



John Weyant

Professor (Research) of Management Science and Engineering, of Energy Science Engineering and Senior Fellow at the Precourt Institute for Energy

Bio

BIO

John P. Weyant is Professor of Management Science and Engineering and Director of the Energy Modeling Forum (EMF) at Stanford University. He is also a Senior Fellow of the Precourt Institute for Energy and an affiliated faculty member of the Stanford School of Earth, Environment and Energy Sciences, the Woods Institute for the Environment, and the Freeman-Spogli Institute for International Studies at Stanford. His current research focuses on analysis of multi-sector, multi-region coupled human and earth systems dynamics, global change systems analysis, energy technology assessment, and models for strategic planning.

Weyant was a founder and serves as chairman of the Integrated Assessment Modeling Consortium (IAMC), a seventeen-year old collaboration among over 60 member institutions from around the world. He has been an active adviser to the United Nations, the European Commission, U.S. Department of Energy, the U.S. Department of State, and the Environmental Protection Agency. In California, he has been and adviser to the California Air Resources, the California Energy Commission and the California Public Utilities Commission..

Weyant was awarded the US Association for Energy Economics' 2008 Adelman-Frankel award for unique and innovative contributions to the field of energy economics and the award for outstanding lifetime contributions to the Profession for 2017 from the International Association for Energy Economics, and a Life Time Achievement award from the Integrated Assessment Modeling Consortium in 2018. Weyant was honored in 2007 as a major contributor to the Nobel Peace prize awarded to the Intergovernmental Panel on Climate Change and in 2008 by Chairman Mary Nichols for contributions to the the California Air Resources Board's Economic and Technology Advancement Advisory Committee on AB 32.

Fields of Specialization:

Energy/Environmental Policy Analysis, Strategic Planning

Interests:

Overall goal is to accelerate the use of systems models at state, country, and global scales, aiming to provide the best available information and insights to government and private-sector decision makers. Specific areas include energy, climate change, and sustainable development policy, including emerging technologies and market design alternatives. Draws on concepts and techniques from science and engineering fundamentals (e.g., thermodynamics, fluid mechanics, materials science, and electrical power systems), operations research, economics, finance, and decision theory.

ACADEMIC APPOINTMENTS

- Professor (Research), Management Science and Engineering

- Professor (Research), Energy Science & Engineering
- Senior Fellow, Precourt Institute for Energy
- Deputy Director, Precourt Energy Efficiency Center
- Affiliate, Stanford Woods Institute for the Environment

HONORS AND AWARDS

- Nobel Peace Prize, Significant Contributions to the Intergovernmental Panel on Climate Change Award, Intergovernmental Panel on Climate Change (2007)
- Adelman Frankel Award for 2008 for Unique and Enduring Contributions to the Field, U.S. Association for Energy Economics, (2008)
- Outstanding Contributions to the Profession Award for 2017, (Maximum One Award per Year), International Association for Energy Economics (2017)
- (First) Life Time Achievement Award, Integrated Assessment Modeling Consortium (2018)

PROGRAM AFFILIATIONS

- Public Policy

PROFESSIONAL EDUCATION

- MS, Rensselaer Polytechnic Institute , Operations Research and Statistics (1970)
- MS, Rensselaer Polytechnic Institute , Aero. Eng. and Astronautics (1970)
- PhD, UC Berkeley , Management Science (1976)

Teaching

COURSES

2025-26

- Advanced Methods in Modeling for Climate and Energy Policy: MS&E 394 (Spr)
- Capstone Project Seminar in Environment and Resources: ENVRES 290 (Aut)
- The Stanford Energy Seminar: CEE 301, ENERGY 301, MS&E 494 (Aut, Win, Spr)

2024-25

- The Stanford Energy Seminar: CEE 301, ENERGY 301, MS&E 494 (Aut, Win, Spr)

2023-24

- Advanced Methods in Modeling for Climate and Energy Policy: MS&E 394 (Spr)
- Capstone Project Seminar in Environment and Resources: ENVRES 290 (Aut)
- International Environmental Policy: MS&E 92Q (Win)
- The Stanford Energy Seminar: CEE 301, ENERGY 301, MS&E 494 (Aut, Win, Spr)

2022-23

- Advanced Methods in Modeling for Climate and Energy Policy: MS&E 394 (Spr)
- Capstone Project Seminar in Environment and Resources: ENVRES 290 (Aut, Win)
- International Environmental Policy: MS&E 92Q (Win)
- Sustainable Energy Interdisciplinary Graduate Seminar: CEE 372, ENERGY 309, MS&E 495 (Aut)
- The Energy Seminar: CEE 301, ENERGY 301, MS&E 494 (Aut, Win, Spr)

STANFORD ADVISEES

Doctoral Dissertation Advisor (AC)

Shahab Mousavi

Doctoral Dissertation Co-Advisor (AC)

