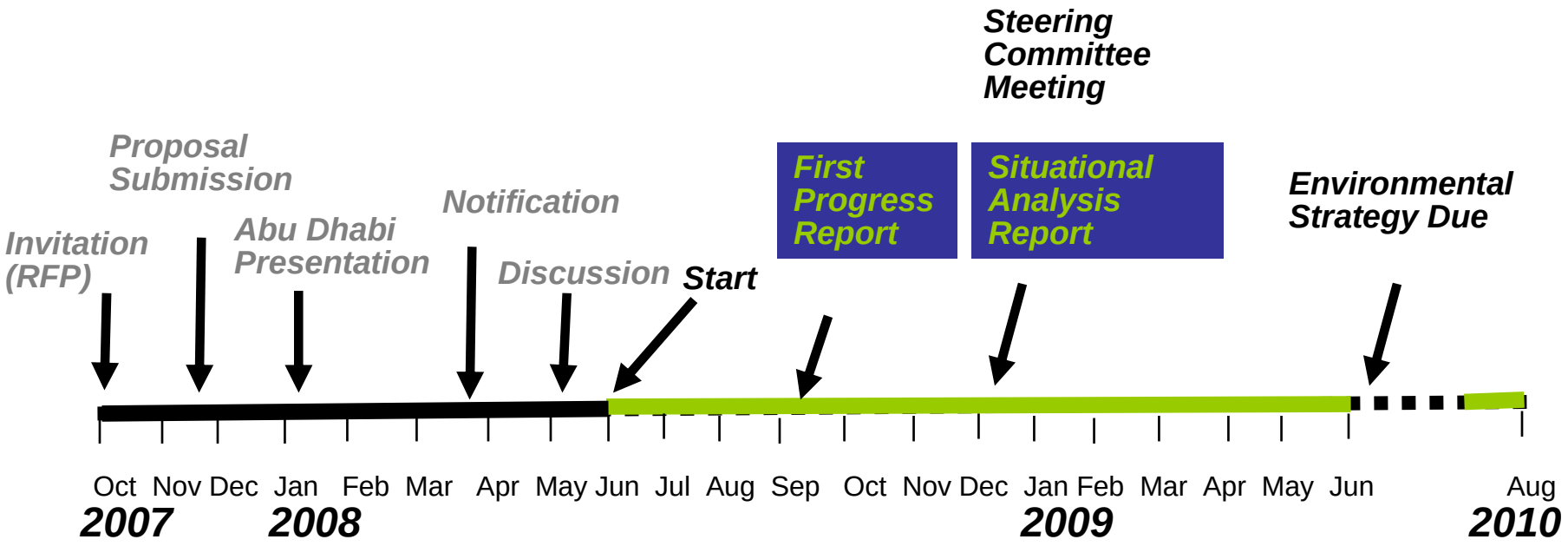
Current Status: Six Months Since Project Start



