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## **Sustainable Energy Development: The Present Situation and Possible Paths to the Future**

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### **About the author**

Dr. Noam Lior is a Professor of Mechanical Engineering and Applied Mechanics at the University of Pennsylvania, where he is also a member of the Graduate Group of International Studies, Lauder Institute of Management and International Studies (MA/MBA program), of the Institute for Environmental Science, and of the Initiative for Global Environmental Leadership (IGEL) at the Wharton Business School. He is Fellow of American Society of Mechanical Engineers, Associate Fellow American Institute of Aeronautics and Astronautics, Associate Member, Club of Rome Member, Club of Rome Slovenian Chapter. He is experienced in various energy systems and components that include solar heating, cooling, and thermal power, OTEC, coal, oil and gas combustion, advanced fossil fuel high efficiency systems for power and refrigeration (some with carbon capture), hybrid nuclear power generation systems, desalination systems and processes, heat transfer, fluid mechanics, and thermodynamics and exergy analysis.

### **Abstract**

Recent estimates and forecasts of the conventional fossil fuel resources and their reserve/production ratio, nuclear power, and renewable energy potential, and energy uses are surveyed. A brief discussion of the status, sustainability (economic, environmental and social impact), and prospects of fossil, nuclear and renewable energy use, and of power generation is presented. Beyond the general review, the paper focuses on some of the many important areas that deserve more attention: (1) The recently emerging game-changing developments of postponement of "peak oil" with increased use of shale gas and tight/shale oil, and transition from coal and oil to gas, which is extending to transportation fuel, (2) The nuclear power future following the Fukushima disaster in Japan, (3) The vital need for clean coal, (4) The continuing devastating effects of the high fuel price fluctuations largely unrelated to supply and demand, (5) Market entry of electric cars, (6) The US Clean Power Plan (if adopted), proposed through the EPA on 2 June 2014.

Some ways to resolve the problem of the availability, cost, and sustainability of energy resources alongside the rapidly rising demand are discussed. The author's view of the promising energy R&D areas, their potential, foreseen improvements and their time scale, and last year's trends in government energy funding are presented.

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