Aldis Elfarsdottir

Master's Program Advisor

Mattia Mauro, Jessica Yan, Mark Yang

Publications

PUBLICATIONS

- **Policy implications of net-zero emissions: A multi-model analysis of United States emissions and energy system impacts** *ENERGY AND CLIMATE CHANGE*
Bistline, J. E. T., Binsted, M., Blanford, G., Boyd, G., Browning, M., Cai, Y., Edmonds, J., Fawcett, A. A., Fuhrman, J., Gao, R., Harris, C., Hoehne, C., Iyer, et al
2025; 6
- **Evolving electricity supply and demand to achieve net-zero emissions: Insights from the EMF-37 study** *ENERGY AND CLIMATE CHANGE*
Gao, R., Mai, T., Mousavi, S., Rossmann, C., Binsted, M., Bistline, J., Blanford, G., Browning, M., Fripp, M., Lamers, P., Muratori, M., Showalter, S., Weyant, et al
2025; 6
- **Impacts of EPA's finalized power plant greenhouse gas standards.** *Science (New York, N.Y.)*
Bistline, J., Bergman, A., Blanford, G., Brown, M., Burtraw, D., Domeshek, M., Fawcett, A., Hamilton, A., Iyer, G., Jenkins, J., King, B., Kolus, H., Levin, et al
2025; 387 (6730): 140-143
- **A Framework for Multisector Scenarios of Outcomes for Well-Being and Resilience** *EARTHS FUTURE*
O'Neill, B. C., Morris, J., Lamontagne, J., Weyant, J., Wise, M.
2024; 12 (5)
- **Power sector impacts of the Inflation Reduction Act of 2022** *ENVIRONMENTAL RESEARCH LETTERS*
Bistline, J. E. T., Brown, M., Domeshek, M., Marcy, C., Roy, N., Blanford, G., Burtraw, D., Farbes, J., Fawcett, A., Hamilton, A., Jenkins, J., Jones, R., King, et al
2024; 19 (1)
- **Equity implications of net-zero emissions: A multi-model analysis of energy expenditures across income classes under economy-wide deep decarbonization policies** *ENERGY AND CLIMATE CHANGE*
Bistline, J., Onda, C., Browning, M., Emmerling, J., Iyer, G., Mahajan, M., McFarland, J., McJeon, H., Orvis, R., Fonseca, F., Roney, C., Sandoval, N., Sarmiento, et al
2024; 5
- **Net-Zero CO2 by 2050 Scenarios for the United States in the Energy Modeling Forum 37 Study.** *Energy and climate change*
Browning, M., McFarland, J., Bistline, J., Boyd, G., Muratori, M., Binsted, M., Harris, C., Mai, T., Blanford, G., Edmonds, J., Fawcett, A. A., Kaplan, O., Weyant, et al
2023; 4: 1-13
- **Emissions and energy impacts of the Inflation Reduction Act.** *Science (New York, N.Y.)*
Bistline, J., Blanford, G., Brown, M., Burtraw, D., Domeshek, M., Farbes, J., Fawcett, A., Hamilton, A., Jenkins, J., Jones, R., King, B., Kolus, H., Larsen, et al
2023; 380 (6652): 1324-1327
- **Climate-related financial risk assessment on energy infrastructure investments** *RENEWABLE & SUSTAINABLE ENERGY REVIEWS*
In, S., Manav, B., Venereau, C. M. A., Cruz, R., Weyant, J. P.
2022; 167
- **Introduction to the Special Issue "EMF 36: Carbon pricing after Paris (CarPri)"** *ENERGY ECONOMICS*
Boehringer, C., Peterson, S., Weyant, J. P.
2022; 112

- **Global biomass supply modeling for long-run management of the climate system** *CLIMATIC CHANGE*
Rose, S. K., Popp, A., Fujimori, S., Havlik, P., Weyant, J., Wise, M., van Vuuren, D., Brunelle, T., Cui, R., Daioglou, V., Frank, S., Hasegawa, T., Humpenoder, et al
2022; 172 (1-2)
- **The contribution of bioenergy to the decarbonization of transport: a multi-model assessment** *CLIMATIC CHANGE*
Leblanc, F., Bibas, R., Mima, S., Muratori, M., Sakamoto, S., Sano, F., Bauer, N., Daioglou, V., Fujimori, S., Gidden, M. J., Kato, E., Rose, S. K., Tsutsui, et al
2022; 170 (3-4)
- **Pricing climate-related risks of energy investments** *RENEWABLE & SUSTAINABLE ENERGY REVIEWS*
In, S., Weyant, J. P., Manav, B.
2022; 154
- **Climate policy models need to get real about people - here's how** *NATURE*
Peng, W., Iyer, G., Bosetti, V., Chaturvedi, V., Edmonds, J., Fawcett, A. A., Hallegatte, S., Victor, D. G., van Vuuren, D., Weyant, J.
2021; 594 (7862): 174-176
- **Accounting for the Greenhouse Gas Emission Intensity of Regional Electricity Transfers.** *Environmental science & technology*
Von Wald, G., Cullenward, D., Mastrandrea, M. D., Weyant, J.
2021
- **Introduction to the special feature on energy scenarios for long-term climate change mitigation in Japan** *SUSTAINABILITY SCIENCE*
Sugiyama, M., Fujimori, S., Wada, K., Weyant, J.
2021
- **The Energy Modeling Forum (EMF)-30 study on short-lived climate forcers: introduction and overview** *CLIMATIC CHANGE*
Smith, S. J., Klimont, Z., Drouet, L., Harmsen, M., Luderer, G., Riahi, K., van Vuuren, D. P., Weyant, J. P.
2020
- **An overview of the Energy Modeling Forum 33rd study: assessing large-scale global bioenergy deployment for managing climate change** *CLIMATIC CHANGE*
Rose, S. K., Bauer, N., Popp, A., Weyant, J., Fujimori, S., Havlik, P., Wise, M., van Vuuren, D. P.
2020
- **Global energy sector emission reductions and bioenergy use: overview of the bioenergy demand phase of the EMF-33 model comparison** *CLIMATIC CHANGE*
Bauer, N., Rose, S. K., Fujimori, S., van Vuuren, D. P., Weyant, J., Wise, M., Cui, Y., Daioglou, V., Gidden, M. J., Kato, E., Kitous, A., Leblanc, F., Sands, et al
2020; 163 (3): 1553-68
- **Key findings from the core North American scenarios in the EMF34 intermodel comparison** *ENERGY POLICY*
Huntington, H. G., Bhargava, A., Daniels, D., Weyant, J. P., Avraam, C., Bistline, J., Edmonds, J. A., Giarola, S., Hawkes, A., Hansen, M., Johnston, P., Molar-Cruz, A., Nadew, et al
2020; 144
- **Integrated Climate-Change Assessment Scenarios and Carbon Dioxide Removal** *ONE EARTH*
Schweizer, V. J., Ebi, K. L., van Vuuren, D. P., Jacoby, H. D., Riahi, K., Strefler, J., Takahashi, K., van Ruijven, B. J., Weyant, J. P.
2020; 3 (2): 166-172
- **Integrated Climate-Change Assessment Scenarios and Carbon Dioxide Removal.** *One earth (Cambridge, Mass.)*
Schweizer, V. J., Ebi, K. L., van Vuuren, D. P., Jacoby, H. D., Riahi, K., Strefler, J., Takahashi, K., van Ruijven, B. J., Weyant, J. P.
2020; 3 (2): 166-172
- **EMF-33 insights on bioenergy with carbon capture and storage (BECCS)** *CLIMATIC CHANGE*
Muratori, M., Bauer, N., Rose, S. K., Wise, M., Daioglou, V., Cui, Y., Kato, E., Gidden, M., Strefler, J., Fujimori, S., Sands, R. D., van Vuuren, D. P., Weyant, et al
2020
- **The Evolution of Integrated Assessment: Developing the Next Generation of Use-Inspired Integrated Assessment Tools** *ANNUAL REVIEW OF RESOURCE ECONOMICS, VOL 12*