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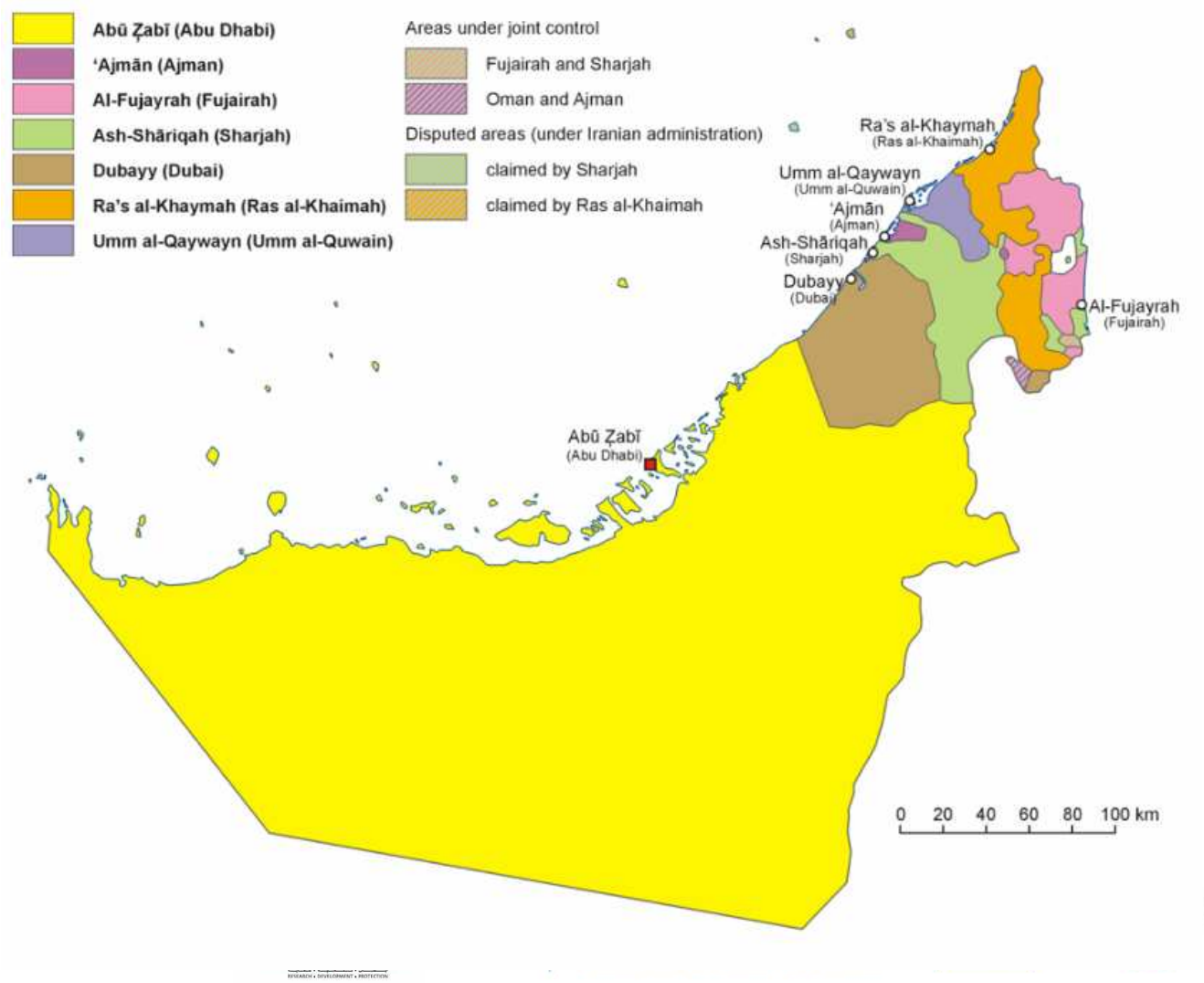
UAE Occupies Northeastern Coast of Arabian Peninsula


Syria
Lebanon
West Bank
Gaza Strip
Iraq
Iran
Jordan
Kuwait
Egypt
Saudi Arabia
Bahrain
Qatar
Dubai
UAE
Oman
Yemen

Confederation of Seven Emirates, Ruled by Sheikhs



Country at a Glance

- Capital city: Abu Dhabi
- Other major cities: Dubai, Sharjah
- Political structure: constitutional monarchy (legislature has advisory role only)
- Population: 4.3 million, 80-85% expatriate
- Life expectancy, income are on par with developed nations:
  - Life expectancy 79 for females, 76 for males (75.6 years in NC)
  - Per-capita income >$26,000 ($26,000 in NC)

UAE Has Modernized at Unprecedented Rate

Abu Dhabi, 1962

Abu Dhabi, 2007

Dubai, 1990

Dubai, 2007

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Highlights of Strategic Planning Process

- Systematic preliminary assessment of public health risks due to the 14 environmental risk factors (contaminated air, water, soil, food, etc.)
- Quantitative, deliberative process for prioritizing the 14 factors based on public health effects
- Detailed modeling of environmental burden of disease for the priority risk factors
- Development of menu of options for mitigating the priority risk factors
- Estimation of the degree to which the options will reduce the environmental burden of disease (using burden of disease models)

Quantitative, Deliberative Method for Ranking Environmental Risks

- Combines quantitative analysis, stakeholder deliberation
- Developed as alternative to ad-hoc efforts to set environmental priorities in 1980s, 1990s
- Empirically tested in a series of experiments
  - 200+ risk managers
  - 100+ lay public participants
  - U.S., China and U.K
- This project represents the first national-scale application

Risk Analysis, Vol. 24, No. 2, 2004

Ecological Risk Ranking: Development and Evaluation of a Method for Improving Public Participation in Environmental Decision Making

Henry H. Willis,[1]* Michael L. DeKay,[2] M. Granger Morgan,[2] H. Keith Florig,[2] and Paul S. Fischbeck[2]

This article reports an extension of the Carnegie Mellon risk-ranking method to incorporate ecological risks and their attributes. On the basis of earlier risk-perception studies, we identified a set of 20 relevant attributes for describing health, safety, and environmental hazards in standardized risk summary sheets. In a series of three ranking sessions, 23 laypeople ranked 10 such hazards in a fictional Midwestern U.S. county using both holistic and multiattribute ranking procedures. Results were consistent with those from previous studies involving only health and safety hazards, providing additional evidence for the validity of the method and the replicability of the resulting rankings. Holistic and multiattribute risk rankings were reasonably consistent both for individuals and for groups. Participants reported that they were satisfied with the procedures and results, and indicated their support for using the method to advise real-world risk-management decisions. Agreement among participants increased over the course of the exercise, perhaps because the materials and deliberations helped participants to correct their misconceptions and clarify their values. Overall, health and safety attributes were judged more important than environmental attributes. However, the overlap between the importance rankings of these two sets of attributes suggests that some information about environmental impacts is important to participants' judgments in comparative risk-assessment tasks.

