

President

Due Diligence, Economics, Permitting, Design, Applications

Advanced Materials
 Hydrogen and Synthesis Gas Production
 Independent Power Production
 Thermal Coatings
 Iron Ore Reduction
 Oil Refining
 Petrochemical Production

Education

Doctorate in Engineering Science from Columbia University, specializing in thermodynamics.

BChE and MChE degrees from the City College, City University of New York.

Years of Experience
 50+

Current Professional Association

American Institute of Chemical Engineers (Fellow and Chair, Metro NY Section)

Dr. Herbert W. Cooper has more than 50 years of United States and international experience working at the intersection of economics, technology and regulatory requirements. This includes the applications and production of advanced materials, thermal coatings, steels, hydrogen and synthesis gas, asphalt, petrochemicals, as well as oil refining, independent power production and other industrial operations. His expertise includes numerous applications of statistical- and probability-based approaches to optimizing the efficiency and economic performance of these facilities during their process- and mechanical-design, construction and operational phases. Technological, environmental, health and safety, and regulatory constraints are included in Dynalytics’ optimizations to help assure that the facilities could be operated in the sustainable manner required in today’s world.

In the early 1960s Dr. Cooper was among the first to develop computer programs to solve chemical engineering problems. These included multiphase pressure drops, chemical kinetics and equilibrium, detailed heat transfer and the design of heat exchangers and fired heaters, as well as the mass and energy balances for complete chemical process plants. During the ensuing years these were enhanced by considering random factors while simultaneously evaluating economic and environmental performance as well as compliance strategies. Economic optimizations have been a major focus of all of Dynalytics activities and continue to the present time.

Dr. Cooper founded Dynalytics Corp. in 1969. This small highly regarded independent consulting company has had a full-time staff of approximately ten experienced chemical engineers for many years, with revenues of approximately three million dollars per year from clients that include major engineering firms, equipment and chemical vendors, oil & chemical, and aerospace companies. This company was converted to a Virtual Company in the late 1990s, primarily employing outside experts as independent contractors. As President of Dynalytics Corp., Dr. Cooper has been intimately involved in all aspects of the development and design of numerous multimillion-dollar chemical and utility plant projects.

Professional Employment

1969 – Present	Dynalytics Corp. <i>Founder and President</i>
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Other Professional Employment

Heat Research Corp. (Acquired by MW Kellogg)	- 1964-1969 -	Manager, Process Design Section
Bechtel Associates	- 1962-1964 -	Chemical Process Engineer
Scientific Design Company	- 1960-1962 -	Process Engineer
Air Pollution Control Section of the City of Philadelphia	- 1958-1960 -	Chemical Engineer

Representative Projects

- **An Asian conglomerate had commenced negotiations to acquire a highly regarded United States producer of carbon nanotubes.** Dynalytics was retained to provide technical expertise to the acquirer's *Due Diligence Team*, with responsibilities for evaluating:
 - The carbon nanotube production process
 - Potential process improvements
 - Production quality control practices
 - Environmental permitting, health and safety issues
 - Potential product improvements
 - Scaleup problems that may arise
- **A major United States defense contractor / aerospace company** has developed a radically new process for separating carbon dioxide from other process plant gases or from boiler / combustion turbine exhaust gases in a very efficient manner. This has the potential for introducing substantial cost savings into an array of carbon-capture and storage processes being considered as ways to help address climate-change concerns, allowing production of chemicals, electricity, steam and hot water in a more sustainable way. Dynalytics has been retained to assess the most logical way to establish this technology within the industrial and commercial market sectors. The assignment includes developing the economically optimum ways to integrate this new technology into various processes for producing hydrogen, and into coal-to-liquid and gas-to-liquid transportation fuel processes.
- **AE Polysilicon Corp.** had developed a new process to efficiently produce very pure polysilicon granules in a sustainable way by a continuous fully integrated high temperature vapor deposition process. The process, which appears to offer environmental and economic advantages over conventional approaches, had been covered by several patents and demonstrated in a sufficiently large pilot plant scale to enable negotiations to proceed with a large multi-national company to establish a Joint Venture. Certain technical developments and marketing matters were new, leading the Company to retain Dynalytics Corp. to assist with the commercial valuation of its intellectual property. Dynalytics developed the framework used for negotiations leading, in part, to the successful formation of the desired Joint Venture.
- **Brookhaven National Laboratory (BNL)** is frequently approached by Independent Power Producers (IPPs) that wish to propose designing, financing, constructing and operating a cogeneration plant at its Upton, NY, site. BNL retained Dynalytics Corp. to advise it as to whether or not it makes strategic, economic and technical sense to invest the time and effort necessary to prepare a detailed *Request for Proposals*, manage the bidding process, and evaluate the responses. Dynalytics' assessment included considerations of the financial community's current expectations, projected economic scenarios for the IPP and for BNL, fuel supply, reliability, regulatory and environmental issues. An extensive discussion of the many contractual documents whose terms would have to be negotiated was also provided.
- **A Major European / Chinese Joint Venture (BASF-YPC)** became embroiled in a dispute with its international Engineering-Procurement-Construction contractor about responsibilities for deficient process performance (capacity, product purities and utility consumption) of its *Synthesis Gas Plant*. This facility provides the hydrogen, carbon monoxide and oxogas feedstocks for several downstream plants that comprise a large integrated chemical complex in China. Dynalytics Corp. was retained to join the Joint Venture's Arbitration team, and assigned responsibilities for analyzing the technical and economic issues related to