- Fisher-Vanden, K., Weyant, J.
edited by Rausser, G. C., Zilberman, D.
2020; 12: 471–87
- **On choosing the resolution of normative models** *EUROPEAN JOURNAL OF OPERATIONAL RESEARCH*
Merrick, J. H., Weyant, J. P.
2019; 279 (2): 511–23
 - **Macro-Energy Systems: Toward a New Discipline** *JOULE*
Levi, P. J., Kurland, S., Carbajales-Dale, M., Weyant, J. P., Brandt, A. R., Benson, S. M.
2019; 3 (10): 2282–86
 - **Inside the Black Box: Understanding key drivers of global emission scenarios** *ENVIRONMENTAL MODELLING & SOFTWARE*
Koomey, J., Schmidt, Z., Hummel, H., Weyant, J.
2019; 111: 268–81
 - **INTRODUCTION TO THE EMF 32 STUDY ON U.S. CARBON TAX SCENARIOS** *CLIMATE CHANGE ECONOMICS*
Fawcett, A. A., McFarland, J. R., Morris, A. C., Weyant, J. P.
2018; 9 (1)
 - **INTRODUCTION TO THE EMF 32 STUDY ON U.S. CARBON TAX SCENARIOS.** *Climate change economics*
Fawcett, A. A., McFarland, J. R., Morris, A. C., Weyant, J. P.
2018; 9 (1)
 - **Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Clack, C. T. M., Qvist, S. A., Apt, J., Bazilian, M., Brandt, A. R., Caldeira, K., Davis, S. J., Diakov, V., Handschy, M. A., Hines, P. D. H., Jaramillo, P., Kammen, D. M., Long, et al
2017; 114 (26): 6722–27
 - **Some Contributions of Integrated Assessment Models of Global Climate Change** *REVIEW OF ENVIRONMENTAL ECONOMICS AND POLICY*
Weyant, J.
2017; 11 (1): 115-137
 - **Dynamically estimating the distributional impacts of US climate policy with NEMS: A case study of the Climate Protection Act of 2013** *ENERGY ECONOMICS*
Cullenward, D., Wilkerson, J. T., Wara, M., Weyant, J. P.
2016; 55: 303-318
 - **Comparison of low-carbon pathways for California** *CLIMATIC CHANGE*
Morrison, G. M., Yeh, S., Eggert, A. R., Yang, C., Nelson, J. H., Greenblatt, J. B., Isaac, R., Jacobson, M. Z., Johnston, J., Kammen, D. M., Mileva, A., Moore, J., Roland-Holst, et al
2015; 131 (4): 545-557
 - **Comparison of integrated assessment models: Carbon price impacts on US energy** *ENERGY POLICY*
Wilkerson, J. T., Leibowicz, B. D., Turner, D. D., Weyant, J. P.
2015; 76: 18-31
 - **The role of technology for achieving climate policy objectives: overview of the EMF 27 study on global technology and climate policy strategies** *CLIMATIC CHANGE*
Kriegler, E., Weyant, J. P., Blanford, G. J., Krey, V., Clarke, L., Edmonds, J., Fawcett, A., Luderer, G., Riahi, K., Richels, R., Rose, S. K., Tavoni, M., Van Vuuren, et al
2014; 123 (3-4): 353-367
 - **Preface and introduction to EMF 27** *CLIMATIC CHANGE*
Weyant, J., Kriegler, E.
2014; 123 (3-4): 345-352
 - **Energy efficiency potentials for global climate change mitigation** *CLIMATIC CHANGE*
Sugiyama, M., Akashi, O., Wada, K., Kanudia, A., Li, J., Weyant, J.
2014; 123 (3-4): 397-411

- **Bioenergy in energy transformation and climate management** *CLIMATIC CHANGE*
Rose, S. K., Kriegler, E., Bibas, R., Calvin, K., Popp, A., Van Vuuren, D. P., Weyant, J.
2014; 123 (3-4): 477-493
- **End use technology choice in the National Energy Modeling System (NEMS): An analysis of the residential and commercial building sectors** *ENERGY ECONOMICS*
Wilkerson, J. T., Cullenward, D., Davidian, D., Weyant, J. P.
2013; 40: 773-784
- **Electric sector investments under technological and policy-related uncertainties: a stochastic programming approach** *CLIMATIC CHANGE*
Bistline, J. E., Weyant, J. P.
2013; 121 (2): 143-160
- **Introduction to the EMF 29 special issue on the role of border carbon adjustment in unilateral climate policy Preface** *ENERGY ECONOMICS*
Boehringer, C., Balistreri, E. J., Rutherford, T. F., Weyant, J.
2012; 34: S95-S96
- **Regional energy system variation in global models: Results from the Asian Modeling Exercise scenarios** *ENERGY ECONOMICS*
Clarke, L., Krey, V., Weyant, J., Chaturvedi, V.
2012; 34: S293-S305
- **A special issue on the RCPs** *CLIMATIC CHANGE*
van Vuuren, D. P., Edmonds, J. A., Kainuma, M., Riahi, K., Weyant, J.
2011; 109 (1-2): 1-4
- **Competing or coordinating: IT R&D investment decision making subject to information time lag** *INFORMATION TECHNOLOGY & MANAGEMENT*
Yao, T., Weyant, J., Feng, B.
2011; 12 (3): 241-251
- **Accelerating the development and diffusion of new energy technologies: Beyond the "valley of death"** *ENERGY ECONOMICS*
Weyant, J. P.
2011; 33 (4): 674-682
- **EMF 25 Summary Report: Energy Efficiency and Climate Change Mitigation** *Energy Modeling Forum*
Weyant, J. P.
2011
- **The next generation of scenarios for climate change research and assessment** *NATURE*
Moss, R. H., Edmonds, J. A., Hibbard, K. A., Manning, M. R., Rose, S. K., Van Vuuren, D. P., Carter, T. R., Emori, S., Kainuma, M., Kram, T., Meehl, G. A., Mitchell, J. F., Nakicenovic, et al
2010; 463 (7282): 747-756
- **A perspective on integrated assessment** *CLIMATIC CHANGE*
Weyant, J. P.
2009; 95 (3-4): 317-323
- **Introduction to the EMF 22 special issue on climate change control scenarios** *ENERGY ECONOMICS*
Clarke, L., Weyant, J.
2009; 31: S63-S63
- **Overview of EMF 22 US transition scenarios** *ENERGY ECONOMICS*
Fawcett, A. A., Calvin, K. V., de la Chesnaye, F. C., Reilly, J. M., Weyant, J. P.
2009; 31: S198-S211
- **Overview of EMF 22 US transition scenarios** *ENERGY ECONOMICS*
Fawcett, A. A., Calvin, K. V., de la Chesnaye, F. C., Reilly, J. M., Weyant, J. P.
2009; 31: S198-S211