KEY WORDS: Comparative risk assessment; ecological risk; environmental attributes; human health risk; risk attributes; risk perception; risk ranking

1. INTRODUCTION

Regulators and other risk managers receive frequent input from representatives of a wide variety of special interest groups. Sometimes, they also receive results from surveys in which members of the public have expressed their impressions of various risks. However, what they rarely receive, but very much need in a democracy, are judgments from samples of average citizens who have taken the time to develop thoughtful, informed views about a set of risks (Brown, 1996). Well-developed procedures to support risk ranking are needed to provide such input.

The U.S. Environmental Protection Agency (EPA) report entitled *Unfinished Business* highlighted the use of risk-ranking methods in environmental policy (U.S. EPA, 1987). That report compared the EPA's allocation of regulatory attention to a ranking of the importance of various risks by senior EPA managers and staff. Subsequently, EPA's Science Advisory Board has conducted two agencywide ranking projects (U.S. EPA, 1990, 2000), and the agency has supported several dozen local and regional

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Step 1: Categorize Risks to Be Assessed and Ranked

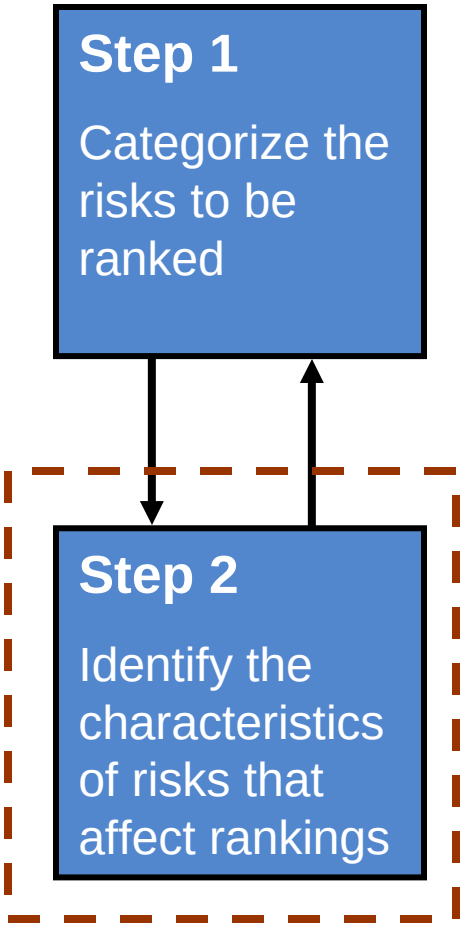
Step 1

Categorize the risks to be ranked

14 Environmental Health Risks Assessed

- Ambient Air Pollution
- Indoor Air Pollution
- Occupational Hazards in Agriculture
- Occupational Hazards in Industry
- Occupational Hazards in Construction
- Drinking Water
- Coastal Recreational Water
- Residential Soil
- Eating Contaminated Seafood
- Eating Contaminated Fruits and Vegetables
- Electromagnetic Fields
- Ambient Noise
- Global Climate Change
- Ozone Layer Depletion

Step 2: Define Characteristics of the Risks That Affect Rankings



- Fatalities
  - Number of deaths per year
  - Chance of death for the **average** resident
  - Chance of death for the resident at **highest risk**
  - Number of deaths in a single event
- Injuries and Illness
  - Long-term vs. short-term
  - Serious vs. less-serious
- Other Factors
  - Time between exposure and effects
  - Level of scientific understanding
  - Uncertainty in risk estimates
  - Controllability of exposures

