Mindfulness-based Health Enhancement and Carbon Footprint Reduction

Bruce Barrett MD PhD

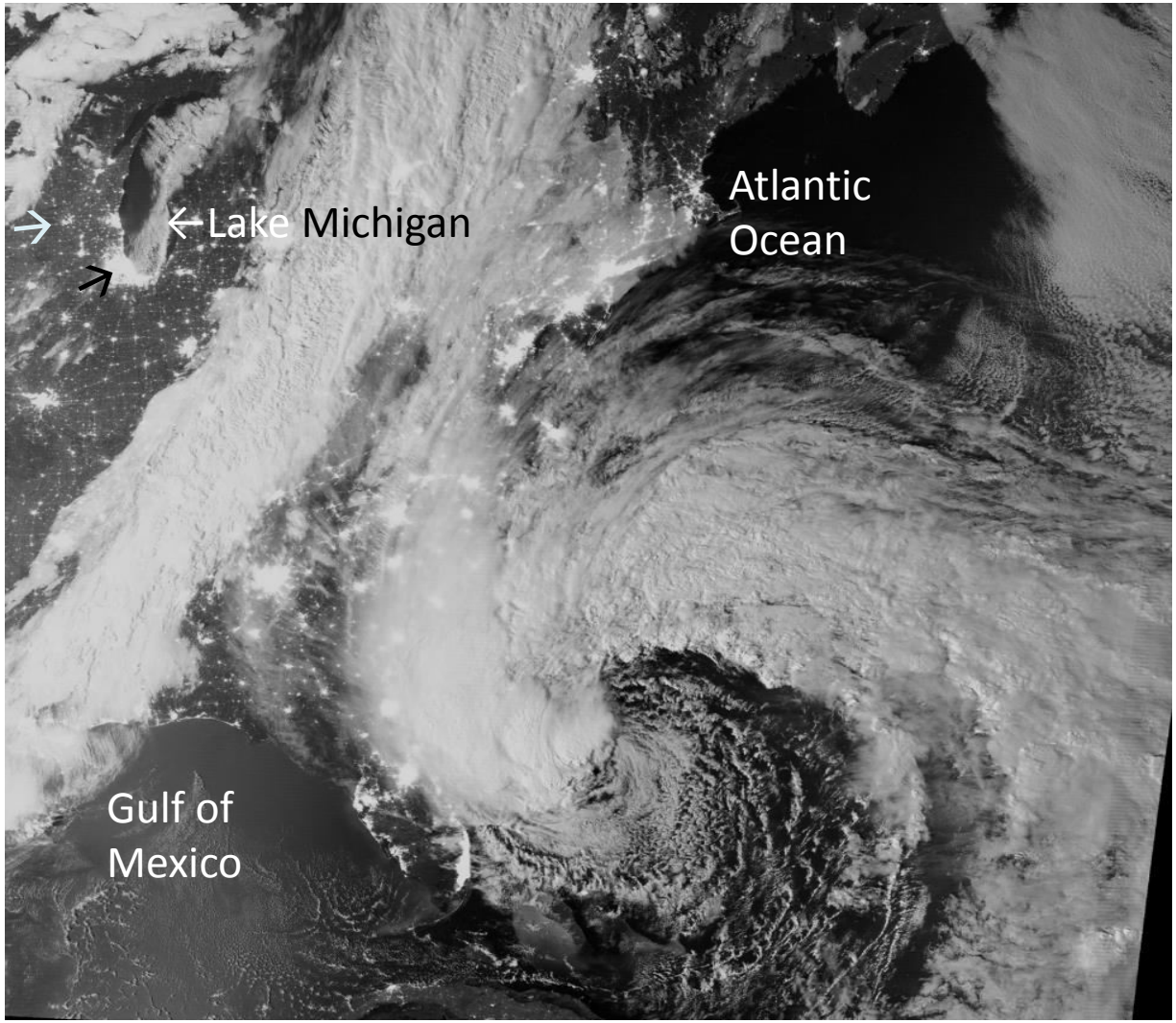
24 October 2016



WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

DEPARTMENT OF
Family Medicine and Community Health
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

Hurricane Sandy 27 October 2013



Images courtesy **Margaret Mooney**
Mindful Climate Action Co-Investigator
Earth Science Educator, UW CIMSS
University of Wisconsin - Madison

Day Night Band Satellite Image
(reflected moonlight)

http://cimss.ssec.wisc.edu/

Mindful Climate Action

http://www.fammed.wisc.edu/mca/



Acknowledgements

- Robert Wood Johnson Foundation Generalist Physician Faculty Scholars Program (2003-2007)
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  R01 Meditation or Exercise to Prevent Respiratory Infection (2009- 2011)

  R01 Meditation or Exercise to Prevent Respiratory Infection (2012- 2017)

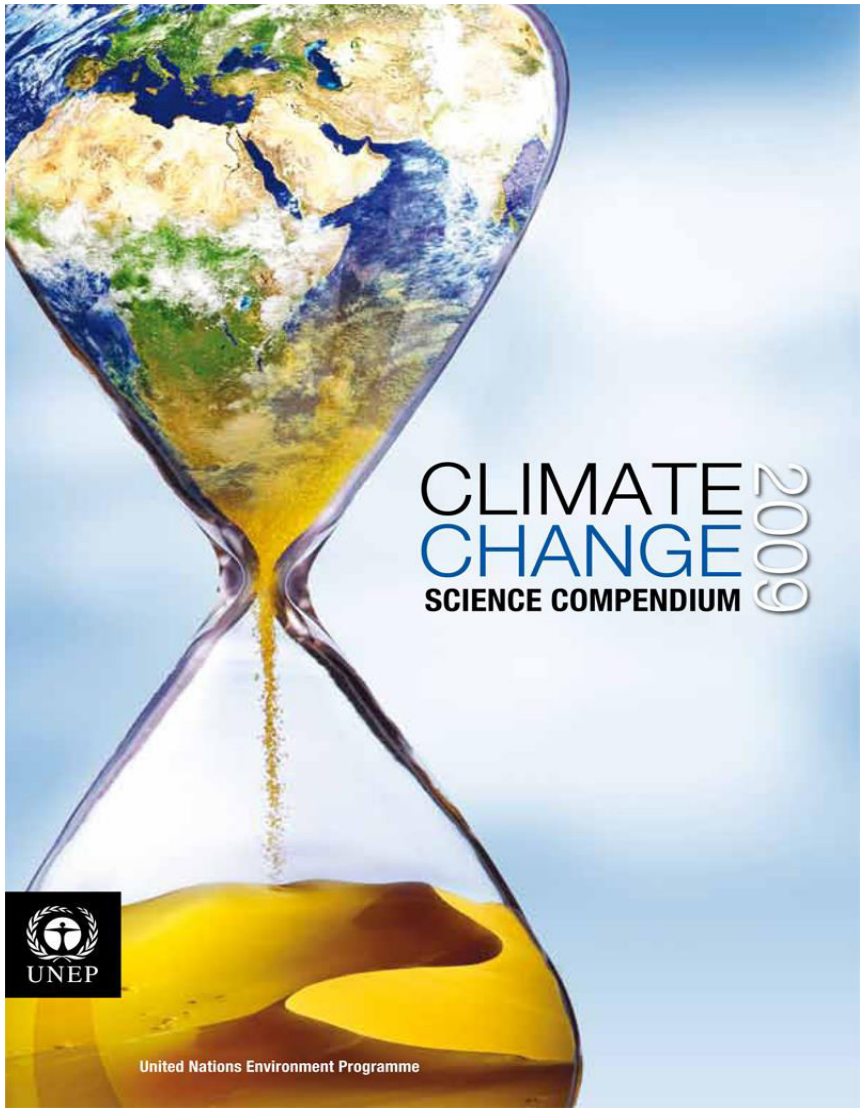
  K24 Mid-Career Research & Mentoring (2012- 2017)

  U.W. Office of Sustainability Climate Quest planning grant (2014-2015)

University of Wisconsin
SCHOOL OF MEDICINE AND PUBLIC HEALTH

Department of Family Medicine & Community Health

Climate Change
Threatens health

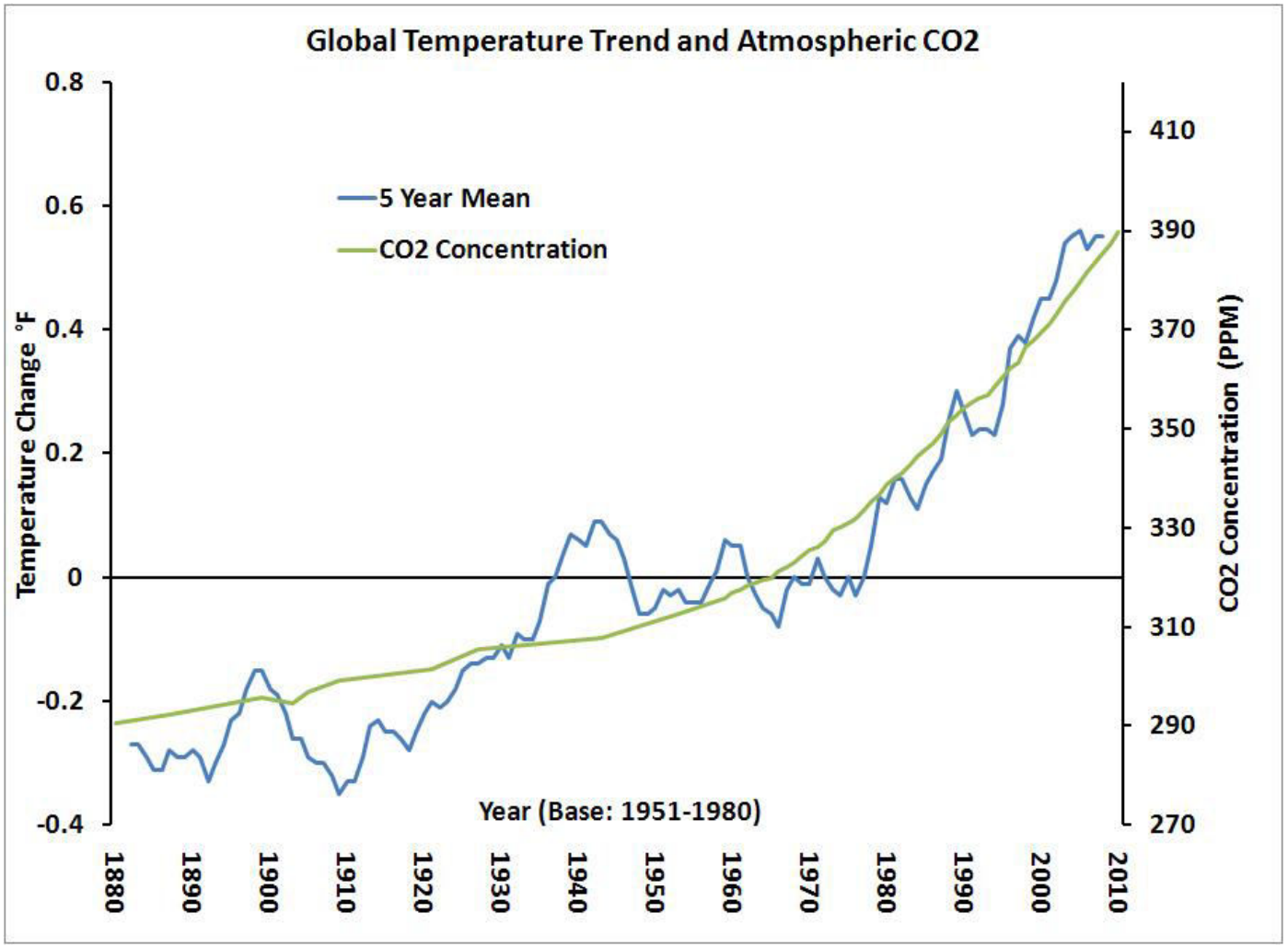


Is Time Running Out ?