- **Optimizing US Mitigation Strategies for the Light-Duty Transportation Sector: What We Learn from a Bottom-Up Model** *ENVIRONMENTAL SCIENCE & TECHNOLOGY*
Yeh, S., Farrell, A., Plevin, R., Sanstad, A., Weyant, J.
2008; 42 (22): 8202-8210
- **On the sources of technological change: What do the models assume?** *ENERGY ECONOMICS*
Clarke, L., Weyant, J., Edmonds, J.
2008; 30 (2): 409-424
- **A Critique of the Stern Review's Mitigation Cost Analyses and Integrated Assessment** *REVIEW OF ENVIRONMENTAL ECONOMICS AND POLICY*
Weyant, J. P.
2008; 2 (1): 77-93
- **Comment on "Alternative measures of output in global economic-environmental models: Purchasing power parity or market exchange rates?" by William Nordhaus** *ENERGY ECONOMICS*
Weyant, J. P.
2007; 29 (3): 373-374
- **On the sources of technological change: Assessing the evidence** *Annual Workshop on Climate Change Impacts and Integrated Assessment*
Clarke, L., Weyant, J., Birky, A.
ELSEVIER SCIENCE BV.2006: 579-95
- **Optimal technology R&D in the face of climate uncertainty** *Conference on Adaptive Research and Governance in Climate Change*
Baker, E., Clarke, L., Weyant, J.
SPRINGER.2006: 157-79
- **Overview of EMF-21: Multigas mitigation and climate policy** *ENERGY JOURNAL*
Weyant, J. R., de la Chesnaye, F. C., Blanford, G. J.
2006: 1-32
- **EMF 21 Multi-Greenhouse Gas Mitigation and Climate Policy Francisco C.** *The Energy Journal Special Issue*
De La Chesnaye, C., Weyant, John, P.
2006
- **Multi-gas scenarios to stabilize radiative forcing** *ENERGY ECONOMICS*
Van Vuuren, D. P., Weyant, J., de la Chesnaye, F.
2006; 28 (1): 102-120
- **Climate suitability for stable malaria transmission in Zimbabwe under different climate change scenarios** *CLIMATIC CHANGE*
Ebi, K. L., Hartman, J., Chan, N., McConnell, J., SCHLESINGER, M., Weyant, J.
2005; 73 (3): 375-393
- **Energy economics** *ENERGY ECONOMICS*
Tol, R. S., Weyant, J. P.
2005; 27 (4): 551-552
- **Special Issue - EMF 19 Alternative Technology Strategies for Climate Change Policy** *ENERGY ECONOMICS*
Weyant, J. P.
2004; 26 (4): 501-515
- **Untitled** *ENERGY ECONOMICS*
Tol, R. S., Weyant, J. P.
2004; 26 (1): V-VI
- **EMF OP 54 Shares, Gaps, and Economy's Response to Oil Disruption** *Stanford University*
Weyant, John, P., Huntington, Hillard, G.
2004
- **EMF OP 57 After the Natural Gas Bubble: An Economic Evaluation of the Recent U.S. National Petroleum Council Study** *Stanford University and Energy Journal April 2005*

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- Weyant, John, P., Costello, K., Huntington, Hillard, G., Wilson, James, F.
2004
- **EMF OP 53 U.S. Carbon Emissions, Technological Process, and Economic Growth Since 1870** *Stanford University*
Weyant, John, P., Huntington, Hillard, G.
2004
 - **Strategic decisions of new technology adoption under asymmetric information: A game-theoretic model** *DECISION SCIENCES*
Zhu, K., Weyant, J. P.
2003; 34 (4): 643-675
 - **EMF WP 20.2 Valuing a Medium-Scale Gas Fired Power Plant with Capacity Expansion Options Under a Competitive Environment** *Central Research Institute for the Electric Power Industry*
Weyant, John, P., Takahashi, M., Hattori, T., Okada, K., Asano, H.
2003
 - **EMF OP 55 Energy Security and Global Climate Change Mitigation** *Stanford University*
Weyant, John, P., Huntington, Hillard, G., Brown, Stephen, P. A.
2003
 - **EMF 20 Report: Natural Gas, Fuel Diversity, and North American Energy Markets** *Energy Modeling Forum EMF 20 Working Group*
Weyant, John, P.
2003; 1
 - **EMF WP 20.3 Fuel Switching Potential of Electric Generators: A Case Study** *Stanford University*
Pyrdol, J., Baron, B.
2003
 - **EMF WP 19.2 Environmental Technology Policy and Emerging Technologies** *Stanford University*
Weyant, John, P., Clarke, L.
2002
 - **EMF-17: Prices and Emissions in a Restructured Electricity Market** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
2002; 1
 - **EMF OP 52 Modeling Energy Markets and Climate Change Policy** *Stanford University and Encyclopedia of Energy*
Huntington, Hillard, G., Weyant, John, P.
2002
 - **EMF WP 20.1 Study Design: Natural Gas, Fuel Diversity and American Energy Markets** *Stanford University*
Weyant, John, P., Huntington, H.
2002
 - **EMF OP 51 Energy Disruptions, Interfirm Price Effects, and the Aggregate Economy** *Stanford University and Energy Economics March 2003*
Weyant, John, P., Huntington, Hillard, G.
2002; 25 (2)
 - **Bn integrated assessment model to evaluate the potential effects of climate change on malaria in Zimbabwe**
Hartman, J., McConnell, J., Chan, N., Ebi, K., Weyant, J.
LIPPINCOTT WILLIAMS & WILKINS.2001: S29-S29
 - **An integrated assessment model to evaluate the potential effects of climate change on malaria in Zimbabwe.**
Hartman, J., McConnell, K. J., Chan, N., Ebi, K. L., Weyant, J.
OXFORD UNIV PRESS INC.2001: S136-S136
 - **A report on the EMF 19 study on technology and global climate change policies** *5th International Conference on Greenhouse Gas Control Technologies*
Beecy, D., Richels, R., Weyant, J.
C S I R O.2001: 1026-1031