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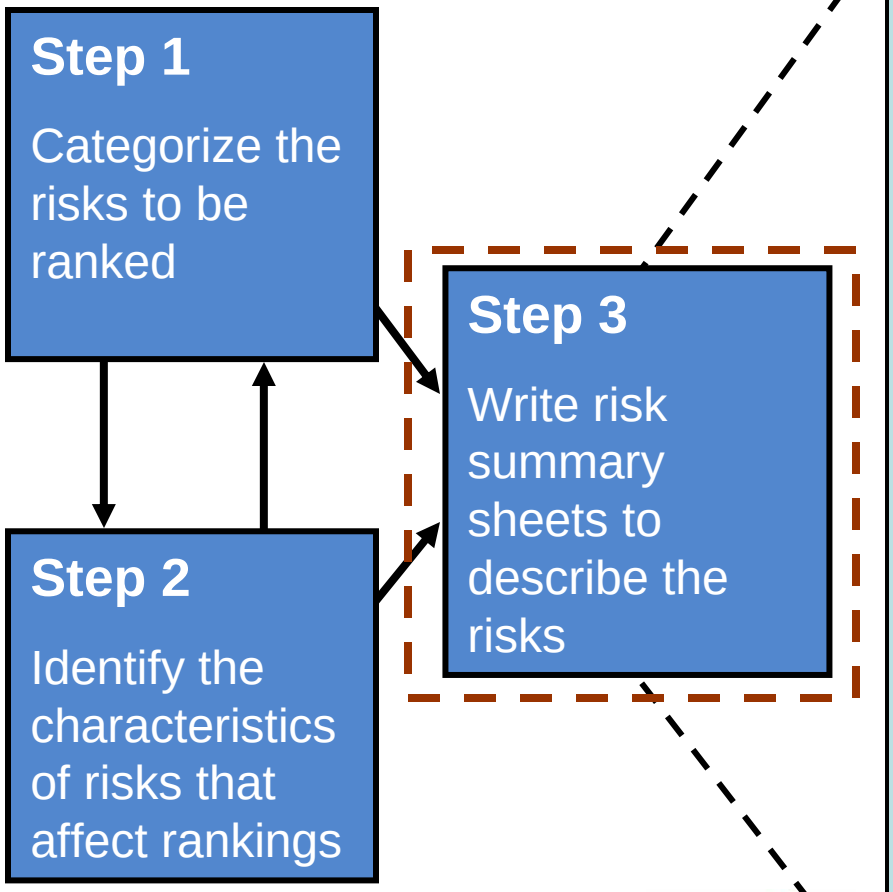
Step 3: Write Risk Summary Sheets