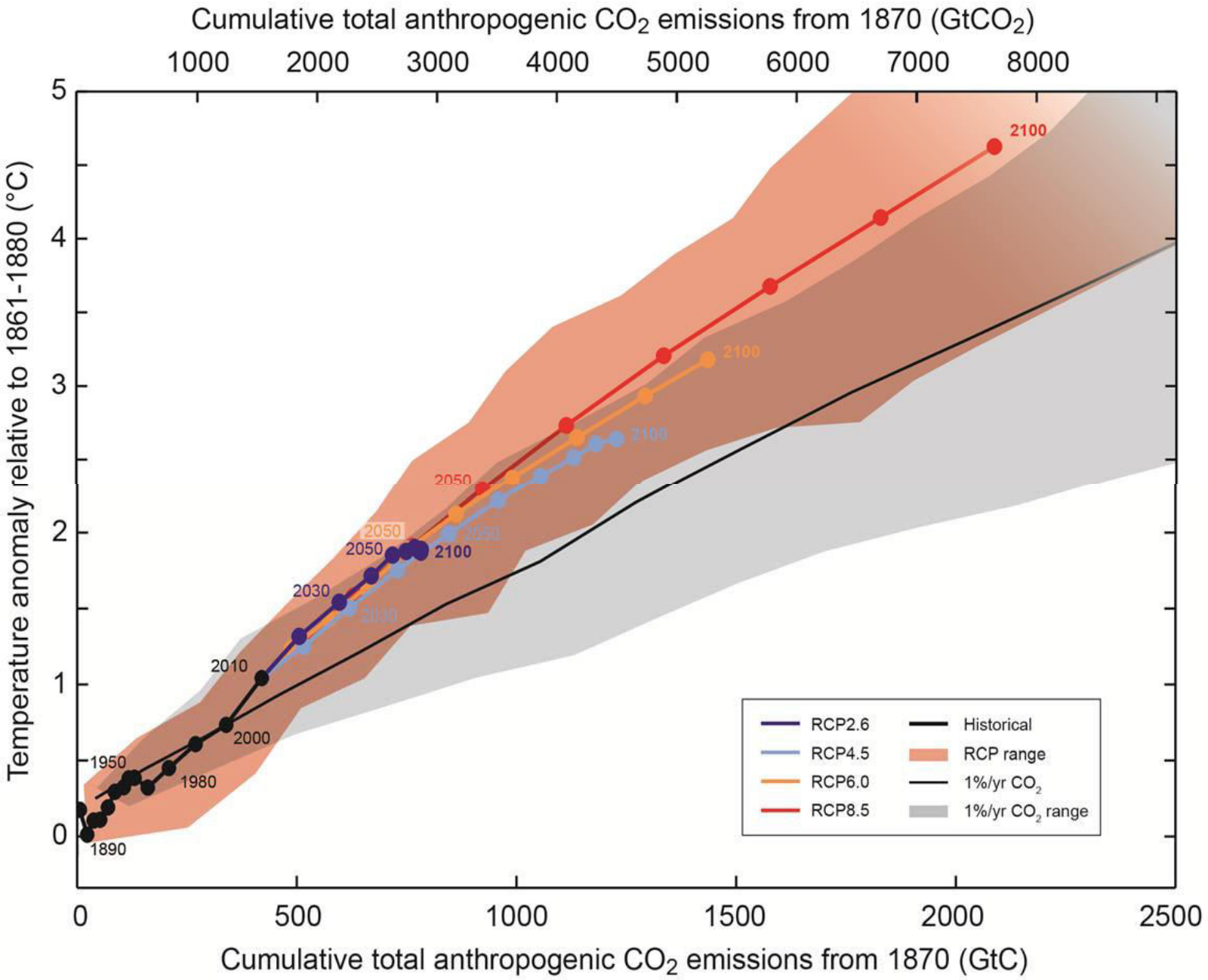
What can we - as researchers and health professionals – do about it?

http://www.unep.org/climatechange/adaptation/ScienceandAssessments/

Global temperature follows $C0_2$ level



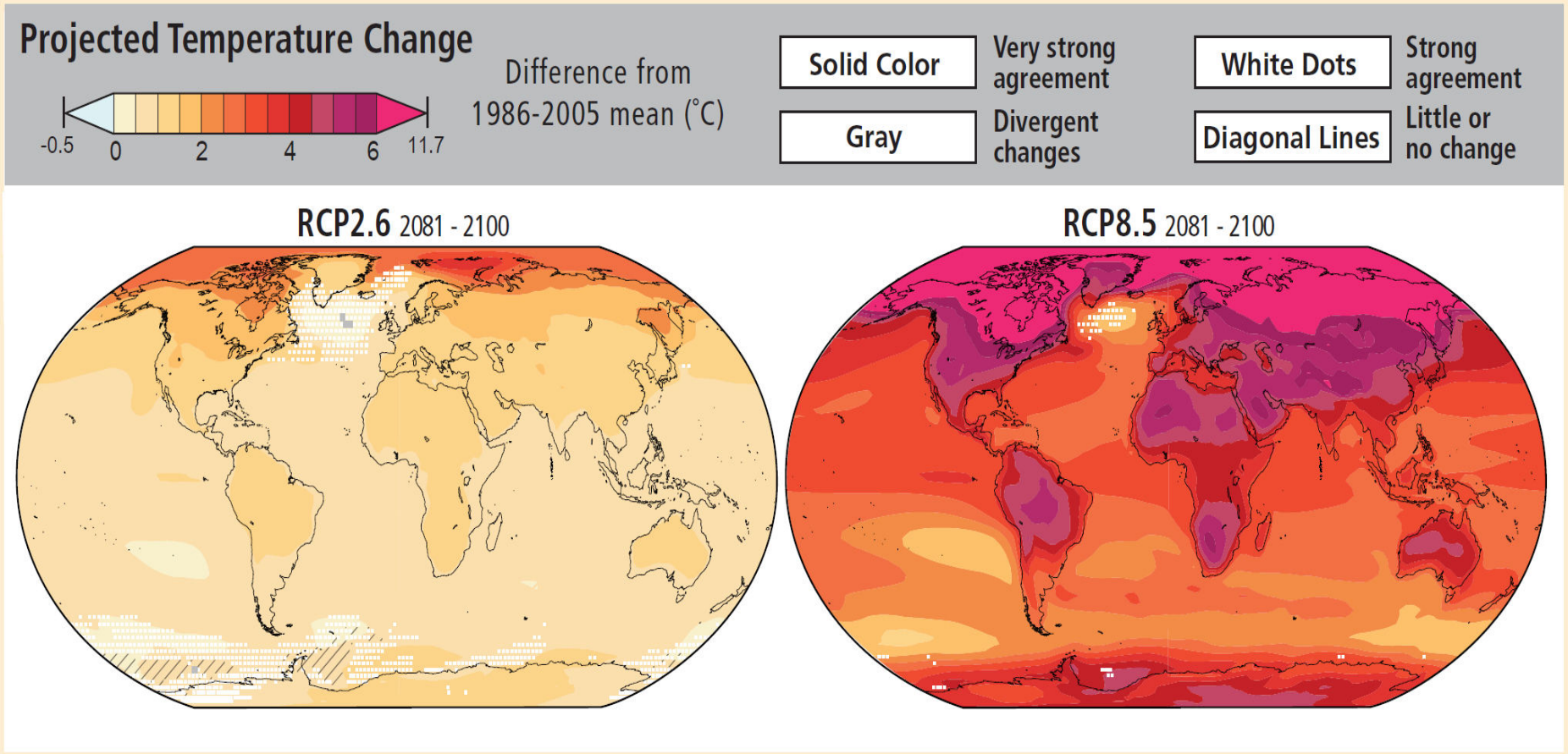
http://www.c2es.org/facts-figures/trends/co2-temp



Best current predictive models from IPCC, September 27, 2013

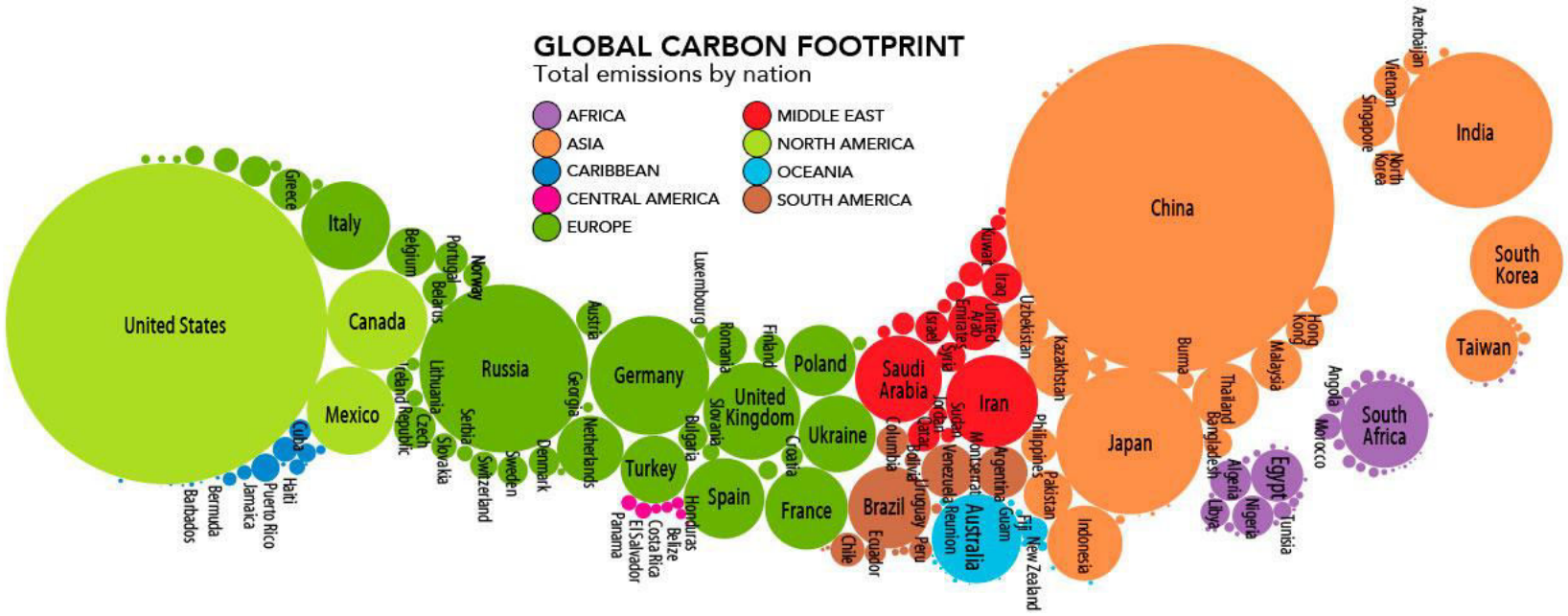
Very low emissions

Business as usual = High emissions



Climate change 2014: Impacts, adaptation, and vulnerability
Intergovernmental Panel on Climate Change. IPCC Working Group 2.