- **EMF OP 50 The Asymmetric Effects of Changes in Price and Income on Energy and Oil Demand** *Stanford University and Energy Journal* 2002
Weyant, John, P., Gately, D., Huntington, Hillard, G.
2001; 1 (23)
- **Approaches for performing uncertainty analysis in large-scale energy/economic policy models** *ENVIRONMENTAL MODELING & ASSESSMENT*
Kann, A., Weyant, J. P.
2000; 5 (1): 29-46
- **EMF OP 49 Projecting Energy Trends Into the New Century** *Stanford University and Encyclopedia of Life Support Systems, EOLSS Publishers*
Weyant, John, P., Huntington, Hillard, G., Rodekoher, M.
2000
- **SPECIAL ISSUE THE COSTS OF THE KYOTO PROTOCOL: A MULTI-MODEL EVALUATION INTRODUCTION AND OVERVIEW** *ENERGY JOURNAL*
Weyant, J. P., Hill, J. N.
1999: VII-XLIV
- **EMF WP 17.1 An International Comparison of Models for Measuring Market Power in Electricity** *Stanford University*
Weyant, John, P., Bushnell, J., Day, C., Duckworth, M., Green, R., Halseth, A.
1999
- **EMF WP 14.5 Induced Technological Change in Climate Policy Modeling** *Stanford University and Environmental Modeling and Assessment*
Weyant, John, P., Olavson, T.
1999; 14 (2,3)
- **Energy and Environmental Policy Modeling**
Weyant, John, P.
Kluwer Academic Press.1999
- **EMF WP 14.4 Approaches for Performing Uncertainty Analysis in Large-Scale Energy/Economic Policy Models** *Stanford University and Environmental Modeling and Assessment 2000*
Kann, A., Weyant, John, P.
1999; 5 (1)
- **Discounting and Intergenerational Equity**
Portney, Paul, R., Weyant, John, P.
edited by Portney, Paul, R., Weyant, John, P.
RFF Press.1999
- **The Costs of the Kyoto Protocol** *Energy Journal (special issue)*
Weyant, John, P.
1999
- **Reducing carbon emissions using clean distributed resources** *19th Annual North American IAEE/USAAE Conference on Technology Critical Role in Energy and Environmental Markets*
Hoff, T. E., Weyant, J. P., Herig, C.
INTERNATIONAL ASSOCIATION FOR ENERGY ECONOMICS.1998: 396-404
- **EMF-15: A Competitive Electricity Industry** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1998; 1
- **EMF OP 43 Crude Oil Prices and U.S. Economic Performance: Where Does the Asymmetry Reside?** *Stanford University*
Weyant, John, P., Huntington, Hillard, G.
1998
- **Designing Competitive Electricity Markets** *Designing Competitive Electricity Markets*
Weynat, John, P.
edited by Chao, H., Huntington, H.

1998: 228

- **Transmission Pricing** *Energy Modeling Forum Utilities Policy (Elsevier Science Ltd.)*
Weyant, John, P.
1997; 3 (6)
- **EMF SR 7 Quantifying Oil Disruption Risks Through Expert Judgment** *Stanford University*
Huntington, Hillard, G., Kann, A., Weyant, John, P.
1997
- **EMF OP 47 The IPCC Energy Assessment** *Stanford University and Energy Policy Special Issue: Energy and Greenhouse Gas Mitigation: The IPCC Report and Beyond*
Weyant, John, P.
1997; 24 (10/11)
- **EMF OP 48 Preliminary Results from EMF 14 on Integrated Assessment of Climate Change** *Stanford University*
Weyant, John, P.
1997
- **The IPCC energy assessment - Commentary** *ENERGY POLICY*
Weyant, J. P.
1996; 24 (10-11): 1005-1008
- **EMF SR 6 Computation of Electric Power Production Cost with Transmission Constraints** *Stanford University*
Weyant, John, P., Earle, Robert, L.
1996
- **EMF-13: Markets for Energy Efficiency** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1996; 1
- **EMF OP 44 Some Implications of Increased Cooperation in World Oil Conservation** *Stanford University; Federal Reserve Bank of Dallas Economic Review, Second Quarter*
Weyant, John, P., Brown, Stephen, P. A., Huntington, Hillard, G.
1996
- **EMF WP 14.2 Hedging Strategies for Global Dioxide Abatement: A Summary of Pull Results - EMF 14 Subgroup Analysis for Decisions Under Uncertainty** *Stanford University*
Weyant, John, P., Manne, Alan, S.
1996
- **EMF WP 14.3 The Berlin Mandate: The Design of Cost-Effective Mitigation Strategies** *Stanford University*
Weyant, John, P., Richls, R., Edmonds, J., Gruenspecht, H., Wigley, T.
1996
- **EMF OP 46 Insights from Integrated Assessment** *Stanford University*
Weyant, John, P.
1996
- **EMF OP 45 Testimony at the Hearings on U.S. Climate Change** *Stanford University*
Weyant, John, P.
1996
- **EMF WP 14.1 Second Round Study for EMF 14: Integrated Assessment of Global Climate Change** *Energy Modeling Forum Stanford University*
Weyant, John, P.
1995
- **EMF OP 42 LDC Cooperation in World Oil Conservation Policies** *Stanford University; The Energy Journal Special*
Weyant, John, P., Brown, Stephen, P.A., Huntington, Hillard, G.
1994