3. INDOOR AIR POLLUTION

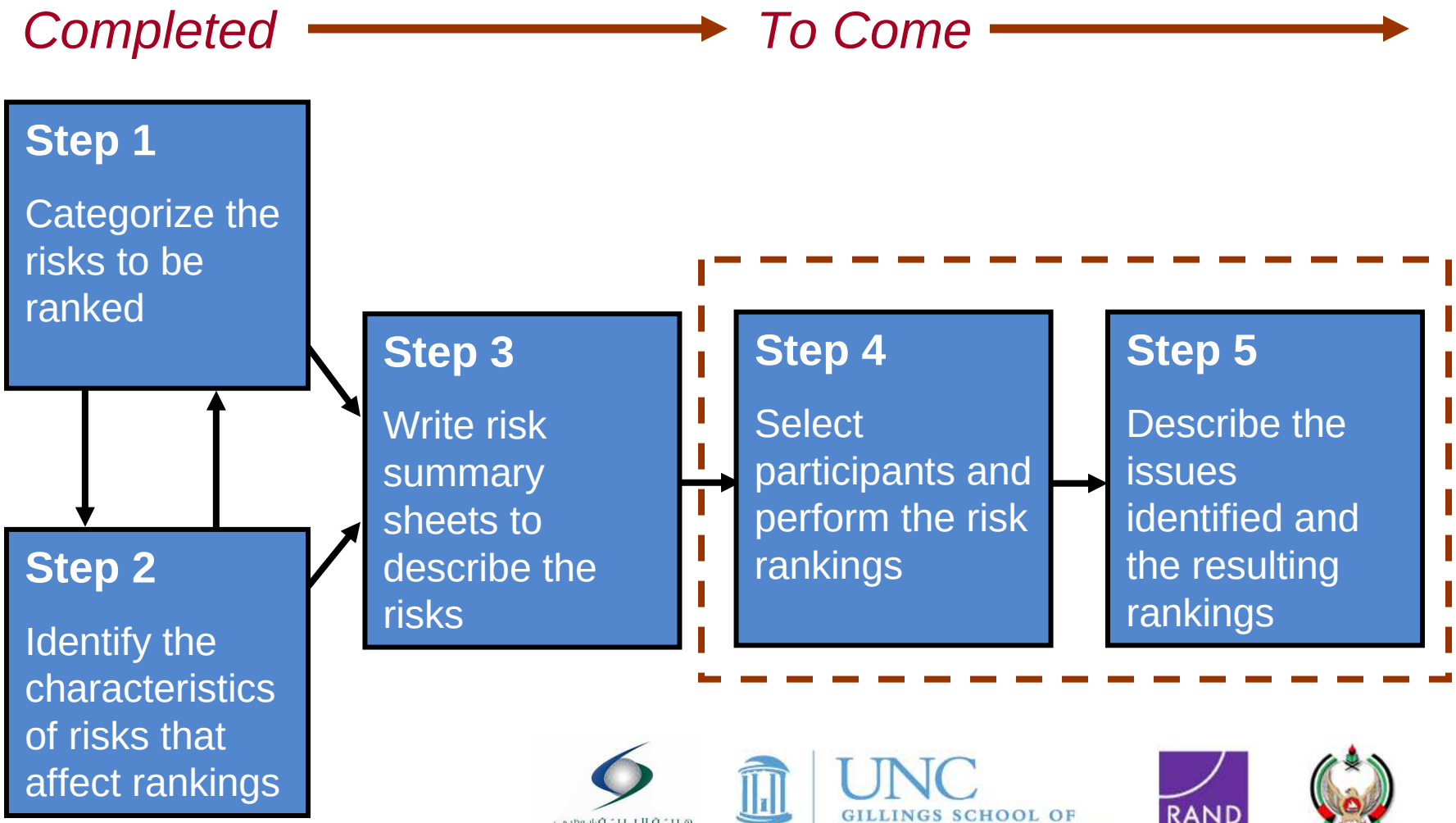
SUMMARY

Indoor air pollutants are found in a number of forms, including environmental tobacco smoke, combustion byproducts, volatile organic compounds, particulate matter, radon, asbestos, heavy metals such as lead and mercury, and mold and biological pollutants. Exposure generally occurs through inhalation and may result in a wide range of health conditions, ranging from acute and chronic respiratory conditions (e.g., sinusitis and asthma, respectively) to cancers of the respiratory tract (e.g., lung cancer).

Table 3.1 Indoor Air Pollution Risk for the United Arab Emirates

Risk Attribute	Low Estimate	Best Estimate	High Estimate
Fatalities			
Number of deaths per year	60	200	300
Chance in a million of death per year for the average resident	20	50	70
Chance in a million of death per year for the resident at highest risk	30	100	140
Greatest number of deaths in a single event	1	7	10
Illness or Injury			
More serious long-term cases per year	Not reported	0	Not reported
Less serious long-term cases per year	Not reported	3,000	Not reported
More serious short-term cases per year	Not reported	300,000	Not reported
Less serious short-term cases per year	Not reported	200	Not reported
Other Factors			
Time between exposure and health effects	Immediate (nausea, asthma) to 30 years (lung cancer, mesothelioma)		
Quality of scientific understanding	Moderate		
Combined uncertainty in death, illness, and injury	High		
Ability of resident to control exposure to hazard	High		

Steps 4 and 5: Use Risk Summaries in Workshops to Elicit Priorities



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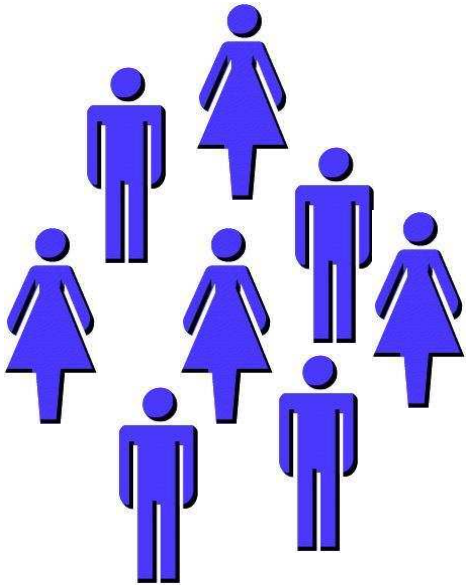
Workshop Will Use a Structured Elicitation Process

Individual Rankings

1. Holistic ranking
2. Constructed
3. Revised

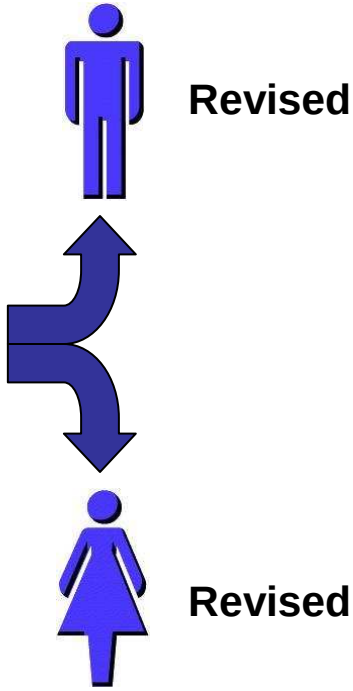
1. Holistic ranking
2. Constructed
3. Revised