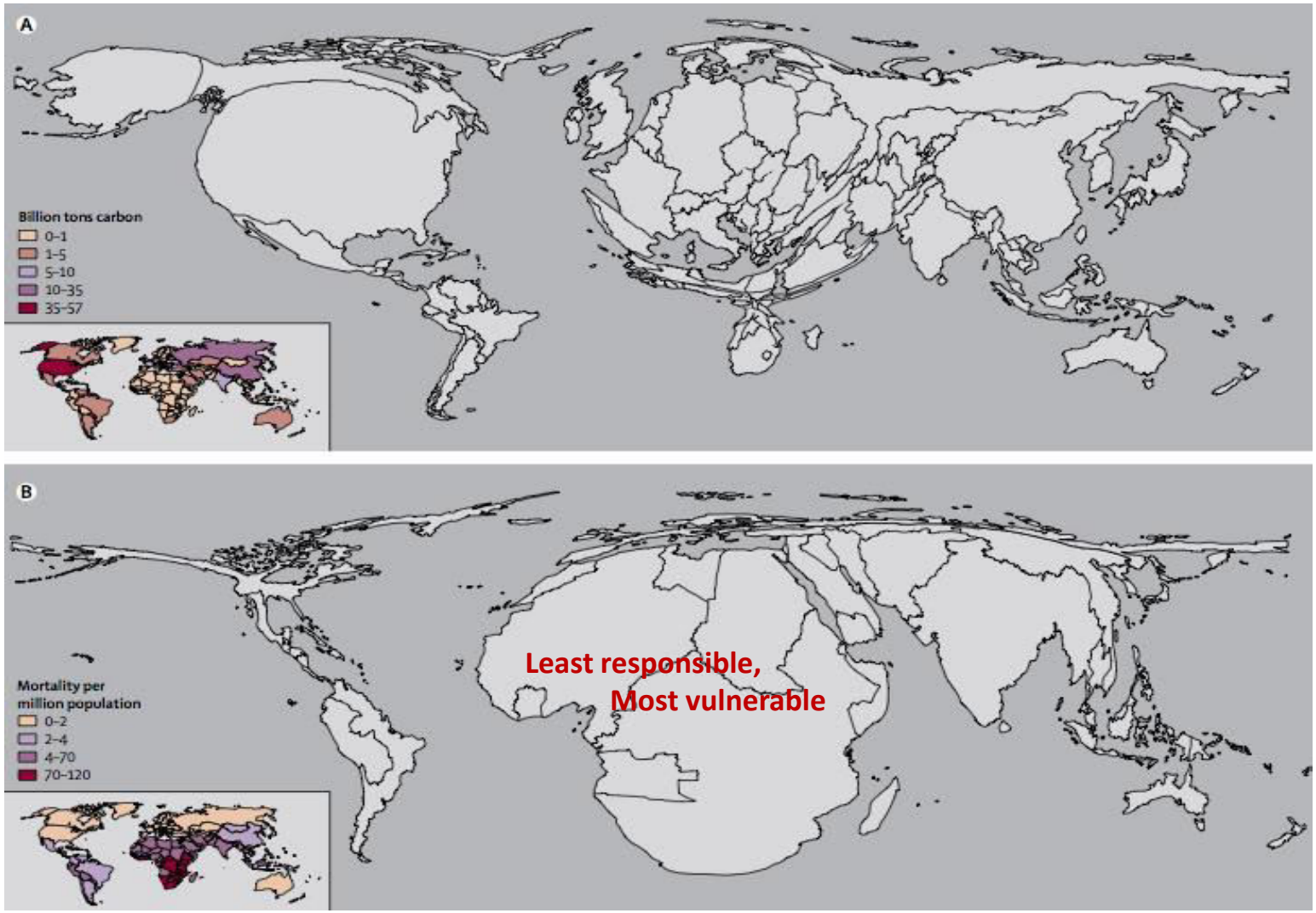
Total Carbon Footprint by Nation



http://www.stanfordkaystudio.com/information.html

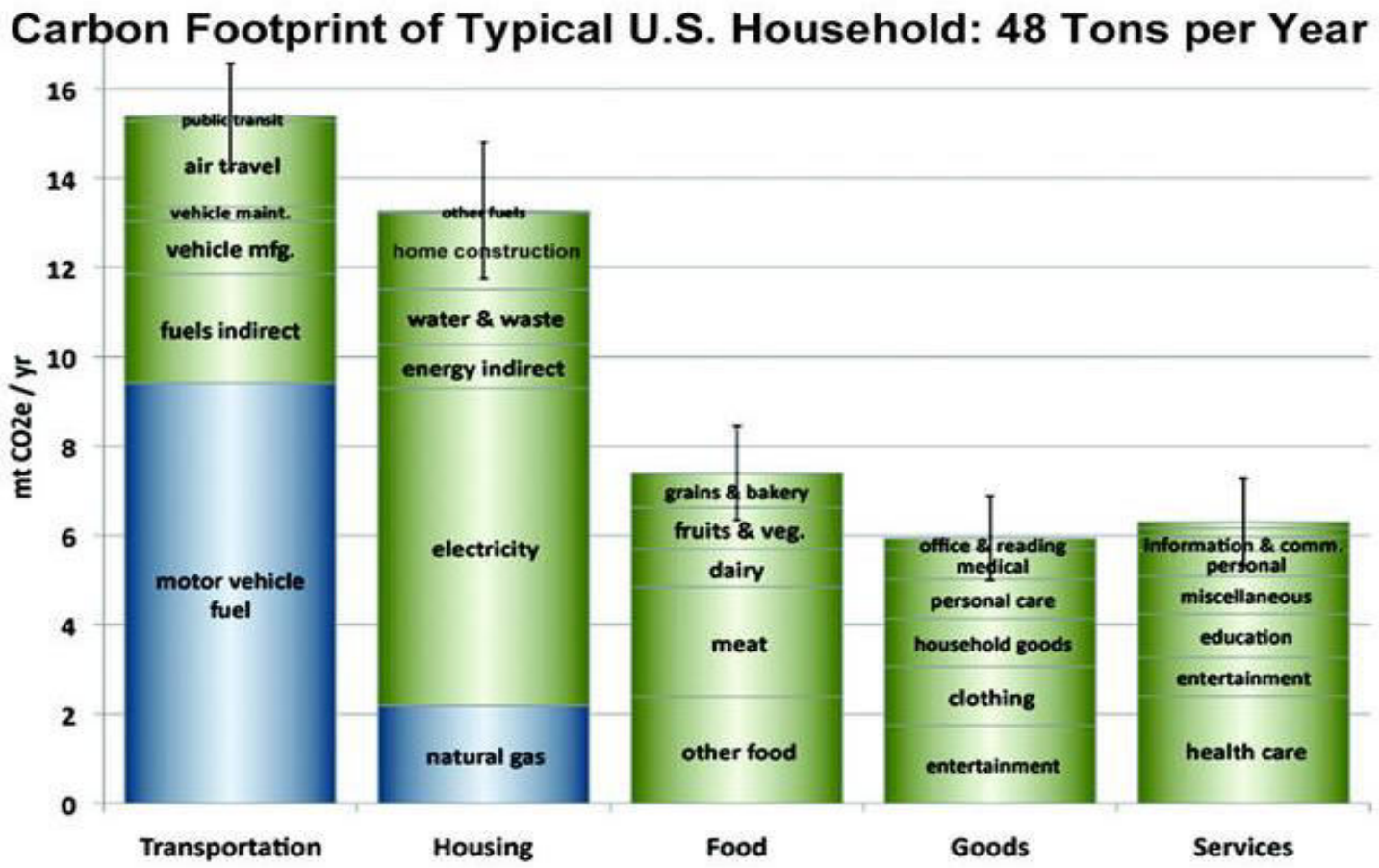
Equity, Responsibility

Billions of tons of carbon emitted 1950-2000



Mortality consequences of global warming & climate change

A. Costello, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet* *373 (9676):1693-1733, 2009*



A visual representation of where the 48 tons of a typical U.S. household's carbon footprint comes from.

Legend: blue = direct | green = indirect

Source: Jones, Kammen "Quantifying Carbon Footprint Reduction Opportunities for U.S. Households and Communities" ES&T, 2011, 45 (9), pp 4088–4095 DOI: 10.1021/es102221h

You can always count on Americans to do the right thing

- after they've tried everything else.

Winston Churchill

http://www.brainyquote.com/quotes/quotes/w/winstonchu135259.html

Mindful Climate Action - Core team

- **Bruce Barrett MD PhD -** Team leader, Family physician, Researcher
- **Cathy Middlecamp PhD –** Professor, Nelson Institute, Office of Sustainability
- **Margaret Mooney MPA –** Earth science educator, Meteorologist
- **Mary Checovich MS –** Project manager, Researcher
- **Maggie Grabow PhD –** Post-doctoral fellow, Environmental health researcher
- **Alex Converse PhD –** Physicist, Data analyst, Mindfulness researcher
- **Bob Gillespie PhD SC –** Mindfulness teacher, Psychotherapist
- **Carmen Alonso PhD –** Mindfulness teacher, Psychotherapist
- **Kristi Rietz OTR-L –** Mindfulness teacher, Wellness program manager
- **Julia Yates MSSW –** Clinical social worker, Psychotherapist
- **Elisa Torres PhD –** Assistant professor, Nursing, Mind-body researcher
- **Roger Brown PhD** – Statistician, Methodologist
- **Nancy Wong MBA PhD** – Chair & Professor, Consumer Science & Retailing



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- **Mark Johnson PhD –** Director, Founder UW Climate Knowledge
- **Katherine Bonus MA** – Founder, UW Mindfulness Program
- **Michele Brogunier MD** – Physician, Member PSR
- **Steve Ackerman PhD –** Director, Professor, Associate Vice Chancellor
- **Dick Smith JD LLB –** Retired Judge, Member Citizens Climate Lobby
- **Dave Rakel MD -** Clinician, Teacher, Director
- **Jon Temte MD PhD –** Clinician, Researcher, Professor

MCA Consultant

Mike Berners-Lee – Director, Small World Consulting,
Lancaster University, United Kingdom

Mindful Climate Action

http://www.fammed.wisc.edu/mca/



Image courtesy of Jason Vargo 2016

Mindful Climate Action

Our goal:

To demonstrably influence behaviors to substantively reduce carbon footprints, and to do so in a way that enhances rather than detracts from human health and happiness.

sustainability

MDPI 20 years

IMPACT FACTOR 1.343

Concept Paper

Mindful Climate Action: Health and Environmental Co-Benefits from Mindfulness-Based Behavioral Training

Bruce Barrett, Maggie Grabow, Cathy Middlecamp, Margaret Mooney, Mary Checovich, Alexander Converse, Bob Gillespie and Julia Yates

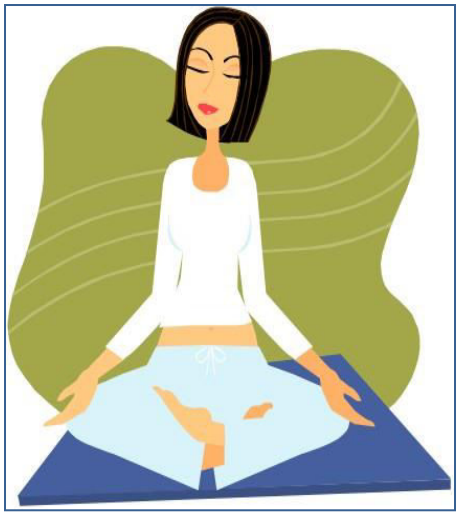
Correspondence: bruce.barrett@fammed.wisc.edu; Tel.: +1-608-263-2220

Academic Editor: Rachel J.C. Chen

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Mindfulness based stress reduction

MBSR

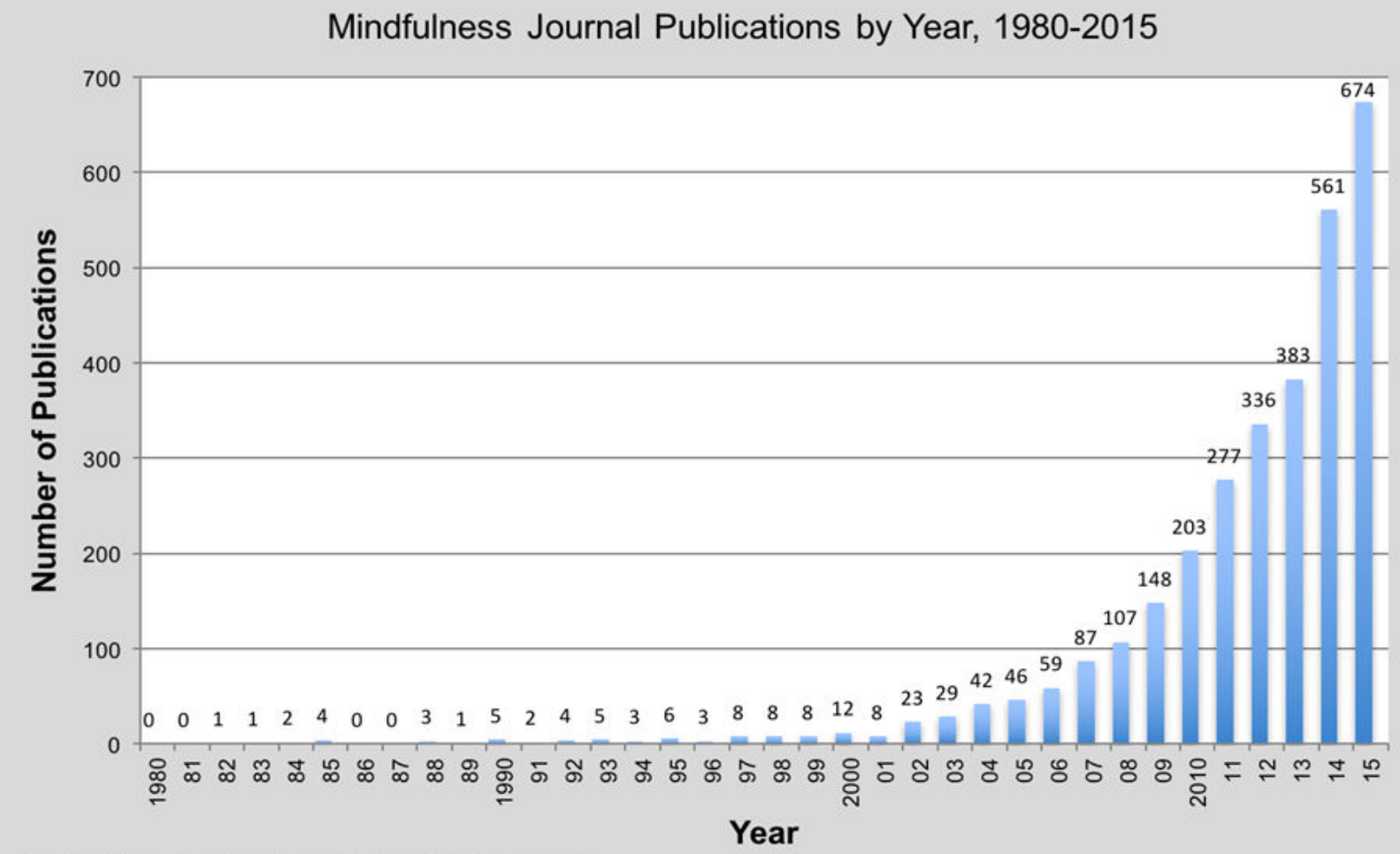






Pioneered by Jon Kabat-Zinn PhD
Center for Mindfulness in Medicine, Health Care
University of Massachusetts Medical School

Mindfulness Research is Growing Rapidly



American Minfulness Research Association, 2016
www.goAMRA.org

Mindfulness was **defined** by Jon Kabat-Zinn [1] as:

"the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally, to the unfolding of experience, moment by moment."

Empirical research suggests that mindfulness-based behavioral training can **reduce stress** and **anxiety, psychological distress, chronic pain, depression**, and **can increase quality of life** [2-7].

Reference List

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(4) Black DS, Slavich GM. Mindfulness meditation and the immune system: a systematic review of randomized controlled trials. *Ann N Y Acad Sci* 2016.

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Family Practice
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Value associated with mindfulness meditation and moderate exercise intervention in acute respiratory infection: The MEPARI Study

David Rakel, Marlon Mundt, Tola Ewers, Luke Fortney, Aleksandra Zgierska, Michele Gassman and Bruce Barrett

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DOI:10.1111/irv.12053
www.influenzajournal.com

Original Article

Advantage of meditation over exercise in reducing cold and flu illness is related to improved function and quality of life

Chidi N. Obasi,[a] Roger Brown,[b] Tola Ewers,[a] Shari Barlow,[a] Michele Gassman,[a] Aleksandra Zgierska,[a] Christopher L. Coe,[c] Bruce Barrett[a]

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Accepted 26 September 2012. Published Online 19 November 2012.