process design and performance, and providing assistance with framing claims and responding to counterclaims. Based, in part, on input from Dynalitics Corp. the dispute ended with a negotiated settlement.

- **Maquarie Infrastructure Company** entered into an agreement to purchase The Gas Company [of Hawaii] LLC from K1 Ventures Limited. Dynalitics Corp. was part of the Black & Veatch due-diligence team for this \$238 million transaction, with specific responsibilities for evaluating the *Synthetic Natural Gas Plant*. Dynalitics' Scope-of-Work included an assessment of the:
 - Efficiency and sustainability of the technology used
 - potential process improvements
 - plant's operation, reliability, and maintenance practices
 - adequacy of staffing levels and skills
 - Environmental health and safety (EHS) practices

Dynalitics often performs **Economic Optimizations** of chemical and utility plants based on using its proprietary large mixed integer non-linear programming computer models that can consider probability-based factors such as uncertainties in future raw material compositions, costs and availabilities. Dr. Cooper has developed and refined these models since the mid-1980s. They select the combination of equipment and their design capacities, the quantities of various feedstocks, fuels, electricity, steam, hot and chilled water to be purchased, and/or produced and/or sold, all while meeting financial, process and environmental constraints. The selection is based on either *minimizing costs* or *maximizing the after-tax internal rate-of-return on equity*. Additional information concerning marginal equipment and utility costs is also developed that indicate costs that would need to be reached to make otherwise uneconomical choices viable, or the economic benefits attainable if constraints are relaxed. The programs' databases of equipment performance characteristics and utility costs are continually updated.

Front-end engineering design and economic optimization have been provided for numerous hydrogen and synthesis gas facilities, including the 20 million standard cubic feet per day hydrogen plant at the **Pacific Resources** refinery in Hawaii, the 50-million standard cubic feet per day of high-temperature reducing-gas (hydrogen + carbon monoxide) production facility used in iron ore reduction reactors at the **Hylsa** plant at Monterrey, Mexico, and an inert gas (argon + nitrogen) production/purification facility for **Waldymetal Femszorasi Rt.**, Budapest, Hungary.

Technical and financial responsibilities for these projects included:

- supervision of process and detailed engineering activities, selection of catalysts for intermediate and final product production and purification to assure that efficiency and sustainability issues were given appropriate consideration
- supervision of procurement and construction activities to assure that budgetary and timetable constraints were being met
- plant startup and performance testing to demonstrate that requirements for product purity, plant capacity and overall process efficiency for conversion of feedstocks to products were being met.

Environmental responsibilities have included acquiring and assessing environmental data, development and implementation of sound approaches to obtaining environmental and other permits required for construction and operation of many large industrial facilities. These range from chemical plants to utility plants for a variety of corporations, hospitals and municipalities.

Assessments of current and legacy issues of **health and safety** performance of industrial facilities, including investigations of compliance history, accident, lost time and illness records, insurance claims have been carried out as part of due-diligence required for acquiring industrial projects.

Additionally, he has been given responsibilities for various aspects of **due diligence** efforts related to the acquisition of technology-oriented companies and the acquisition or development of devices such as fuel cells.

Patents were granted to Dr. Cooper for:

- a new “*Pyrolysis Process*” (US 3711568, United Kingdom 1410617, Canada 981701) for producing petrochemicals
- “*Tube Fins of Outwardly Organized Materials*” (US 3731738) for transferring heat efficiently and economically
- a “*Gas Energizing Apparatus*” (US 4090960) that produces ozone for water treatment and chemical production efficiently and economically.