Group Rankings



Groups of 8-10 people
- Holistic ranking

Final Rankings

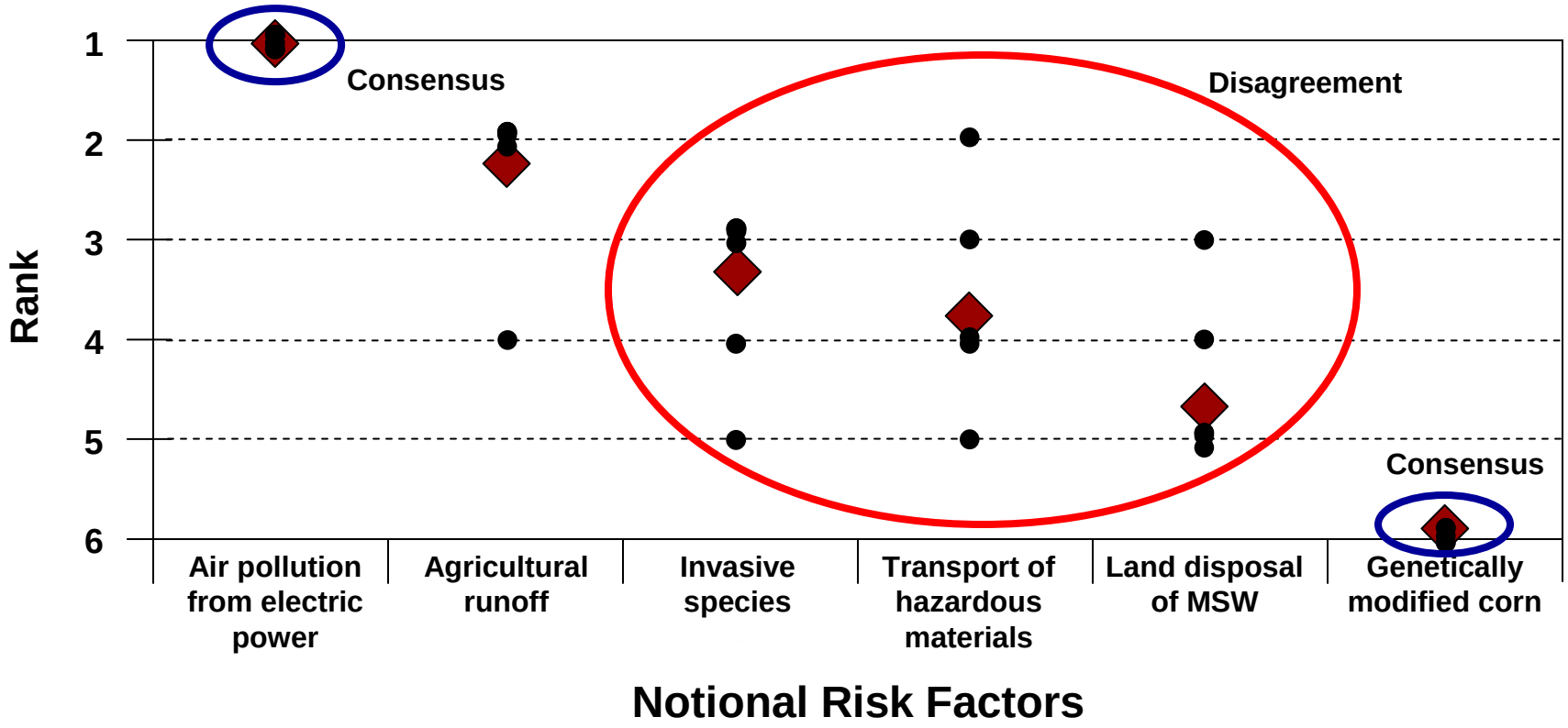


Allow dissent from group ranking

Workshop process takes 6 – 8 hours

Risk Ranking Results Will Reveal Priorities and Levels of Agreement

- **Average ranking of each risk reveals aggregated priorities**
- **Individual rankings reveal areas of consensus and disagreement about relative importance of each risk**



Preliminary Assessment Identified Risks With High Fatality, Injury and Illness Impacts

	High Injuries and Illnesses	Low Injuries and Illnesses	Unreported Injuries and Illnesses
High Fatalities	• Ambient air • Indoor air • Occupational exposures (agriculture, industry, construction) • Climate change	• Ozone depletion	
Low Fatalities		• Drinking water • Coastal water • Food (seafood, fruits and vegetables) • Electromagnetic fields	• Ambient noise
Unreported Fatalities			• Residential soil