Purpose To examine whether apparent advantages following training in meditation over exercise can be attributed to specific symptoms, functional impairments, or quality-of-life indicators assessed by the Wisconsin Upper Respiratory Symptom Survey (WURSS-24).

Methods Results from the

Hindawi Publishing Corporation
Evidence-Based Complementary and Alternative Medicine
Volume 2013, Article ID 952716, 14 pages
http://dx.doi.org/10.1155/2013/952716

Hindawi

Research Article

Randomized Controlled Trial of Mindfulness Meditation and Exercise for the Treatment of Acute Respiratory Infection: Possible Mechanisms of Action

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Background. A randomized trial suggests that meditation and exercise may prevent acute respiratory infection (ARI). This study explores potential mediating mechanisms. *Methods.* Community-recruited adults were randomly assigned to three nonbl arms: 8-week mindfulness-based stress reduction ($N = 51$), moderate-intensity exercise ($N = 51$), or wait-list control (N Primary outcomes were ARI illness burden (validated Wisconsin Upper Respiratory Symptom Survey). Potential me included self-reported psychophysical health and exercise intensity (baseline, 9 weeks, and 3 months). A Baron and approach-based mediational analysis model, adjusted for group status, age, and gender, evaluated the relationship betwe primary outcome and a potential mediator using zero-inflated modeling and Sobel testing. *Results.* Of 154 randomiz completed the trial (51, 47, and 51 in meditation, exercise, and control groups) and were analyzed (82% female, 94% Ca 59.3 ± SD 6.6 years old). Mediational analyses suggested that improved mindfulness (Mindful Attention Awareness Sc months may mediate intervention effects on ARI severity and duration ($P < 0.05$); 1 point increase in the mindfulne corresponded to a shortened ARI duration by 72–9.6 hours. *Conclusions.* Meditation and exercise may decrease the AR burden through increased mindfulness. These preliminary findings need confirmation, if confirmed, they would have im policy and clinical implications. This trial registration was Clinicaltrials.gov: NCT01057771.

1. Introduction

Acute respiratory infection (ARI), also known as a "common cold" or "cold," is extremely common, often debilitating, and easily transmittable. It is one of the top 10 most expensive illnesses [1] and one of the leading causes for health care utilization and school and work absenteeism [2–4]. Despite its high prevalence and impact, available treatments for ARI are not very effective and usually limited to symptomatic care [5, 6]. Development of new therapies for ARI prevention and/or treatment could tremendously benefit both individuals and society at large.

It is common wisdom that being in a state of "goo is one of the few measures one can do in order to p bad cold." Research corroborates this belief by doc links between poor psychophysical health and w related outcomes [7–9]. Recently, two health exercise and mindfulness meditation ("meditati been gaining support as both "healthy lifestyle" and medically-recommended therapies for a vari ditions. Regular exercise may not only protect fro also decrease the duration and severity of ARI 12]. Evidence shows that meditation training ca immune response, including an enhanced respon

Meditation or Exercise for Preventing Acute Respiratory Infection: A Randomized Controlled Trial

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David Rakel, MD[a]
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Chidi N. Obasi, MD[a]
Roger Brown, PhD[b]
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Shari Barlow, BA[a]
Michele Gassman, MA[a]
Christopher L. Coe, PhD[a]

ABSTRACT

PURPOSE This study was designed to evaluate potential preventive effects of meditation or exercise on incidence, duration, and severity of acute respiratory infection (ARI) illness.

METHODS Community-recruited adults aged 50 years and older were randomized to 1 of 3 study groups: 8-week training in mindfulness meditation, matched 8-week training in moderate-intensity sustained exercise, or observational control. The primary outcome was area-under-the-curve global illness severity during a single cold and influenza season, using the Wisconsin Upper Respiratory Symptom Survey (WURSS-24) to assess severity. Health care visits and days of missed work were counted. Nasal wash collected during ARI illness was assayed for neutrophils, interleukin-8, and viral nucleic acid.

RESULTS Of 154 adults randomized into the study, 149 completed the trial (82% female, 94% white, mean age 59.3 ± 6.6 years). There were 27 ARI episodes and 257 days of ARI illness in the meditation group (n = 51), 26 episodes and 241 illness days in the exercise group (n = 47), and 40 episodes and 453 days in the control group (n = 51). Mean global severity was 144 for meditation, 248 for exercise, and 358 for control. Compared with control, global severity was significantly lower for meditation ($P = .004$). Both global severity and total days of illness (duration) trended toward being lower for the exercise group ($P = .16$ and $P = .032$, respectively), as did illness duration for the meditation group ($P = .034$). Adjusting for covariates using zero-inflated multivariate regression models gave similar results. There were 67 ARI-related days of-work missed in the control group, 32 in the exercise group ($P = .041$), and 16 in the meditation group ($P < .001$). Health care visits did not differ significantly. Viruses were identified in 54% of samples from meditation, 42% from exercise, and 54% from control groups. Neutrophil count and interleukin-8 levels were similar among intervention groups.

CONCLUSIONS Training in meditation or exercise may be effective in reducing ARI illness burden.

Ann Fam Med 2012;10:337-346. doi:10.1370/afm.1376.

MORE ONLINE

Conflicts of interest. Bruce Barrett was previously supported by career development grants from the National Center for Complementary and Alternative Medicine (K22 AT00056) and from the Robert Wood Johnson Foundation, both of which were essential for developing the methodology and infrastructure for recruiting and monitoring research subjects, and for assessing their acute respiratory infections.

CORRESPONDING AUTHOR
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INTRODUCTION

Acute respiratory infection (ARI) is extremely common, often debilitating, and among the most costly of human illnesses. Influenza, the most serious of the viral ARIs, is associated with approximately 36,000 deaths and more than 500,000 hospitalizations in the United States yearly.[1] Nevertheless, symptoms of influenza infection are usually indistinguishable from those produced by other viruses.[2,3] In the United States each year, noninfluenza ARI accounts for more than 20 million doctor visits and 40 million lost school and work days, with an economic

Human Vaccines & Immunotherapeutics 10:1, 1–9; January 2014; © 2014 Landes Bioscience

RESEARCH PAPER

Age and psychological influences on immune responses to trivalent inactivated influenza vaccine in the meditation or exercise for preventing acute respiratory infection (MEPARI) trial

Mary S Hayney[1,*], Christopher L Coe[2], Daniel Muller[3], Chidi N Obasi[4], Uba Backonja[5], Tola Ewers[5], and Bruce Barrett[5]

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Keywords: influenza vaccine, meditation, exercise, antibody, cytokine, interferon-γ, interleukin-10, aging, body mass index, positive emotion, stress

Abbreviations: BMI, body mass index; HAI, hemagglutination inhibition assay; HAU, hemagglutination inhibition units; IL-10, interleukin-10; IFNγ, interferon gamma; LOT, Life Orientation Test; SF-36, Medical Outcomes Study Short Form; MBSR, mindfulness-based stress reduction; PSS-10, Perceived Stress Scale; PBMC, peripheral blood mononuclear cells; STAI, Speilberger's State Trait Anxiety Inventory

Background: Strategies to improve influenza vaccine protection among elderly individuals are an important research priority. Mindfulness-based stress reduction (MBSR) and exercise have been shown to affect aspects of immune function in some populations. We hypothesized that influenza vaccine responses may be enhanced with meditation or exercise training as compared with controls.

Results: No differences in vaccine responses were found comparing control to MBSR or exercise. Individuals achieving seroprotective levels of influenza antibody ≥160 units had higher optimism, less anxiety, and lower perceived stress than the nonresponders. Age correlated with influenza antibody responses, but not with IFNγ or IL-10 production.

Conclusion: The MBSR and exercise training evaluated in this study failed to enhance immune responses to influenza vaccine. However, optimism, perceived stress, and anxiety were correlated in the expected directions with antibody responses to influenza vaccine.

Methods: Healthy individuals ≥50 y were randomly assigned to exercise (n = 47) or MBSR (n = 51) training or a waitlist control condition (n = 51). Each participant received trivalent inactivated influenza vaccine after 6 weeks, and had blood draws prior to and 3 and 12 weeks after immunization. Serum influenza antibody, nasal immunoglobulin A, and peripheral blood mononuclear cell interferon-γ (IFNγ) and interleukin-10 (IL-10) concentrations were measured. Measures of optimism, perceived stress, and anxiety were obtained over the course of the study. Seroprotection was defined as an influenza antibody concentration ≥160 units. Vaccine responses were compared using ANOVA, t tests, and Kruskal-Wallis tests. The correlation between vaccine responses and age was examined with the Pearson test.

Introduction

Influenza is a common acute respiratory illness with substantial morbidity and mortality, particularly among older adults.[1] The seasonal influenza vaccine is effective for the prevention of infection in younger adults, but may promote inadequate defense in up to 1/3 of the elderly, especially the frail in nursing homes.[2] Strategies to improve protection provided by immunization continue to be a high research and public health priority. Seroprotection is traditionally defined as an antibody concentration at least 40 hemagglutination units (HAU) following influenza vaccination.[3] However, this concentration of antibody confers protection from infection at a rate of about 50%. Protection from infection improves with higher antibody responses,[4–7] although little further clinical benefit results from

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From our first Mindfulness Trial

Preventive Medicine 70 (2015) 69–75

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Review

Climate change, human health, and epidemiological transition

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ARTICLE INFO

Available online 28 November 2014

Keywords:
Climate change
Environment
Epidemiology
Global warming
Population health

ABSTRACT

The health of populations depends on the availability of clean air, water, food, and sanitation, exposure to pathogens, toxins and environmental hazards, and numerous genetic, behavioral and social factors. For many thousands of years, human life expectancy was low, and population growth was slow. The development of technology-based civilizations facilitated what Abdel Omran called "epidemiological transition," with increasing life expectancy and rapid population growth. To a large extent, the spectacular growth of human populations during the past two centuries was made possible by the energy extracted from fossil fuels. We have now learned, however, that greenhouse gases from fossil fuel combustion are warming the planet's surface, causing changes in oceanic and atmospheric systems, and disrupting weather and hydrological patterns. Climate change poses unprecedented threats to human health by impacts on food and water security, heat waves and droughts, violent storms, infectious disease, and rising sea levels. Whether or not humanity can reduce greenhouse gas emissions quickly enough to slow climate change to a rate that will allow societies to successfully adapt is not yet known. This essay reviews the current state of relevant knowledge, and points in a few directions that those interested in human health may wish to consider.

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Contents

Conflict of interest statement . . . 73
Acknowledgments . . . 73
Reference . . . 73

In his seminal 1971 paper "The epidemiological transition," Abdel Omran put forth a conceptual framework linking the many facets of epidemiology with the forces behind population dynamics, emphasizing the changing nature of structural influence (Omran, 1971). At that point in human history, clear and convincing evidence had emerged documenting a "transition in which degenerative and man-made diseases displace pandemics of infection as the primary causes of morbidity and mortality." Around the same time, scientists were beginning to report that human emissions of greenhouse gases were causing global warming and climate change (Benton, 1970; Gast, 1971; Manabe and Wetherald, 1975).

Omran divided human history into three major epidemiological epochs. The first, or "Age of Pestilence and Famine," lasted for thousands of years and was characterized by cyclic patterns of localized population growth ended by major die-offs, often precipitated by war, civilization collapse, and/or epidemic infection. In the second "Age of Receding Pandemics" Omran wrote that "mortality declines progressively; and the rate of decline accelerates as epidemic peaks become less frequent or disappear." In Omran's third epoch, the "Age of Degenerative and Man-Made Diseases," "mortality continues to decline and eventually approaches stability at a relatively low level. The average life expectancy at birth rises gradually until it exceeds 50 years. It is during this stage that fertility becomes the crucial factor in population growth."

For more than a century, knowledge regarding "degenerative and man-made diseases" has increased at a dizzying pace. The era of using science to identify and respond to human-engendered disease arguably began when John Snow in 1854 traced the source of a London cholera epidemic and then removed the Broad Street pump handle to limit further contagion (Koch and Denike, 2009; Paneth, 2004; Tulchinsky, 2010). Not long afterwards, work by Louis Pasteur (Bordenave, 2003) and others led to a remarkably broad and detailed understanding of infectious disease, much of which was caused or exacerbated by population growth, urbanization, and crowding. These discoveries provided rationale for large scale potable water, sanitation and public health

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ARTICLES AND REVIEWS

When It Rains, It Pours: Future Climate Extremes and Health

Jonathan A. Patz, MD, MPH, Maggie L. Grabow, PhD, MPH, and Vijay S. Limaye, PhD

ABSTRACT

Clinical Review & Education

Special Communication

Climate Change
Challenges and Opportunities for Global Health

Jonathan A. Patz, MD, MPH; Howard Frumkin, MD, DrPH; Tracey Holloway, PhD; Daniel J. Vimont, PhD; Andrew Haines, MBBS, MD

IMPORTANCE Health is inextricably linked to climate change. It is important for clinicians to understand this relationship in order to discuss associated health risks with their patients and to inform public policy.