- **EMF-13: Markets for Energy Efficiency** *Energy Modeling Forum*
Weyant, John, P.
1994; 2
- **EMF OP 34 Oil Price Forecasting During the 1980s: What Went Wrong?** *Energy Journal*
Weyant, John, P., Huntington, Hillard, G.
1994; 2 (15)
- **EMF OP 41 Been Top Down So Long It Looks Like Bottom Up** *Stanford University; Energy Policy*
Weyant, John, P., Huntington, Hillard, G.
1994; 10 (22)
- **EMF OP 40 Assessing the Economic Cost of U.S. Oil Conservation** *Stanford University*
Weyant, John, P., Brown, Stephen, P.A., Huntington, Hillard, G.
1994
- **COSTS OF REDUCING GLOBAL CARBON EMISSIONS** *JOURNAL OF ECONOMIC PERSPECTIVES*
Weyant, J. P.
1993; 7 (4): 27-46
- **MODEL COMPARISONS OF THE COSTS OF REDUCING CO2 EMISSIONS** *105th Annual Meeting of the American-Economic-Association*
GASKINS, D. W., Weyant, J. P.
AMER ECON ASSN.1993: 318-23
- **EMF SR 5 Comparative Analysis of Energy Intensity Between the U.S. and Japan** *Stanford University*
Weyant, John, P., Nagata, Y.
1993
- **EMF WP 12.14 Results from the Jorgensen-Wilcoxon Model - Reducing U.S. Carbon Emissions: An Econometric General Equilibrium Assessment** *Stanford University*
Weyant, John, P., Jorgensen, Dale, W., Wilcoxon, Peter, J.
1993
- **EMF WP 12.4 Decomposition of Carbon Emission Reduction Projections** *Stanford University*
Weyant, John, P., Sit, M.
1993
- **EMF WP 12.2 Study Design for EMF 12 Global Climate Change: Energy Sector Impacts of Greenhouse Gas Emission Control Strategies** *Energy Modeling Forum Stanford University*
Weyant, John, P.
1993
- **EMF OP 38 Costs of Reducing Global Carbon Emissions: An Overview** *Stanford University*
Weyant, John, P.
1993
- **EMF WP 12.7 Cost-Benefit Analysis and Climate Change** *Stanford University*
Weyant, John, P., Peck, S., Teisberg, Thomas, J.
1993
- **EMF WP 12.5 The Technology Group Analysis** *Stanford University*
Weyant, John, P., Friedman, R., Newman, J., Belanger, S., Diener, A., Morris, S.
1993
- **EMF WP 12.3 Structural Comparison of EMF 12 Models** *Stanford University*
Weyant, John, P., Beaver, R.
1993
- **EMF WP 12.13 Results from the Edmonds-Reilly Model** *Stanford University*
Weyant, John, P., Edmonds, J.

1993

- **EMF WP 12.8 The Efficiency Value of Carbon Tax Revenues** *Stanford University*
Weyant, John, P., Shackleton, R., Shelby, M., Cristofaro, A., Brinner, R., Yanchar, J.
1993
- **EMF OP 37 EMF 12: Model Comparisons of the Costs of Reducing CO2 Emissions Darius** *Stanford University*
Gaskins, W., Weyant, John, P.
1993
- **EMF OP 35 Limiting Oil Imports: Cost Estimates From a Range of U.S. Model Projections** *Stanford University*
Weyant, John, P., Huntington, Hillard, G.
1993
- **EMF WP 13.3 Modeling Energy Technology Choices: Which Finance Tools Are Appropriate?** *Stanford University*
Weyant, John, P., Johnson, B.
1993
- **EMF WP 12.20 The Value of Cooperation in Abating Climate Change** *Stanford University*
Weyant, John, P., Hammitt, J., Adams, J.
1993
- **EMF WP 12.19 Sorting Out Facts and Uncertainties in Economic Response** *Stanford University*
Weyant, John, P., Yohe, Gary, W.
1993
- **EMF WP 12.18 Results from the Gemini-Energy Environmental Model - Analyzing Strategies for Reducing Greenhouse Gas Emissions** *Stanford University*
Weyant, John, P., Cohan, D., Deiner, A., Drozd, M., Gjerde, A., Haas, S.
1993
- **EMF WP 12.17 Results from the ICF Global-Macro Model: Estimation of Costs to Meet the CO2 Emission Targets in the Energy Sector** *Stanford University*
Weyant, John, P., Pepper, W.
1993
- **EMF WP 12.16 Results from the TGAS Model - Is the Forecast for Carbon Taxes Forecast by TGAS an Outlier: Why the Forecasts by Other Models are Too Low** *Stanford University*
Weyant, John, P., Kaufmann, Robert, T.
1993
- **EMF WP 12.15 Results from the U.S. Markal Model for EMF 12** *Stanford University*
Weyant, John, P., Morris, S., C., Lee, J., Goldstein, G.
1993
- **EMF WP 12.12 Lessons for the Implementation of Policies to Mitigate Carbon Dioxide Emissions** *Stanford University*
Weyant, John, P., Leary, Neil, A., Scheraga, Joel, D.
1993
- **EMF WP 12.6 The Transition to Reduced Levels of Carbon Emissions** *Stanford University*
Weyant, John, P., Peterson, E., Belanger, S., Cohan, D., Diener, A., Drozd, J., Michael
1993
- **EMF WP 12.21 Carbon Coalitions: The Cost and Effectiveness of Energy Agreements to Alter Trajectories of Atmospheric Carbon Dioxide Emission** *Stanford University*
Edmonds, J., Barns, David, W., Ton, M.
1993
- **EMF WP 12.10 Energy Security Impacts of Carbon Emission Reduction** *Stanford University*
Weyant, John, P., Rosenthal, D., Haspel, A., Lewis, H.
1993