Dr. Cooper has dealt extensively with Federal agencies including the Environmental Protection Agency and the Department of Justice, State agencies such as Departments of Environmental Conservation, and local governmental agencies such as Planning and Zoning Boards. Additionally he has represented clients in dealing with commercial banks and multilateral entities such as The World Bank Group, the Asian Development Bank and The European Bank for Reconstruction and Development.

Under Dr. Cooper’s guidance, Dynalitics successfully established several **international joint ventures**, participating in them as an equity owner and as managing partner. The experiences of negotiating with senior staff of major transnational companies and high-level government officials of many countries have provided him with keen insight into overcoming economic, environmental, technical, and social challenges in the multi-cultural global arena.

Chemical Engineering Courses taught by Dr. Cooper on the graduate level throughout the years include *Thermodynamics* (Columbia University), *Process Heat Transfer*, *Heat Exchanger Design*, and *Survey of Chemical Plant Equipment* (the latter three at The Polytechnic Institute of Brooklyn.)

Professional and Public Service Activities

In addition to his industrial activities, Dr. Cooper is a Fellow and an active member of the American Institute of Chemical Engineers, earlier as Chair of the Long Island Section and currently as Chair of the Metro New York Section. In this capacity he provides leadership for the Section, including its program planning and implementation. In addition to its monthly dinner meetings, the Section’s full-day *Annual Energy and Resources Conferences* have been quite successful with respect to their contents and attendance. He has spearheaded significant outreach activities focused on attracting High School students to the Chemical Engineering profession, assisting academic chemical engineering departments with career-related activities and grants, and attracting Young Professionals to become active members of the AIChE on the national and local levels. Additionally, he has been the Speaker at many AIChE meetings, as well as those of other professional organizations, as noted below.

Previously, as an active member of the National Fire Protection Association, Dr. Cooper served as Chair of its *Physical and Chemical Data Consistency Advisory Committee*. He has been an active member of the Energy Committees of various organizations such as the 110/Action Group, Action Long Island and the Long Island Association, and been appointed to the New York State Department of Environmental Conservation’s *Emission Offsets, Banking and Trading Advisory Committee*. In these groups he made presentations to legislators and their staffs to help them increase their understanding of technical matters and bring degrees of realism to proposed environmental and renewable energy legislation.

Starting in the early 1990s, as the Iron Curtain came down between Western and Eastern Europe, Dr. Cooper was asked by British Gas Corp. to assist them in their strategic efforts to introduce Western economic approaches to the chemical and utility sectors of the Republic of Hungary. This led to many presentations of the interaction of technology and economics to governmental officials, initially in Budapest and then in many smaller cities. This was followed by an invitation from the government of Czechoslovakia to help modernize its approaches to chemical and utility production during its transition from Communism to a somewhat market-oriented system. This involved, on a volunteer basis, an analysis of the country's chemical production and infrastructure situations. The effort ended when the country split into two new countries; the Czech Republic and the Slovak Republic.

Starting in the 1980s and continuing on an on-going basis, Dr. Cooper has served on numerous Career Panels in High Schools and Colleges as a Speaker and as a Judge of Student Projects. This is now an integral part of the activities of the Metro New York Section of the American Institute of Chemical Engineers,

Dr. Cooper is particularly proud to have served his community as a publicly elected Trustee of the Jericho, NY, Public Library who the Board of Directors then repeatedly elected as its President during many terms spanning approximately fifteen years. During that time he successfully led the fund-raising campaign and realization of a major building expansion, the introduction of computers, the selection of Library Directors as retirements occurred, and similar Board-level matters.

Recent Seminars and Presentations

American Institute of Chemical Engineers, New York Section – *Climate Change: Opportunities for Chemical Engineers*, 7th Annual Energy & Resources Conference, New York, NY, May 30th, 2013

United States Military Academy, West Point, NY - *Dealing with Randomness: Optimizing Decisions for Uncertain Situations* – April 29th, 2013

American Institute of Chemical Engineers, New Jersey Section - *Optimizing Your Production Process Using Advanced Probability-Based Techniques*, West Orange, NJ, March 19th, 2013

Action Long Island, Farmingdale, NY – *Efficiency, Sustainability and Economic Performance of Photovoltaic Solar Systems* – May 25th, 2011

United States Military Academy, West Point, NY - *Chemical Plant Design: Economically Optimum Process Integration* – April 13th, 2010

Brookhaven National Laboratory, Upton, NY – *Fuel Cell Systems: Technology and Economics* - May 19th, 2009