OBJECTIVES To provide new US-based temperature projections from downscaled climate modeling and to review recent studies on health risks related to climate change and the cobenefits of efforts to mitigate greenhouse gas emissions.

DATA SOURCES, STUDY SELECTION, AND DATA SYNTHESIS We searched PubMed from 2009 to 2014 for articles related to climate change and health, focused on governmental reports, predictive models, and empirical epidemiological studies. Of the more than 250 abstracts reviewed, 56 articles were selected. In addition, we analyzed climate data averaged over 13 climate models and based future projections on downscaled probability distributions of the daily maximum temperature for 2046-2065. We also compared maximum daily 8-hour average with air temperature data taken from the National Oceanic and Atmospheric Administration National Climate Data Center.

RESULTS By 2050, many US cities may experience more frequent extreme heat days. For example, New York and Milwaukee may have 3 times their current average number of days hotter than 32°C (90°F). The adverse health aspects related to climate change may include heat-related disorders, such as heat stress and economic consequences of reduced work capacity; and respiratory disorders, including those exacerbated by fine particulate pollutants, such as asthma and allergic disorders; infectious diseases, including vectorborne diseases and water-borne diseases, such as childhood gastrointestinal diseases; food insecurity, including reduced crop yields and an increase in plant diseases; and mental health disorders, such as posttraumatic stress disorder and depression, that are associated with natural disasters. Substantial health and economic cobenefits could be associated with reductions in fossil fuel combustion. For example, the cost of greenhouse gas emission policies may yield net economic benefit, with health benefits from air quality improvements potentially offsetting the cost of US carbon policies.

CONCLUSIONS AND RELEVANCE Evidence over the past 20 years indicates that climate change can be associated with adverse health outcomes. Health care professionals have an important role in understanding and communicating the related potential health concerns and the cobenefits from reducing greenhouse gas emissions.

Editorial

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Jonathan A. Patz, MD, MPH, Global Health Institute, University of Wisconsin, 1710 University Ave, Madison, WI 53726 (patz@wisc.edu).

JAMA. doi:10.1001/jama.2014.13186
Published online September 22, 2014.

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Goal / Hypothesis

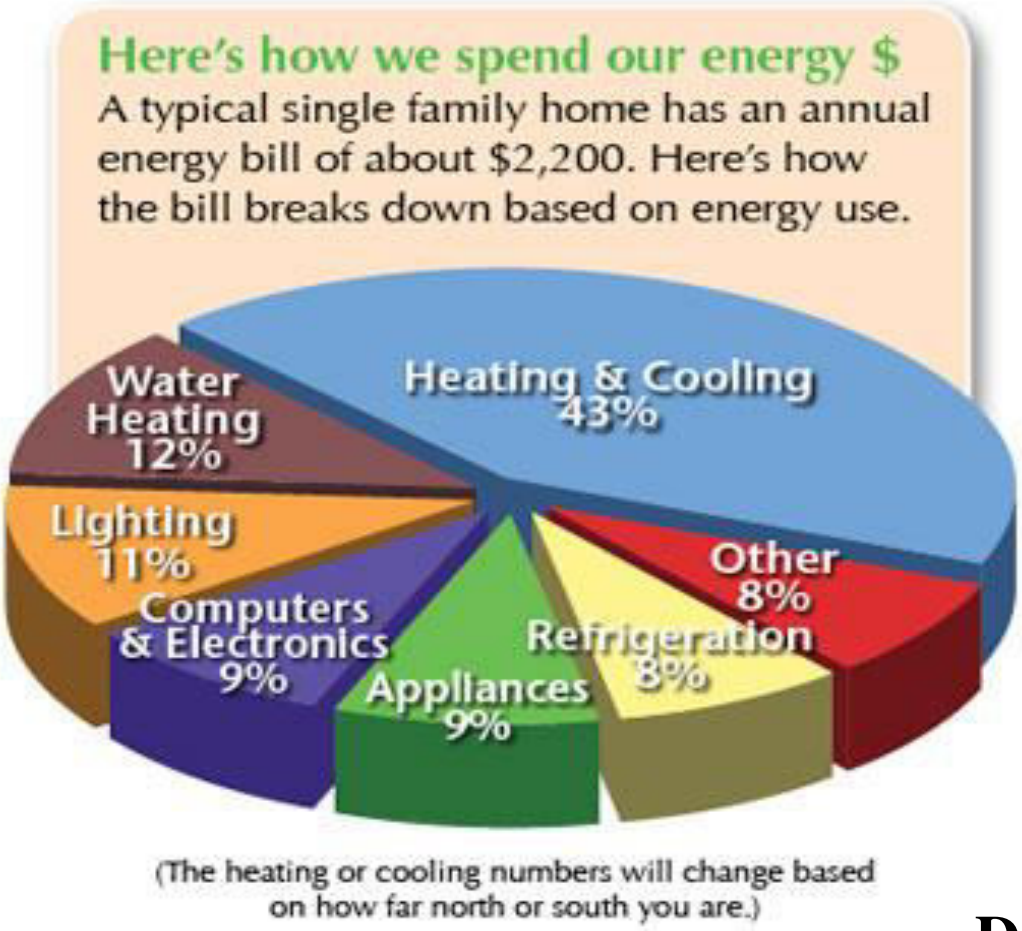
Mindfulness-based behavioral trainings will:

Help people to reduce their carbon footprints



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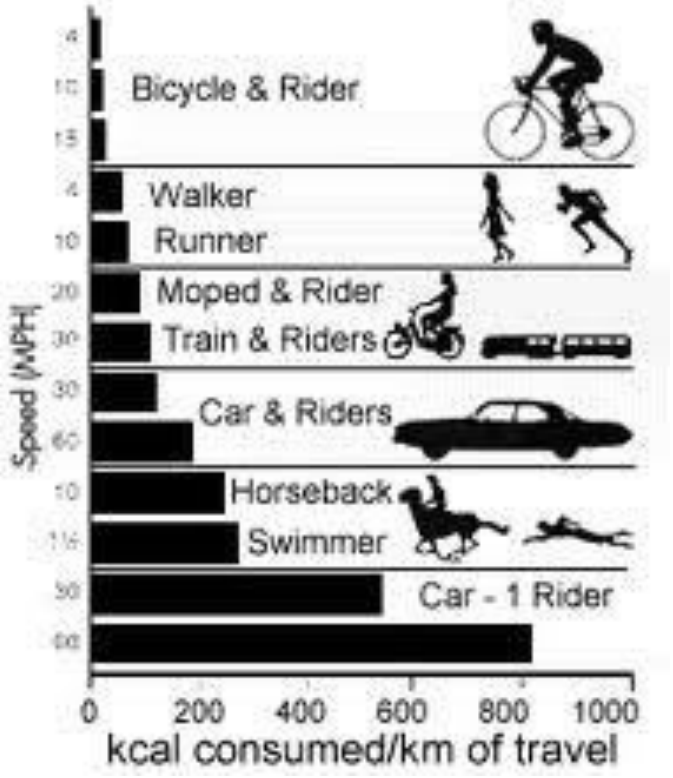
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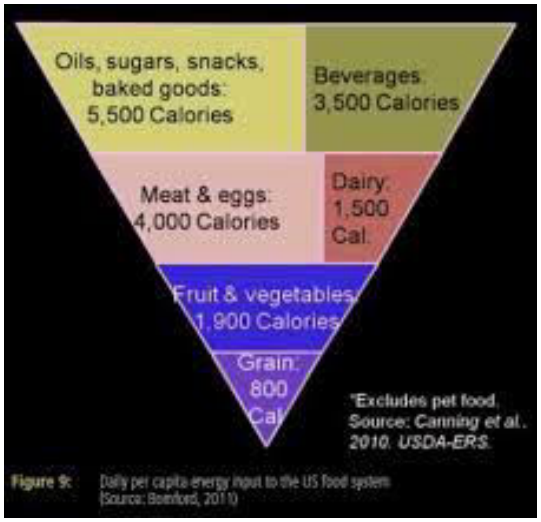


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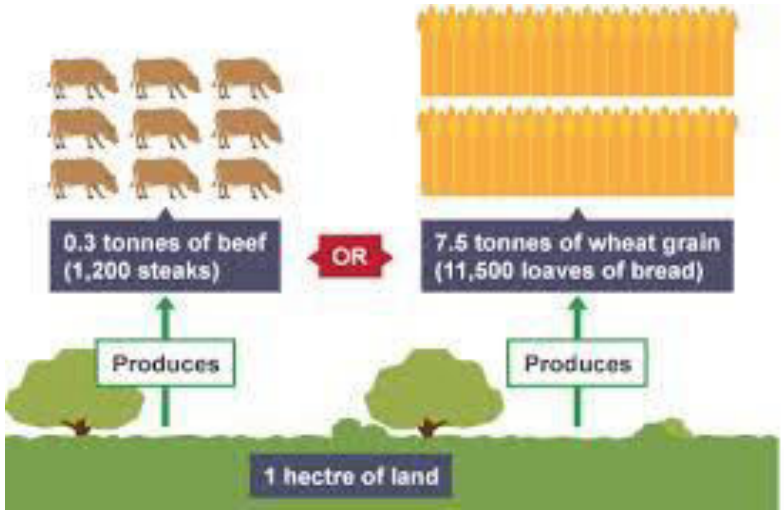
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Co-Benefits = “win-win” scenario

Clinical Review & Education

Special Communication

Climate Change
Challenges and Opportunities for Global Health

Jonathan A. Patz, MD, MPH; Howard Frumkin, MD, DrPH; Tracey Holloway, PhD; Daniel J. Vimont, PhD; Andrew Haines, MBBS, MD

Int J Public Health (2013) 58:305–311
DOI 10.1007/s00038-012-0422-5

REVIEW

Health co-benefits and risks of public health adaptation strategies to climate change: a review of current literature

June J. Cheng · Peter Berry

CLIMATE CHANGE

Clinical Medicine 2009, Vol 9, No 3: 212–13

The health co-benefits of climate change policies: doctors have a responsibility to future generations

Ian Roberts

SPOTLIGHT: CLIMATE CHANGE

How the low carbon economy can improve health

Health professionals are uniquely placed to guide the climate change conversation towards better policies that are good for the planet and for people, say **Andy Haines** and **Carlos Dora**

Andy Haines *professor of public health and primary care*[1], Carlos Dora *co-ordinator*[2]

[1]Departments of Social and Environmental Health Research and Nutrition and Public Health Intervention Research, London School of Hygiene and Tropical Medicine, London WC1E 7HT, UK; [2]Interventions for Healthy Environments Unit, Department of Public Health and the Environment, World Health Organization, Geneva, Switzerland

news & views

MITIGATION POLICY

Health co-benefits

Efforts to tackle climate change have met significant financial and political barriers that have been difficult to overcome. Research now shows that such measures are justified on grounds other than mitigation of climate change.

George D. Thurston

Plenaries

Health benefits of a low carbon economy

*A. Haines**

London School of Hygiene and Tropical Medicine, 15-17 Tavistock Place, London WC1H 9SH, United Kingdom

Implications of incorporating air-quality co-benefits into climate change policymaking

G F Nemet[1,2], T Holloway[1] and P Meier[3]

[1] Nelson Institute Center for Sustainability and the Global Environment (SAGE), University of Wisconsin–Madison, Madison, WI, USA
[2] La Follette School of Public Affairs, University of Wisconsin–Madison, Madison, WI, USA
[3] Energy Institute, University of Wisconsin–Madison, Madison, WI, USA

nature climate change

LETTERS

PUBLISHED ONLINE: 22 SEPTEMBER 2013 | DOI: 10.1038/NCLIMATE2009

Co-benefits of mitigating global greenhouse gas emissions for future air quality and human health

J. Jason West[1]*, Steven J. Smith[2], Raquel A. Silva[1], Vaishali Naik[3], Yuqiang Zhang[1], Zachariah Adelman[1], Meridith M. Fry[1], Susan Anenberg[4], Larry W. Horowitz[5] and Jean-Francois Lamarque[6]

What would happen if 50% of short automobile trips (≤ 8 kilometers) were replaced by foot or bicycle?

↑ **physical activity**

↓ **air pollution**

↓ **automobile accidents**

↓ **petrol consumption**

Modelled using data from 11 metropolitan areas in the Upper Midwestern U.S, and validated methods/algorithms



Research

Air Quality and Exercise-Related Health Benefits from Reduced Car Travel in the Midwestern United States

Maggie L. Grabow,[1,2] Scott N. Spak,[1,3,4] Tracey Holloway,[1,4] Brian Stone Jr.,[5] Adam C. Mednick,[1,6,7] and Jonathan A. Patz[1,2,8]

[1]Nelson Institute, SAGE (Sustainability and the Global Environment), University of Wisconsin–Madison, Madison, Wisconsin, USA; [2]Department of Population Health Sciences, School of Medicine and Public Health, University of Wisconsin–Madison, Madison, Wisconsin, USA; [3]Now: Public Policy Center, University of Iowa, Iowa City, Iowa, USA; [4]Department of Atmospheric and Oceanic Sciences, University of Wisconsin–Madison, Madison, Wisconsin, USA; [5]School of City and Regional Planning, Georgia Institute of Technology, Atlanta, Georgia, USA; [6]Department of Urban and Regional Planning, University of Wisconsin–Madison, Madison, Wisconsin, USA; [7]Wisconsin Department of Natural Resources, Madison, Wisconsin, USA; [8]Global Health Institute, University of Wisconsin–Madison, Madison, Wisconsin, USA

Background: Automobile exhaust contains precursors to ozone and fine particulate matter (PM ≤ 2.5 μm in aerodynamic diameter; $PM_{2.5}$), posing health risks. Dependency on car commuting also reduces physical fitness opportunities.