- **EMF WP 12.9 The Distributional Impacts of a Carbon Tax** *Stanford University*
Weyant, John, P., Schillo, B., Giannarelli, L., Kelly, D., Swanson, S., Wilcoxon, P.
1993
- **EMF WP 13.4 Models of Individual Energy Technology Choice: Their Implications for Energy Technology Market Participants and Policy-Makers** *Stanford University*
Weyant, John, P., Johnson, B.
1993
- **EMF WP 12.1 Global Climate Change: Impacts of Greenhouse Gas Control Strategies, Executive Summary** *Energy Modeling Forum Stanford University*
Weyant, John, P.
1993
- **EMF OP 39 Structural Comparison of the Models in EMF 12** *Stanford University; Energy Policy*
Weyant, John, P., Beaver, R.
1993
- **EMF PP 7.4 A Selection of Possible Studies for the Energy Modeling Forum** *Stanford University*
Huntington, Hillard, G., Weyant, John, P.
1992
- **EMF WP 12.27 Technical Details for the Core Set of Models Participating in EMF 12** *Stanford University*
Weyant, John, P., Beaver, R.
1992
- **EMF OP 36 OECD Oil Demand: Estimated Response Surfaces for Nine World Oil Policy Models** *Stanford University*
Weyant, John, P., Huntington, Hillard, G.
1992
- **EMF WP 13.2 Back to Basics: Searching for Principles to Guide the Energy Conservation Policy Debate** *Stanford University*
Weyant, John, P., Johnson, B.
1992
- **EMF WP 13.1 Projecting Energy Efficiency Improvement Potential: A Comparison of Methodologies Used in Six Recent Studies** *Stanford University*
Weyant, John, P., Johnson, B.
1992
- **EMF WP 12.28 A Structural Comparison of Models Used in EMF 12 to Analyze the Costs of Policies for Reducing Energy Sector CO2 Emissions** *Stanford University*
Weyant, John, P., Beaver, R.
1992
- **EMF OP 33 A Comparison of Aggregate Energy Demand Models for Global Warming Policy Analyses** *Stanford University*
Weyant, John, P., Beaver, Ronald, D., Huntington, Hillard, G.
1991
- **EMF OP 30 Emerging Competition in California Gas Markets** *EMF OP 30 Emerging Competition in California Gas Markets Stanford University*
Weyant, John, P.
1991
- **EMF-11: International Oil Supplies and Demands** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1991
- **EMF OP 31 Economic Impacts of U.S. Oil Replacement Policies: Methodology and Results for the OTA Analysis** *Stanford University*
Huntington, Hillard, G., Weyant, John, P.
1991

- **EMF OP 30 Emerging Competition in California Gas Markets** *EMF OP 30 Emerging Competition in California Gas Markets Stanford University*
Weyant, John, P.
1991
- **EMF-11: International Oil Supplies and Demands** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1991
- **ENERGY ECONOMY MODELING - A SURVEY** *ENERGY*
Cofala, J., KUCZMOWSKI, T., Weyant, J.
1990; 15 (3-4): 387-394
- **INTEGRATED MODELS** *ENERGY*
Labys, W. C., Weyant, J. P.
1990; 15 (3-4): 341-344
- **POLICY MODELING - AN OVERVIEW** *ENERGY*
Weyant, J. P.
1990; 15 (3-4): 203-206
- **ENGINEERING ECONOMIC MODELING - ENERGY-SYSTEMS** *ENERGY*
Weyant, J. P., KUCZMOWSKI, T. A.
1990; 15 (3-4): R5-R5
- **EMF OP 28 Whither Long Term Canada-U.S. Natural Gas Trade? A View from the (Modelling) Trenches** *Stanford University*
Weyant, John, P., Rowse, J.
1990
- **EMF OP 29 Oil: Alternative Perspectives on the Decade** *Stanford University*
Weyant, John, P., Huntington, Hillard, G.
1990
- **EMF SR 4 Engineering-Economic Modeling: Energy Systems** *Energy - The International Journal*
Weyant, John, P., Kuczmowski, Thomas, A.
1990; 3/4 (15)
- **EMF WP 10.2 The Roles of Analytical Models in National Electricity Policy Debates: Issues and Frontiers** *Stanford University*
Weyant, John, P., Blair, P.
1990
- **EMF WP 10.1 Electricity Market Players Subgroup Report** *Stanford University*
Weyant, John, P., Borison, A.
1990
- **EMF OP 32 Substitution Between Activities with Different Energy Intensities** *Resources and Energy*
Weyant, John, P., Huntington, Hillard, G.
1990; 1 (13)
- **EMF OP 27 The Effects of Changes in the Economic Structure on Energy Demand in the USSR and the US** *EA Medvedeva Stanford University*
Weyant, John, P., Boyd, G., Kononov, Yu., D., Huntington, Hillard, G.
1990
- **EMF-9: North American Natural Gas Markets** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1989
- **EMF WP 9.8 Database for EMF Study on North American Natural Gas Markets** *Energy Modeling Forum Stanford University*
Weyant, John, P.
1989

- **EMF OP 25 The Impact of Sectoral Shifts in Industry on U.S. Energy Demands** *Energy*
Weyant, ohn, P., Huntington, Hillard, G.
1989
- **EMF-9: North American Natural Gas Markets: Selected Technical Studies** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1989
- **EMF SR 3 Survey of Utility Real-Time Pricing Projects in the U.S.** *Stanford University*
Weyant, John, P., Asano, H.
1989
- **INDUSTRIAL ENERGY DEMAND - A SIMPLE STRUCTURAL APPROACH** *RESOURCES AND ENERGY*
Peck, S. C., BOSCH, D. K., Weyant, J. P.
1988; 10 (2): 111-133
- **IS THERE POLICY-ORIENTED LEARNING IN THE ANALYSIS OF NATURAL-GAS POLICY ISSUES** *POLICY SCIENCES*
Weyant, J. P.
1988; 21 (2-3): 239-261
- **EMF OP 26 Energy and National Security: Should GNP Impacts Preclude Oil Tariffs?** *The Energy Journal*
Weyant, John, P., Huntington, Hillard, G.
1988; 2 (9)
- **EMF OP 22 Industrial Energy Demand: A Simple Structural Approach** *Resources and Energy*
Peck, S. C., Bosch, Debora, K., Weyant, John, P.
1988; 2 (10)
- **EMF OP 24 The Energy Problem: A Real World Laboratory For the Empirical Economist** *Stanford University*
Weyant, John, P., Huntington, Hillard, G.
1987
- **EMF 8 Industrial Energy Demand** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1987
- **EMF OP 23 EMF 8 Projections of U.S. Industrial Energy Demand** *Stanford University*
Weyant, John, P.
1987
- **EMF OP 20 The U.S. Dollar and the World Oil Market** *Energy Policy*
Weyant, John, P., Huntington, Hillard, G.
1986
- **EMF OP 21 The Oil Price Collapse and Growing American Vulnerability** *Stanford University*
Rowen, Henry, S., Weyant, John, P.
1986
- **GENERAL ECONOMIC EQUILIBRIUM AS A UNIFYING CONCEPT IN ENERGY-ECONOMIC MODELING** *MANAGEMENT SCIENCE*
Weyant, J. P.
1985; 31 (5): 548-563
- **EMF OP 18 Oil Prices and Inflation** *Annual Review of Energy*
Weyant, John, P., Huntington, Hillard, G.
1985; 10
- **EMF OP 19 Using Data Analysis and Modeling in Planning** *Petroleum Management*
Weyant, John, P.
1985; 7 (7)