American Institute of Chemical Engineers, New York Section - *Produce Electricity and Methanol Simultaneously: Technically Interesting, Good Policy, Difficult Economics*, New York, NY, March 16th, 2009

American Institute of Chemical Engineers, New Jersey Section - *Fuel Cells, The Hydrogen Economy and You*, Little Falls, NJ, October 7th, 2008

Long Island Contractors' Association, Seminar - *Hot Mix Asphalt vs. Warm Mix Asphalt: Economic, Technical and Regulatory Issues*, Farmingdale, NY, June 20th 2008

American Institute of Chemical Engineers, 2nd Annual Energy & Resources Conference: Reducing CO₂ Emissions: Short-Term & Long-Term Strategies, *Overview of Issues, Strategies and Current Efforts*, New York, NY, December 6th, 2007

American Institute of Chemical Engineers, 52nd Annual Ammonia Symposium - Invited Keynote Speaker *Vulnerabilities of the International Energy Supply for the Ammonia Industry*, Henderson, Nevada, September 17th, 2007

The European Union Studies Center – *Energy Politics in Europe: Kilocalories, Kilowatts and the European Union*, New York, New York, November 9th, 2006

ORC Worldwide - *A Severe Energy Interruption: How Your Company Can Cope*, Washington, D.C., August 8th, 2006

American Institute of Chemical Engineers, New York and Tappan Zee Sections - *Electricity from Fuel Cells: Realities vs. Pipedreams*, New York, NY, May 8th, 2006

New York Association of Public Power, *Fuel Cells: Their Current Status*, Albany, New York, April 6th, 2006

American Institute of Chemical Engineers - Invited speaker
A Mega-World-wide Energy Interruption: Can it Happen?, New York, NY, January 10th, 2005

National Association of Power Engineers - *The International Energy Situation*, New York, NY, October 24th, 2004

American Institute of Chemical Engineers - *Codes, Standards and Recommended Practices*, New York, NY, May 2003

International Environmental Standards for Power Projects - *Incorporating International Environmental Legislation into Power Project Development*, New York, NY, August 12th-13th, 1996

Association of Energy Engineers - Various one-day courses on Environmental Permitting

Various Companies - One-day in-house courses on Environmental Data Analysis

Relevant Publications

Cooper, H., *Producing Electricity and Chemicals Simultaneously: Interesting Technology, Interesting Policy, Difficult Economics, Numerous Challenges*, CEP [Chemical Engineering Progress], An AIChE Publication, Vol. 106/No. 2, February 2010

Cooper, H., *Vulnerabilities of the International Energy Supply for the Ammonia Industry*, Proceedings of The American Institute of Chemical Engineers' 52nd Annual Ammonia Symposium, Henderson, Nevada, September 17th, 2007

Cooper, H., *Fuel Cells, The Hydrogen Economy and You*, CEP [Chemical Engineering Progress], An AIChE Publication, Vol. 103/No. 11, pp. 34-43, November 2007

Cooper, H., *Vulnerabilities of the United States ' Energy Supply: the International Context*, published in part in CEP [Chemical Engineering Progress], An AIChE Publication, Vol. 102/No. 4, pp. 24-32, April 2006

Cooper, H and L. Ebin, *What to look for in a Project Feasibility Study*, Hydrocarbon Processing, Houston, Texas, Part 1, August 2004, Part 2, September 2004

Cooper, H., *Understand Basic Engineering Codes*, Hydrocarbon Processing, Houston, Texas, August 2003

Cooper, H., *Managing Environmental Issues during International Project Development*, , Cogeneration and Competitive Power Journal, 13(2), Lilburn, Georgia; pp. 10-22,1998

Cooper, H. and DeMeo, T., *The Utility Move to Reduce Greenhouse Gas Emissions: Will it Work?*, Cogeneration and Competitive Power Journal 13(1) 1998, pp. 23-34

Cooper, H., *Incorporating International Environmental Legislation into Power Project Development*, Cogeneration and Competitive Power Journal, Lilburn, Georgia; Part 1, 12(3), pp. 6-22,1997; Part 2, 12(4), 1997

Cooper, H., *Environmental Permitting for Cogeneration and IPP: The Byzantine Maze*, The Cogeneration Journal, Lilburn, Georgia; Part 1, 4(4), pp. 14-22,1989; Part 2, 5(1), pp. 62-80, 1990

Cooper, H., *The Determination of the Fugacities of Hydrogen in Hydrogen and Propane Mixtures Using a Semi-permeable Membrane*, Doctoral Thesis, Columbia University, 1967

September, 2013