Objective: In this study we sought to quantify benefits from reducing automobile usage for short urban and suburban trips.

Methods: We simulated census-tract level changes in hourly pollutant concentrations from the elimination of automobile round trips ≤ 8 km in 11 metropolitan areas in the upper midwestern United States using the Community Multiscale Air Quality (CMAQ) model. Next, we estimated annual changes in health outcomes and monetary costs expected from pollution changes using the U.S. Environmental Protection Agency Benefits Mapping Analysis Program (BenMAP). In addition, we used the World Health Organization Health Economic Assessment Tool (HEAT) to calculate benefits of increased physical activity if 50% of short trips were made by bicycle.

Results: We estimate that, by eliminating these short automobile trips, annual average urban $PM_{2.5}$ would decline by 0.1 μg/m^3 and that summer ozone (O_3) would increase slightly in cities but decline regionally, resulting in net health benefits of $4.94 billion/year [95% confidence interval (CI): $0.2 billion, $13.5 billion), with 25% of $PM_{2.5}$ and most O_3 benefits to populations outside metropolitan areas. Across the study region of approximately 31.3 million people and 37,000 total square miles, mortality would decline by approximately 1,295 deaths/year (95% CI: 912, 1,636) because of improved air quality and increased exercise. Making 50% of short trips by bicycle would yield savings of approximately $3.8 billion/year from avoided mortality and reduced health care costs (95% CI: $2.7 billion, $5.0 billion). We estimate that the combined benefits of improved air quality and physical fitness would exceed $8 billion/year.

Conclusion: Our findings suggest that significant health and economic benefits are possible if bicycling replaces short car trips. Less dependence on automobiles in urban areas would also improve health in downwind rural settings.

Key words: air pollution, BenMAP, bicycling, built environment, climate change, ozone, particulate matter, physical activity, urban design, vehicle emissions. *Environ Health Perspect* 120:68–76 (2012). http://dx.doi.org/10.1289/ehp.1103440 [Online 2 November 2011]

The current fossil fuel–based transportation system of the United States negatively impacts human health by increasing air pollution and automobile accidents and by decreasing physical activity. Here, we consider how replacing short automobile trips with bicycle transport might yield health benefits through improved air quality and physical fitness, with a focus on the upper midwestern United States as our study region.

Both ozone (O_3) and fine particular matter ≤ 2.5 μm in aerodynamic diameter ($PM_{2.5}$) in the ambient air exacerbate bronchitis and asthma and may contribute to cardiovascular mortality (Brunekreef and Holgate 2002). Asthma affects 8.2% of U.S. citizens, and an estimated 10 million adults have diagnosed chronic obstructive pulmonary disease (COPD) (Centers for Disease Control and Prevention 2009). In addition, recent estimates attribute 63,000–88,000 premature deaths per year due to $PM_{2.5}$ [U.S. Environmental Protection Agency (EPA) 2010c]. In the United States, on-road vehicles are responsible for about 26% of volatile organic compounds (VOCs) and 35% of nitrogen oxide (NO_x) emissions (U.S. EPA 2005c, 2005d). NO_x and VOCs combine to form O_3 and contribute to nitrate and secondary organic aerosols, important components of $PM_{2.5}$. Nearly 240 U.S. counties, with > 118 million total residents, exceeded U.S. EPA O_3 standards in 2011, and > 200 counties (> 88 million total residents) failed to meet $PM_{2.5}$ standards, in part because of pollution from short car trips (U.S. EPA 2011a, 2011b).

Transport-related inactivity, that is, the use of motorized transport rather than walking and bicycling, has been linked to increased mortality and decreases in healthy life years, with the greatest impacts on chronic diseases including heart disease, stroke, colon cancer, diabetes mellitus type 2, obesity, breast cancer, and osteoporosis [World Health Organization (WHO) 2002]. Carlson et al. (2009) estimated that 32.4% of the U.S. population is fully inactive (no moderate-intensity or vigorous-intensity physical activity lasting at least 10 min at a time), while only 33.5% is physically active, defined as 30 min/day with moderate-intensity activity, ≥ 5 days/week. In a recent Dutch study, Johan de Hartog et al. (2010) concluded that shifting from short car trips to bicycle trips would reduce all-cause mortality, with estimated reductions in mortality due to increased physical activity that were nine times greater than estimated increases in mortality due to increased pollution inhalation and traffic-related fatality estimates in the Netherlands.

In the United States, 28% of all car trips are ≤ 1.6 km (1 mi), which is the distance that a typical European would walk (European Commission 2001; Pucher and Dijkstra 2003). Another 41% of all trips are ≤ 3.2 km (2 mi), a distance that many Europeans would be as likely to bicycle as to

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Supplemental Material is available online (http://dx.doi.org/10.1289/ehp.1103440).

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Research by M.G. and J.P. was supported by the U.S. Environmental Protection Agency (EPA) STAR program (grant R83275201O), Health Risks from Climate Variability and Change in the Upper Midwest: a Place-based Assessment of Climate-related Morbidity. M.G. was also supported by NSF grant DGE-0549407, an Integrative Graduate Education and Research Traineeship (IGERT) titled "Vulnerability and Sustainability in Coupled Human-Natural Systems." S.S., T.H., B.S., and A.M. were supported by U.S. EPA STAR grant R831840.

Contents of this article are solely the responsibility of the grantee and do not necessarily represent the views of the U.S. EPA.

The authors declare they have no actual or potential competing financial interests.

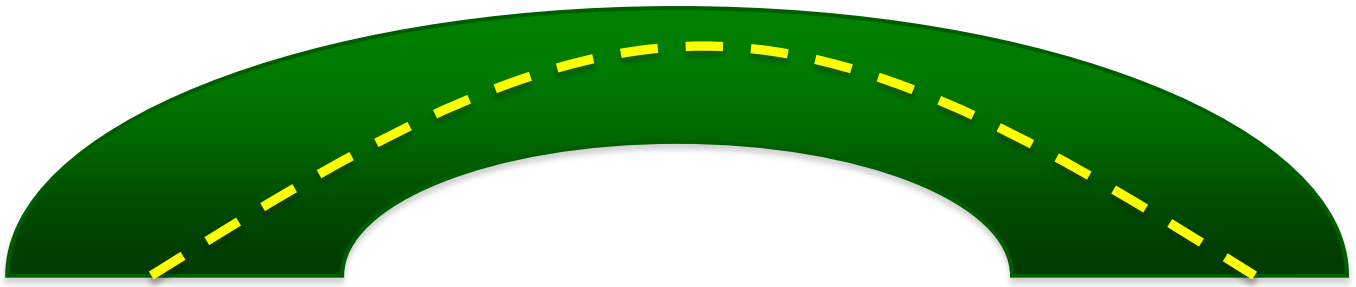
Received 12 January 2011; accepted 5 October 2011.

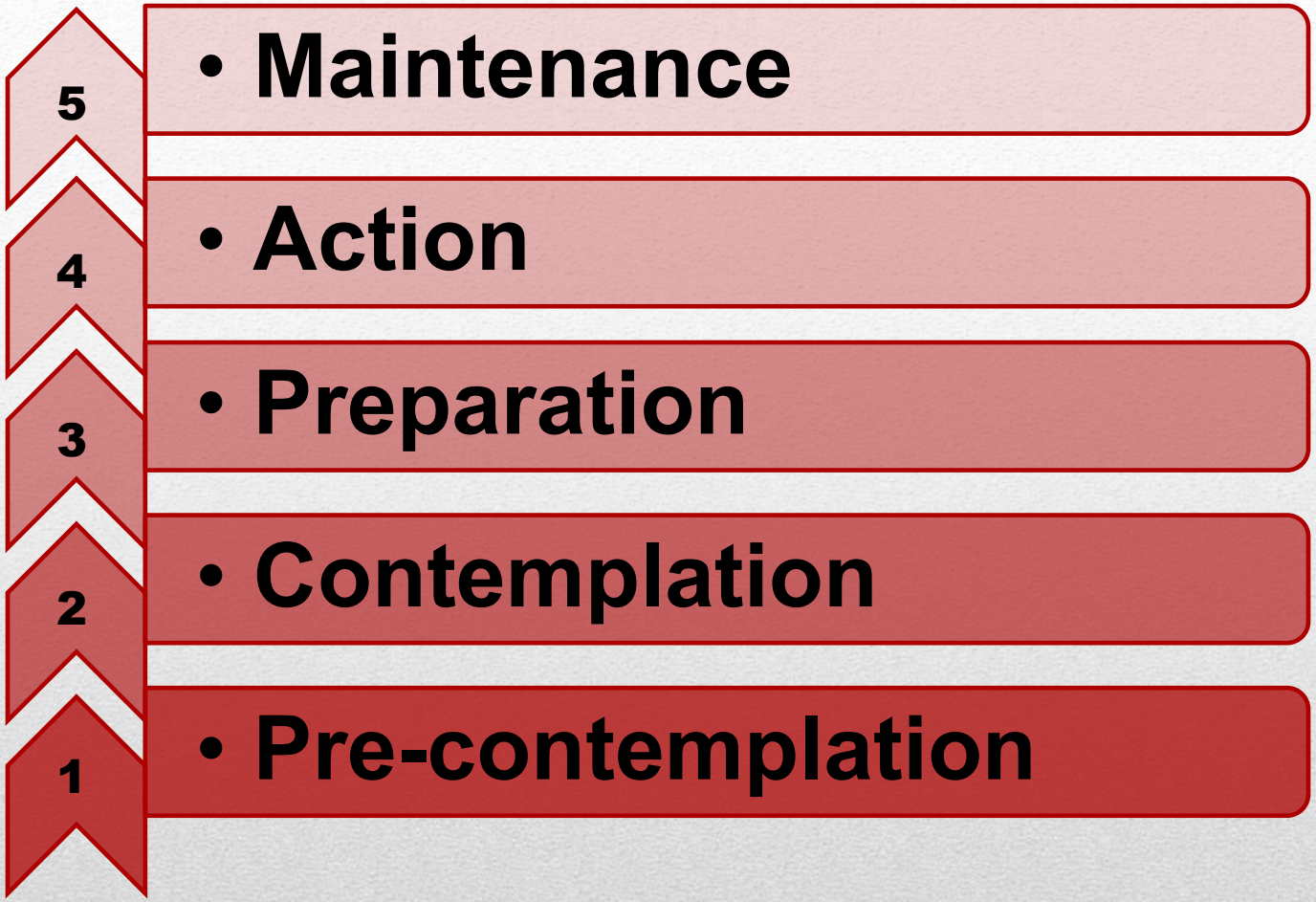
Air Quality and Exercise-Related Health Benefits of Reduced Car Travel in the Midwestern United States

Grabow et. al

- Mortality declines regionally by 1,295 deaths per year
- Combined regional benefits exceeds $8.7 billion / year
- Health improvement in downwind rural areas
- Reduction in climate change causing greenhouse gases
- Small changes in air quality = huge health benefits