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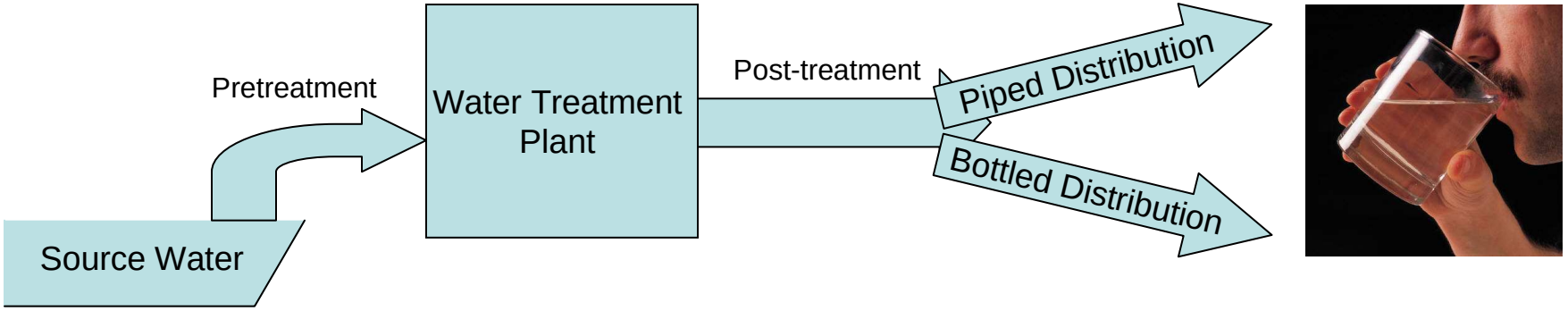
Low Fatalities		• Drinking • Coastal v • Food (sea vegetables) • Electromagnetic fields	
Unreported Fatalities			• Residential soil

Assessment Identified Several High Risks

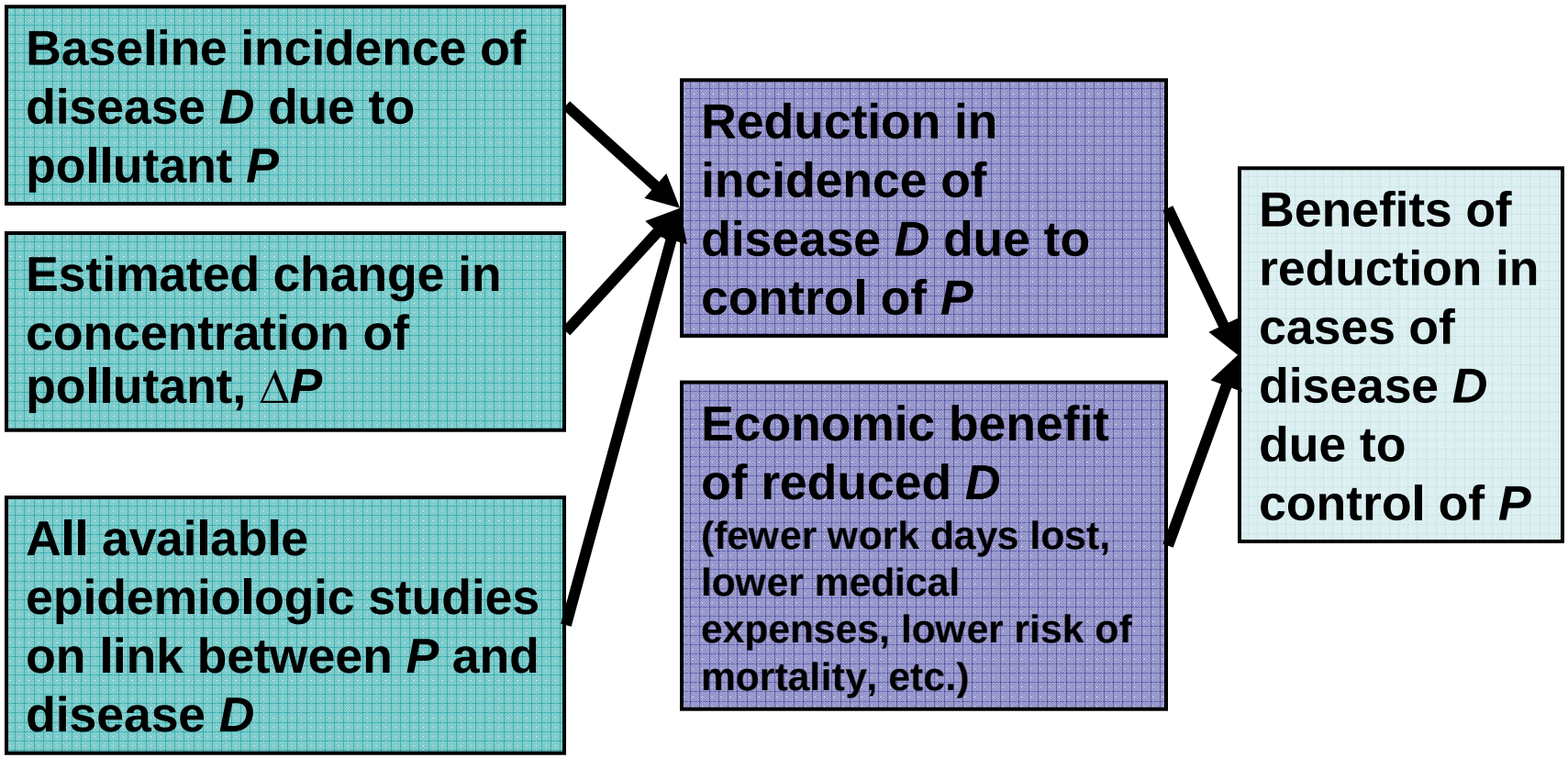
UNC Is Building Simulation Models to Quantify Public Health Effects