- **EMF SR 2 Application of Quantitative Methods for Energy-Economic Planning in Semisocialized Economies** *Stanford University*
Weyant, John, P., Ussher, Miguel, S., Salerno, Adriana, C.
1985
- **THE CONTINUING THREAT OF OIL-SUPPLY INTERRUPTIONS** *JOURNAL OF POLICY ANALYSIS AND MANAGEMENT*
Weyant, J. P.
1984; 3 (3): 393-405
- **EMF SR 1 Rate-of-Return Regulation and Efficiency: The Economics of the Natural Gas Pipeline and Distribution Industry** *Stanford University*
Weyant, John, P., Samuelson, Ralph, D.
1984
- **EMF 7 Macroeconomic Impacts of Energy Shocks** *Energy Modeling Forum Energy Modeling Forum*
Weyant, John, P.
1984; 1
- **EMF OP 11 Real Oil Prices During 1980-82** *The Energy Journal*
Weyant, John, P., Huntington, Hillard, G.
1984; 3 (5)
- **EMF OP 17 The Response of Energy Demand to Higher Prices: What Have We Learned?** *Stanford University; The American Economic Review*
Weyant, John, P., Sweeney, James, L.
1984; 2 (74)
- **EMF OP 13 Optimal Supply of a Depletable Resource with a Backstop Technology: Heal's Theorem Revisited** *Stanford University*
Weyant, John, P., Oren, Shmuel, S., Powell, Stephen, G.
1984
- **EMF OP 12 The Transition to Nondepletable Energy: Social Planning and Market Models of Capacity Expansion** *Stanford University*
Weyant, John, P., Powell, Stephen, G., Oren, Shmuel, S.
1984
- **THE IMPACT OF RISING OIL PRICES ON THE WORLD-ECONOMY - MATTHIESSEN,L (Book Review)** *JOURNAL OF ECONOMIC LITERATURE*
Book Review Authored by: Weyant, J. P.
1984; 22 (2): 628-630
- **OPTIMAL OIL IMPORT TARIFFS - AN INTERNATIONAL PERSPECTIVE FOR THE 1980S** *ENERGY POLICY*
Kline, D. M., Weyant, J. P.
1983; 11 (2): 101-118
- **EMF PP 6.4 Energy Model Comparison: An Overview** *Large Scale Energy Models - Prospects and Potentials*
Weyant, John, P., Sweeney, James, L., Thrall, Robert, M.
1983
- **POLICIES TO REDUCE OECD VULNERABILITY TO OIL-SUPPLY DISRUPTIONS** *ENERGY*
Kline, D. M., Weyant, J. P.
1983; 8 (3): 199-211
- **REDUCING DEPENDENCE ON OIL IMPORTS** *ENERGY ECONOMICS*
Kline, D., Weyant, J. P.
1982; 4 (1): 51-64
- **EMF PP 6.5 Modeling for Insights, Not Numbers: The Experiences of the Energy Modeling Forum** *OMEGA: The International Journal of the Management Sciences*
Weyant, John, P., Sweeney, James, L.
1982
- **EMF 6 World Oil** *Energy Modeling Forum*

Weyant, John, P.
1982

- **MODELING FOR INSIGHTS, NOT NUMBERS - THE EXPERIENCES OF THE ENERGY MODELING FORUM** *OMEGA-INTERNATIONAL JOURNAL OF MANAGEMENT SCIENCE*
Huntington, H. G., Weyant, J. P., Sweeney, J. L.
1982; 10 (5): 449-462
- **MANAGING AN OIL BONANZA - AN ANALYSIS OF ALTERNATIVE MEXICAN EXPORT POLICIES** *ENERGY POLICY*
LEJTMAN, T. M., Weyant, J. P.
1981; 9 (3): 186-196
- **EMF OP 14.1 Will Oil Prices Collapse?** *The Magazine of Economic Affairs*
Rowen, Henry, S.
1981; 5 (24)
- **OIL AND NATIONAL-SECURITY - AN INTEGRATED PROGRAM FOR SURVIVING AN OIL CRISIS** *ANNUAL REVIEW OF ENERGY*
ROWEN, H. S., Weyant, J. P.
1981; 6: 171-198
- **OIL AND NATIONAL-SECURITY - AN INTEGRATED PROGRAM FOR SURVIVING AN OIL CRISIS** *ANNUAL REVIEW OF ENERGY*
ROWEN, H. S., Weyant, J. P.
1981; 6: 171-198
- **QUANTITATIVE MODELS IN ENERGY-POLICY** *POLICY ANALYSIS*
Weyant, J. P.
1980; 6 (2): 211-234
- **EMF 4 Aggregate Elasticity of Energy Demand** *Energy Modeling Forum*
Weyant, John, P.
1980
- **EMF 5 U.S. Oil and Gas Supply** *Energy Modeling Forum*
Weyan, John, P.
1980
- **ENERGY-POLICY MODELING - SURVEY** *OPERATIONS RESEARCH*
Manne, A. S., Richels, R. G., Weyant, J. P.
1979; 27 (1): 1-36
- **EMF 3 Electric Load Forecasting: Probing the Issues with Models** *Energy Modeling Forum*
Weyant, Jophn, P.
1979
- **EMF PP 6.1 The Energy Modeling Forum: Past, Present and Future** *Stanford University and Energy Policy - The Global Challenge (Fall 1979)*
Sweeney, James, L., Weyant, John, P.
1979
- **EMF 2 Coal in Transition: 1980-2000** *Energy Modeling Forum*
Weyant, John, P.
1978
- **EMF 1 Energy and Economy** *Energy Modeling Forum*
Weyant, John, P.
1977; 2
- **Markets for Energy Efficiency** *Energy Policy (Elsevier Science Ltd.)*
Weyant, John, P., Huntington, Hillard, G., Schipper, L., Sanstad, Alan, H.
; 10 (22)