Stages of Change Theory –

DiClemente & Prochaska



Climate Change *Deniers:*
Pre-contemplation



Climate Change *Acceptors:*
Contemplation

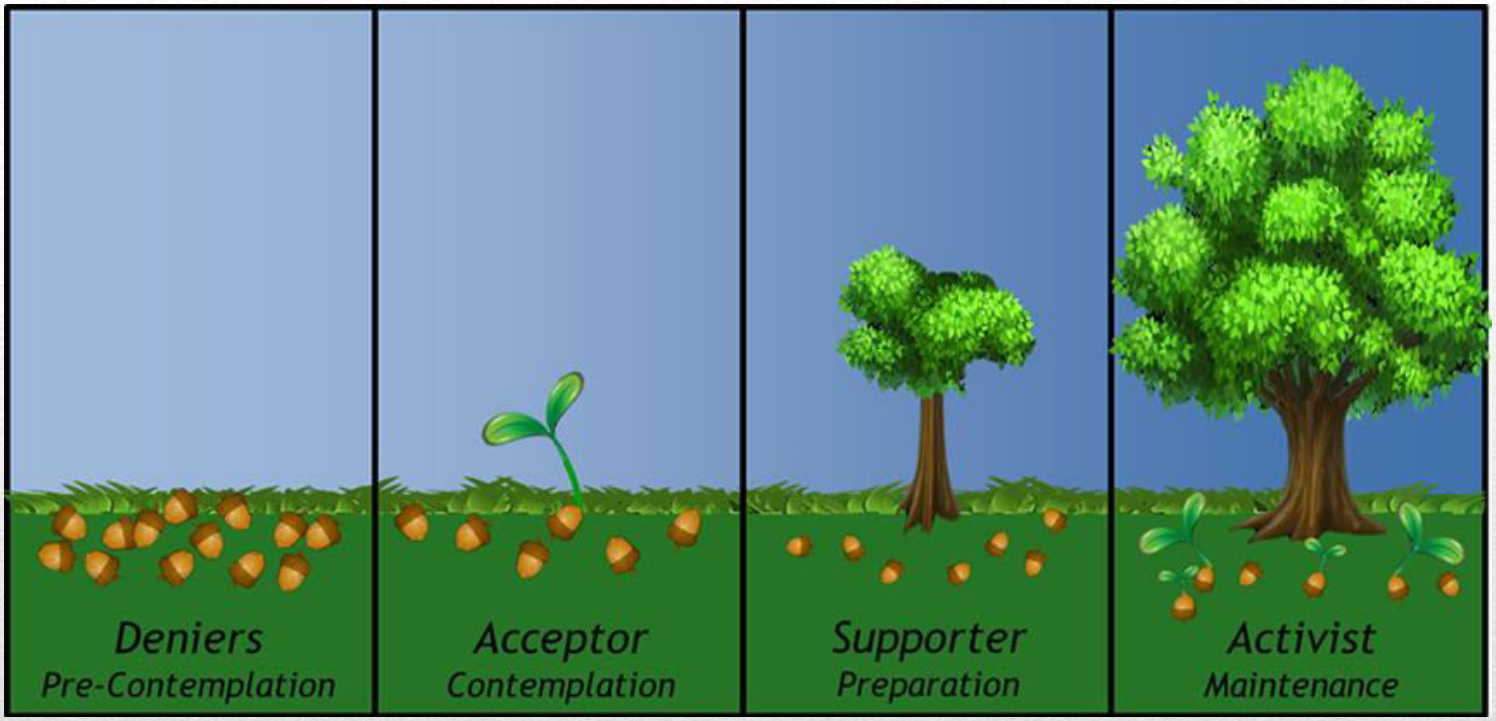


Climate Change *Supporters:*
Preparation



Climate Change *Activists:*
Maintenance

Four Climate Change "camps"



Mindful Climate Action: Health and Environmental Co-Benefits from Mindfulness-Based Behavioral Training

Bruce Barrett, Maggie Grabow, Cathy Middlecamp, Margaret Mooney, Mary Checovich, Alexander Converse, Bob Gillespie and Julia Yates

sustainability

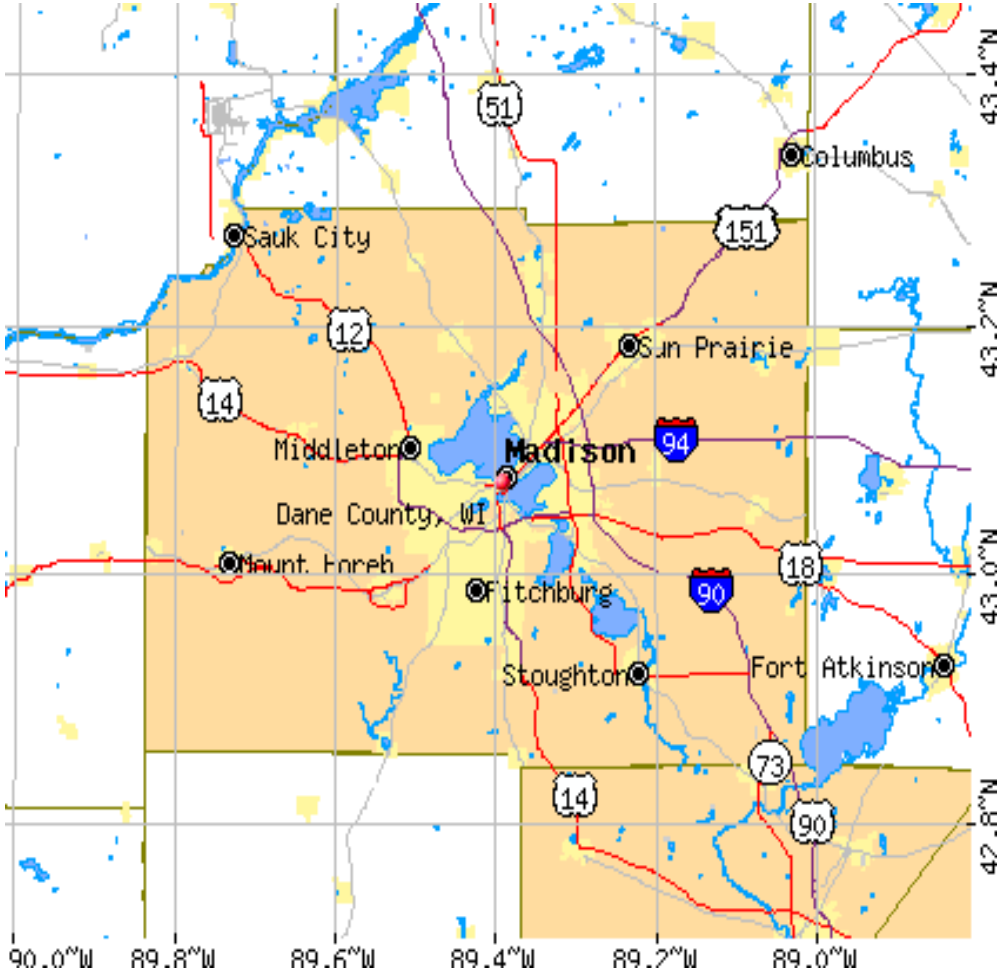
Published 17 October 2016

Week	Mindfulness Topic	Practices Learned	Climate Action Topic	Objective
1	Cultivating Beginner's Mind (Simple Awareness)	• Mindful eating • Breath Awareness • Body Scan	Mindful Eating: Healthy and Sustainable Diets	Develop awareness of the varying environmental and health impacts of food
2	Cultivating Non-striving (Attention and The Brain)	• Loving Kindness Meditation	Water Considerations for Sustainable Lifestyles	Learn and understand the many implications of a changing climate on water scarcity
3	Cultivating Acceptance (Dealing with Thoughts)	• Mindfulness within movement • Hatha Yoga • Walking Meditation	Walking Meditation, Exercise, and Active Transport	Motivate participants to choose active modes of transport whenever possible
4	Cultivating Patience (Stress: Responding vs. Reacting)	• Sitting meditation	Energy Conservation	Make connections between daily activities and energy use and understand the benefits of reducing energy consumption;
5	Cultivating Letting Go (Dealing with Difficult Emotions/Sensations)	• Sitting meditation	Climate Connections Across Time and Space	Develop awareness of the connectedness of all living beings and ecosystems
6	Cultivating Trust (Mindfulness and Communication)	• Compassion for the conditioned mind • Yoga Part 2	Ethical considerations and observed inequities in the causes and consequences of climate change.	Develop awareness of broader impacts of climate change on those least responsible;
7	Cultivating Forgiveness (Mindfulness and Compassion)	• Sitting meditation with choiceless awareness • (Metta)Loving Kindness meditation	Personal and Planetary Well-Being; Purchasing and Consumption	Understand concepts of desire and fulfillment, motivation, striving, purchasing, and the cycle of wanting and reward
8	Sustaining Practice in Times of Transition (Conclusion)	• Self-directed yoga	Mindful Climate Learnings	Discuss how to keep the momentum of mindful climate action going in every-day lives

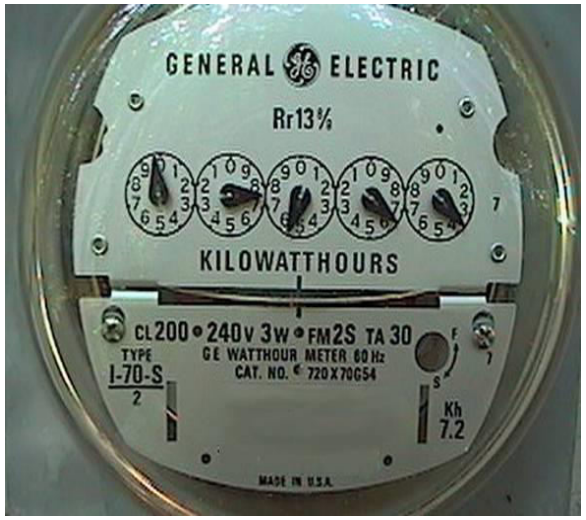
Objective, Measureable Outcomes

Outcome	Research Tool (outcome measures)
Climate Change and Energy Knowledge	College intro-level test on climate change, energy & carbon footprint
Utilities	**Household** consumption of: (over 12 months) 1) **gas** (therms); 2) **electricity** (kilowatt hours) 3) **water** (gallons)
Fossil-Fuel Transport	**Automobile miles** driven - **Odometer** readings **Travel by air, bus and train** - Itineraries
Active Transport	**Active transport** vs carbon-fueled transport - **Moves app** **Exercise** - **ActiGraph** accelerometer
Dietary Composition	**Dietary carbon footprint** - Prospective food & drink intake log analyzed using Nutritional Data System for Research (NDSR)
General Mental and Physical Health	SF-36 – Highly validated, short form **General Health** survey PSS-10 - Perceived **Stress** Scale PHI - Pemberton **Happiness** Index CES-D -Center for Epidemiologic Studies **Depressive Symptoms** Scale MSES – Mindfulness-based **Self-Efficacy** Scale StPS - Stanford **Presenteeism** Scale ***Good Health is a Co-Benefit of Carbon Footprint Reduction!***

Household Gas & Electric use will be monitored monthly using MG&E's accessible online database



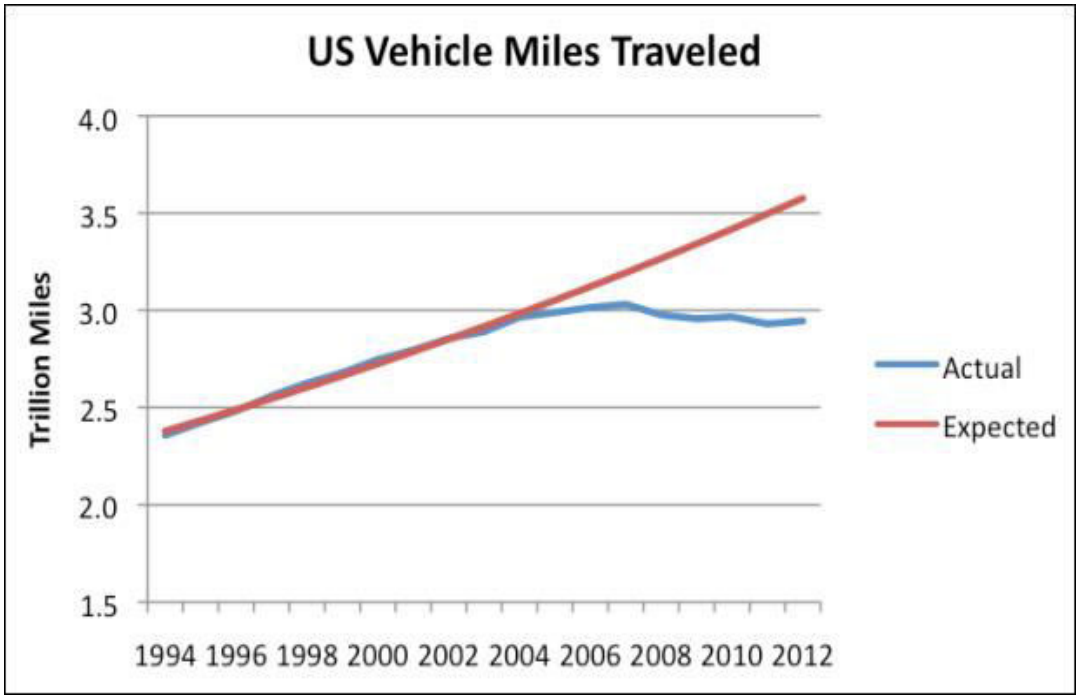
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Automobile miles driven will be monitored using odometer readings photos emailed or texted using smart phone