- Models will be used to refine the preliminary estimates of the burden of disease due to the top-priority risk factors
- Then, models will be used to estimate public health benefits of strategies to control the key risk factors
- Steps in modeling process:
  - Estimate concentrations of contaminants in different exposure media (air, water, soil, food, etc.)
  - Estimate number of individuals exposed to different levels of contaminants
  - Estimate expected health effects, based on exposure-response information from previous epidemiologic and toxicologic studies
  - Characterize uncertainty in the estimates

Example: Modeling Exposure to Contaminants in Potable Water



UNC Will Use the Simulation Models to Quantify Benefits of Strategy Options



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Epidemiologic Study: Two Goals

1. Assess the health and indoor air exposures in 600 Emirati households in all seven emirates
   - Measure the concentrations of indoor air pollutants
   - Determine the prevalence of key health conditions and factors
   - Evaluate the potential association of indoor air pollutants with respiratory disease and symptoms
2. Examine childhood nutrition, obesity, the “nutrition transition,” and the effects of rapid urbanization

UNC Epidemiology Team Will Survey 600 Households

- Occupation
- Socioeconomic status
- Housing characteristics
- Lifestyle factors such as smoking, diet, physical activity
- Brief medical histories (e.g., diabetes, respiratory and cardiovascular disease)
- Current health status
- Height, weight, body measurements

Our team will use computer-assisted interview techniques.

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UNC Scientists Will Sample Indoor Air in the 600 Households

- Nitrogen dioxide, NO_2
- Sulfur dioxide, SO_2
- Carbon monoxide, CO
- Hydrogen sulfide, H_2S
- Benzene and formaldehyde
- Particles, PM_{10} and $PM_{2.5}$

Monitors used to detect gaseous pollutants

Monitors to detect particles (developed at UNC)

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Relevance to North Carolina

- UAE project provides model for developing a science-based NC environmental health strategic plan
  - Estimate environmental burden of disease in NC
  - Systematically rank environmental threats to public health based on estimated risks, other factors
  - Identify risk mitigation strategies (short term and long term)
  - Assess effectiveness of these strategies in reducing burden of disease in NC

Implementation costs would be substantially lower due to experience gained in UAE

North Carolina, UAE Similarities

- Comparable populations and geographic sizes
- Similar per-capita income levels
- Rapid population growth and land development
- Large immigrant communities
- Concern for susceptible populations
- Parallel environmental problems, e.g
  - Ambient air quality: ozone and particulate matter
  - Water quantity: drought and population growth
  - Water quality: nonpoint sources (especially agriculture)
  - Food: contaminants in local fish
  - Climate change: high vulnerability along coasts

NC Environmental Health Strategy Could Serve as a Model for the U.S.

- Previous U.S. efforts to develop environmental health strategic plans have lacked systematic, scientific method
  - EPA 1987 report *Unfinished Business: A Comparative Assessment of Environmental Problems*
    - Based on opinions of 75 career EPA staff
    - No participation of scientists outside the EPA
    - No public participation
    - No quantitative analysis of burden of disease
    - No systematic method underlying ranking
- NC could serve as national model of first systematic, science-based strategic plan for environmental health in the U.S.
- UNC's work in the UAE provides a foundation for this effort and further empirical validation of the methods

Summary

- UNC is leading the first national-scale application of an empirically validated environmental strategic planning method
  - Method was developed to improve on previous ad-hoc approaches
- Key steps in the method
  - Preliminary assessment of environmental risk factors
  - Structured deliberations to rank the factors
  - Identification of strategy options for reducing risks for key factors
  - Modeling to estimate public health benefits of strategy options
- Documentation, data, and experience from UNC's UAE work could benefit North Carolina
  - North Carolina could be the first U.S. state to develop a science-based strategic plan for environmental health

Questions?