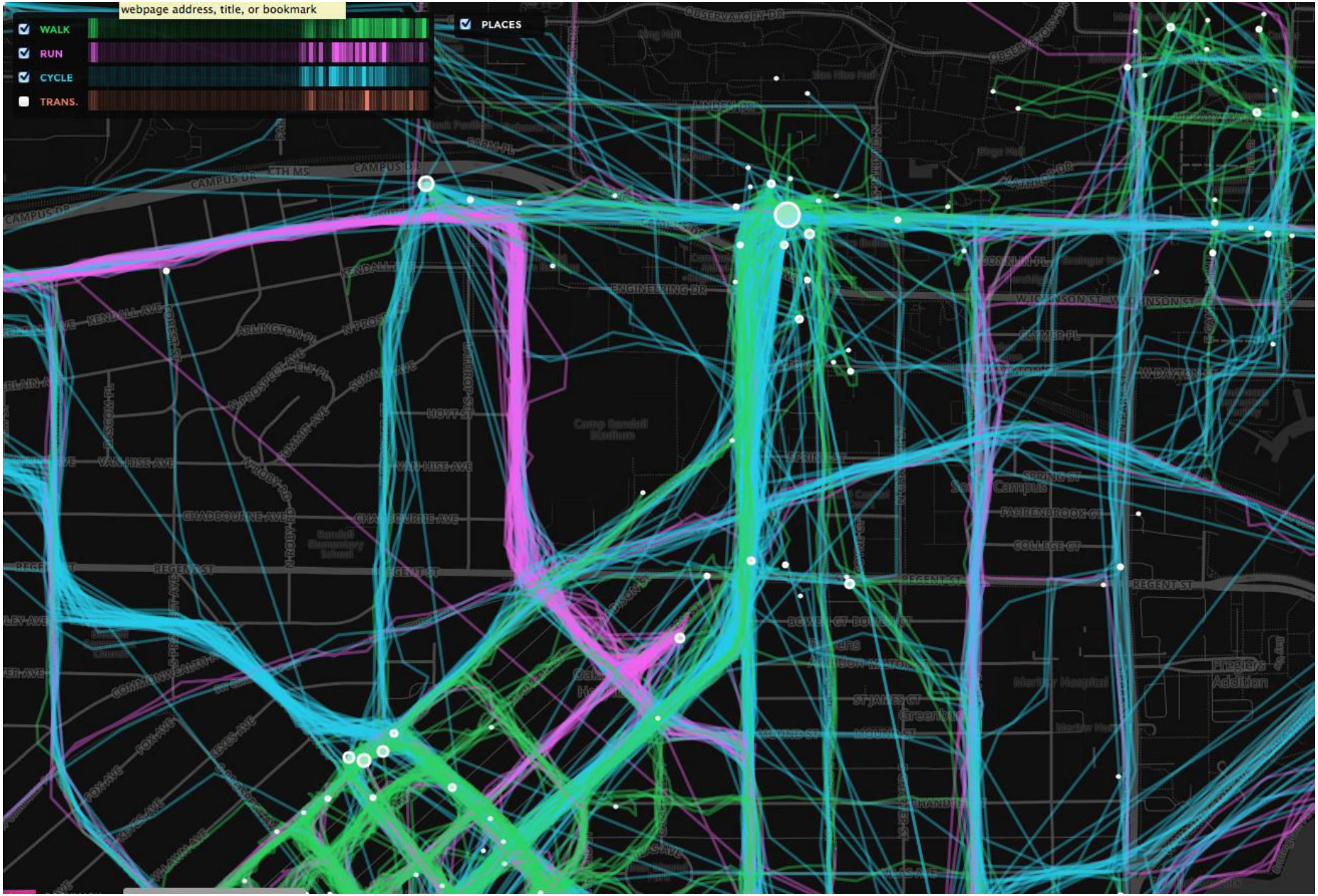






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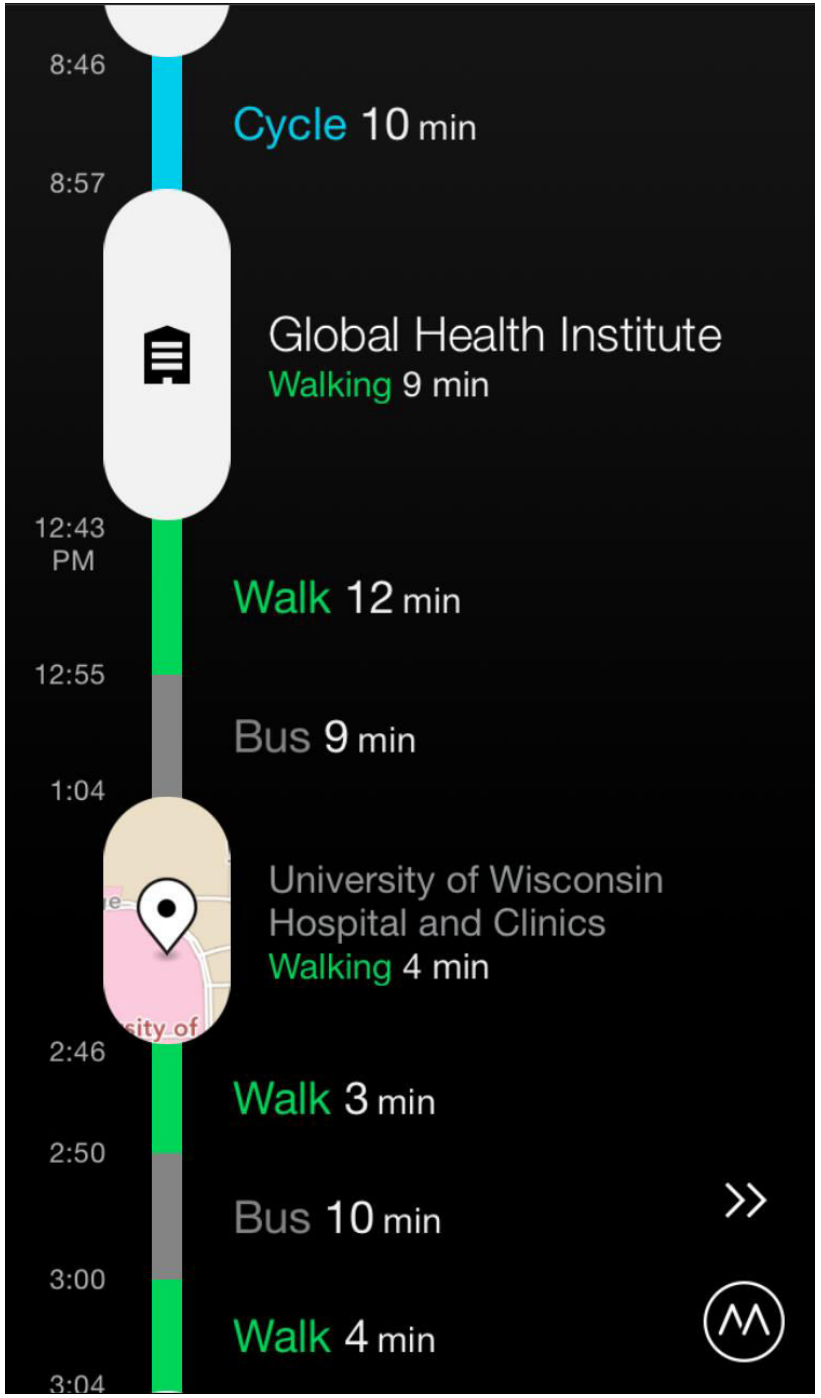
MOVES App Activity Map by Transportation Mode



MOVES App
Activity Storyline ➔



Travel Mode Distance Summary ➔

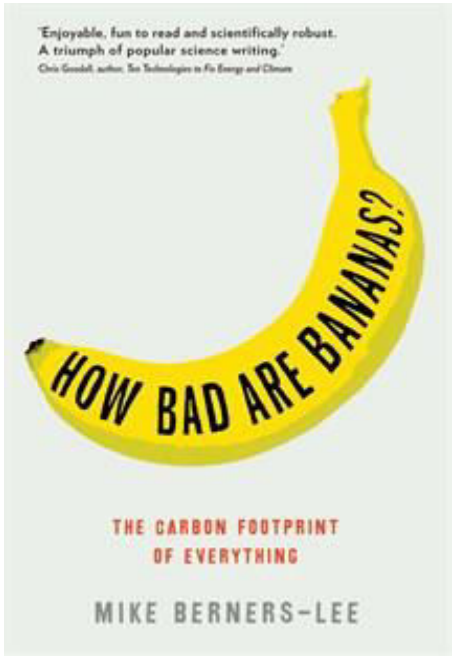




- Widely used & State of the art
- Comprehensive and current food database
- Streamlined data entry and food coding
- Calculates calories, nutrients, micronutrients
- Adaptable towards carbon footprint calculation

Consulting Advisor

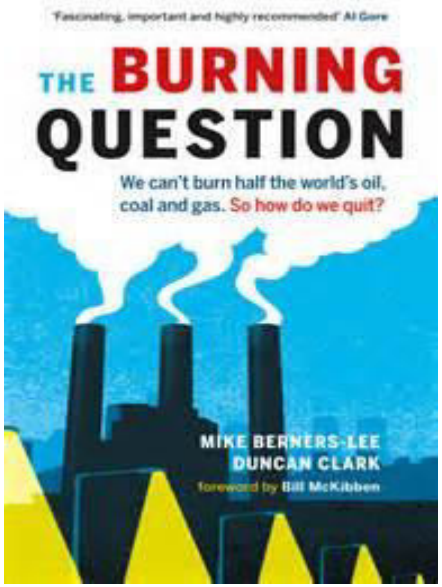
- **Mike Berners-Lee** and **Small World Consulting** at the **University of Lancaster, Great Britain**, will consult and assist with quantifying carbon footprints



$$CF = \Sigma CiEi$$

CF = individual carbon footprint
C = Consumption
E = Emission
i = Input

Inputs to be assessed include:
Gas & Electricity; Automobile transport
Air transport; Dietary consumption



Berkeley
UNIVERSITY OF CALIFORNIA

http://coolclimate.berkeley.edu/



CoolClimate Network

carbon footprint calculator



Business & Community Partners

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PROJECTS



Next,



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January 2017

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

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February 2017

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

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March 2017

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
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26	27	28	29	30	31	

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Scaling Up MINDFUL CLIMATE ACTION **business plan**

market MCA trainings to:

1) **Businesses** ↓energy costs ↓ absenteeism ↑ worker productivity

2) **Community** and **faith-based organizations** mission & moral mandate

3) **Educational institutions** educational mission & innovation

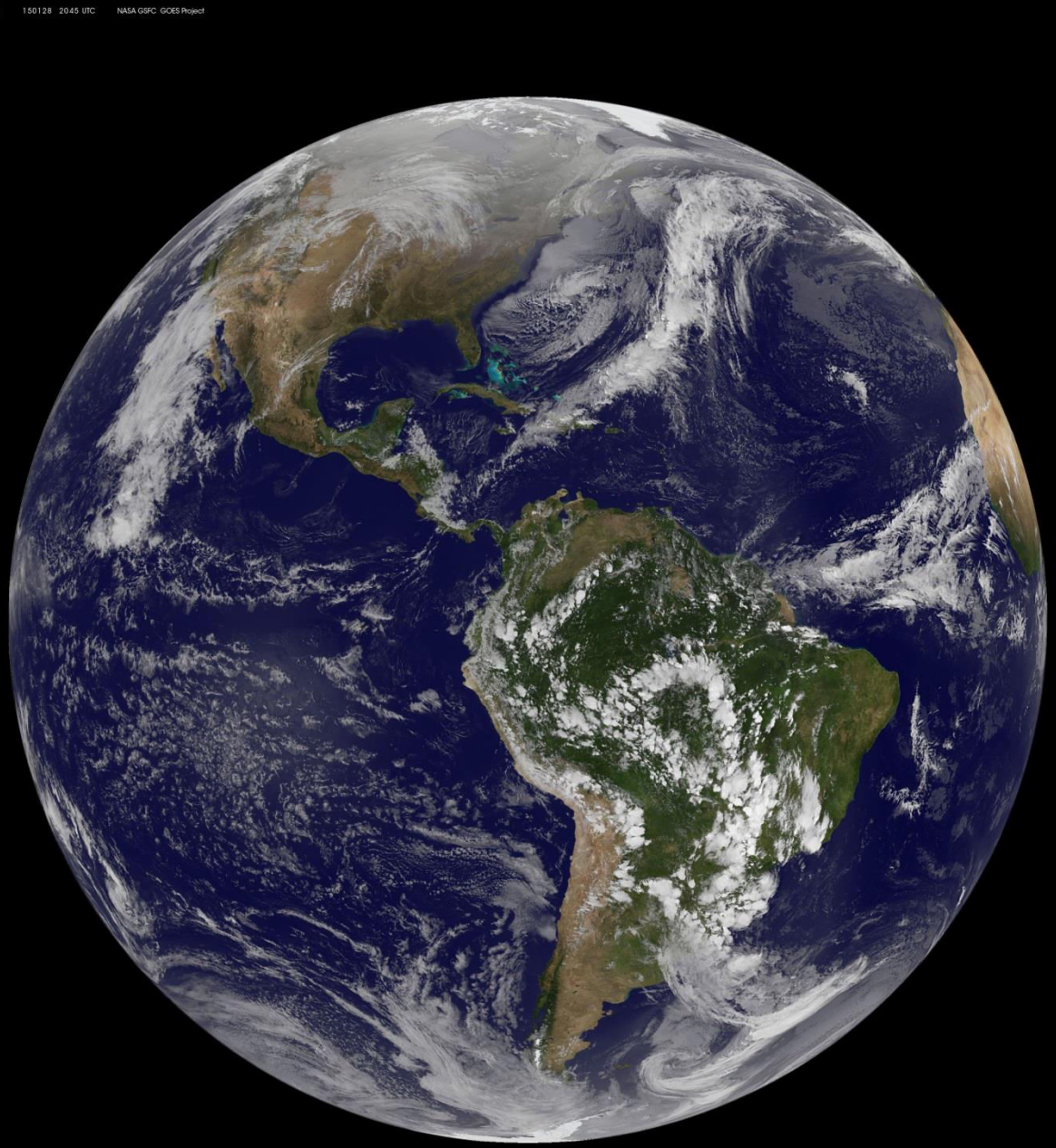
4) **General Public** in-person courses & web-based learning



http://yourstory.in/wp/content/uploads/2012/06



Expanding MCA Program



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NOAA
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