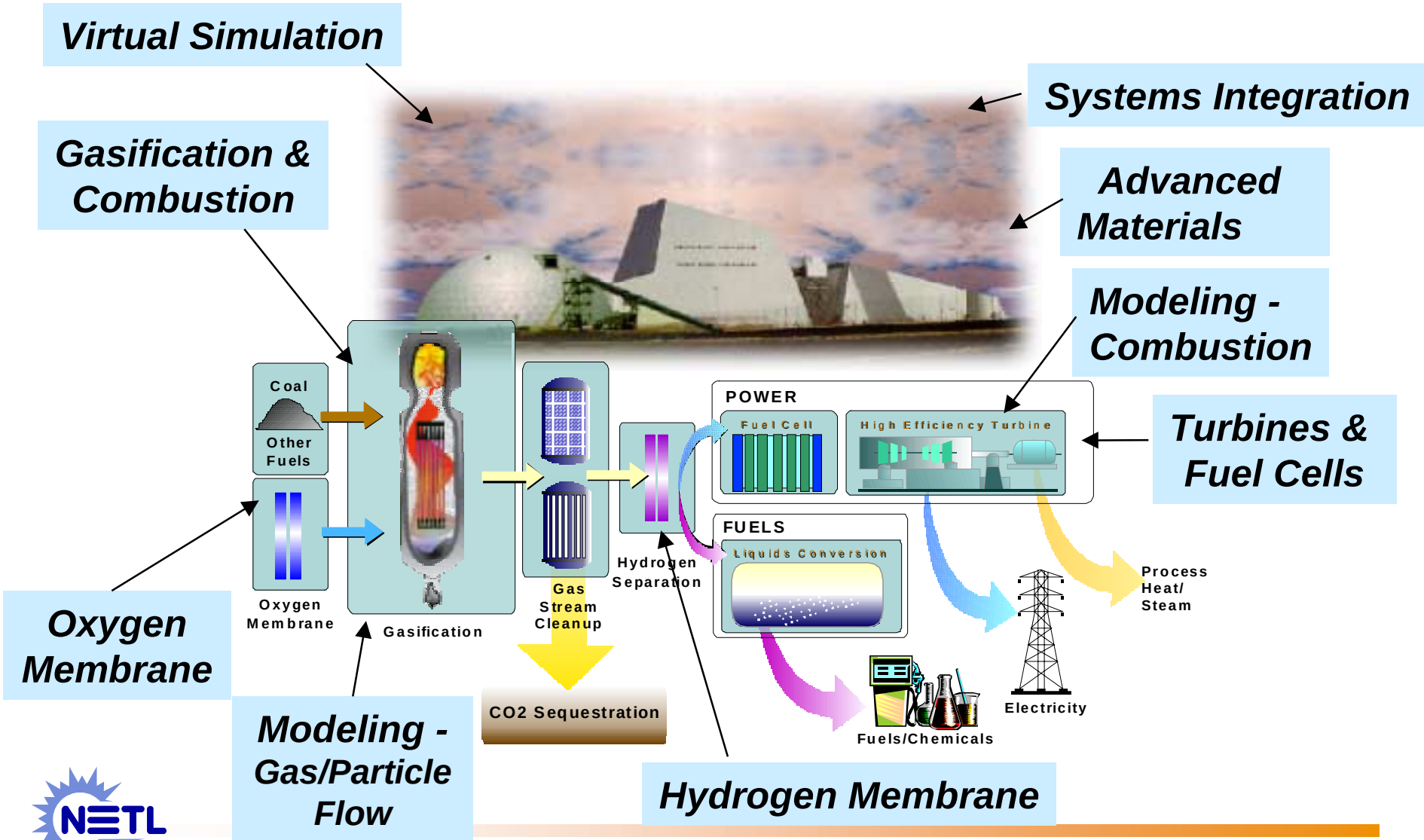
Vision 21 Program

New Projects Contribute to the Ultra-Clean Energy Plant



VISION 21 Projects
Systems Integration

National Fuel Cell Research Center

(Irvine, CA)

KraftWork Systems (Amston, CT)
Spencer Mgt. Assoc. (Diablo, CO)
Pratt & Whitney Aircraft (East Hartford, CT)

Define engineering issues associated with integrating key components and subsystems into Vision 21 plants

VISION 21 Projects
Computational Modeling & Virtual Simulation

Reaction Engineering International
(Salt Lake City, UT)
Visual Influence (Sandy, UT)
RECOM (Magstad, Germany)
Foster Wheeler (Livingston, NJ)
MIT (Cambridge, MA)
Iowa State University (Ames, IA)

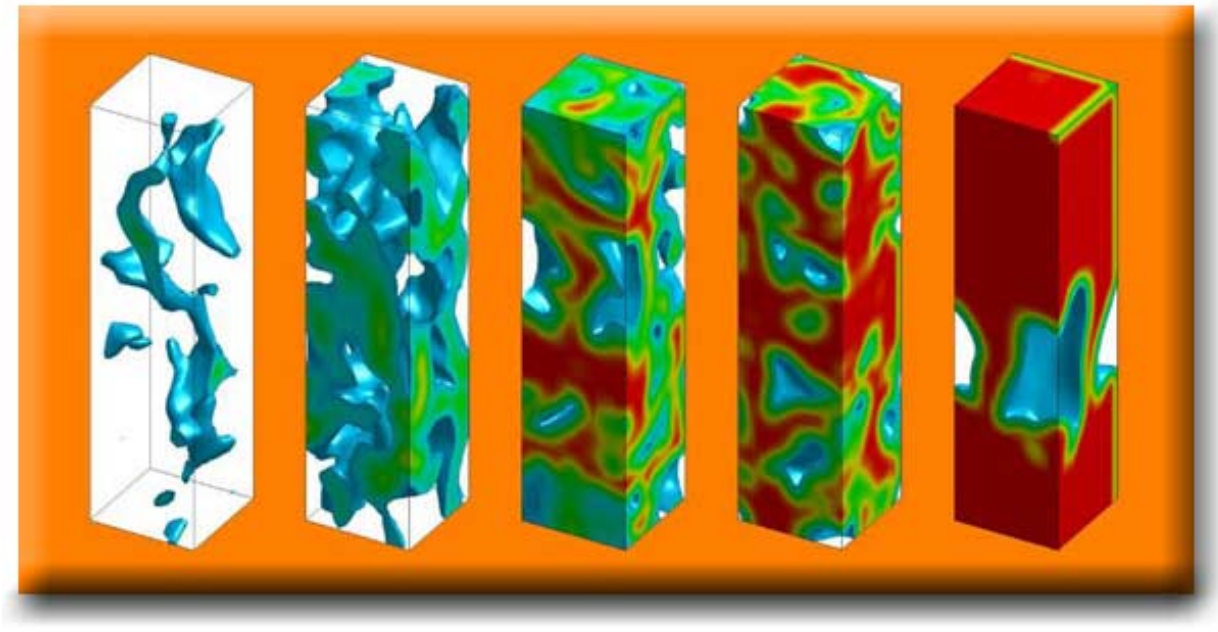
Computational virtual "workbench" to simulate Vision 21 technology modules and complete plants

Fluent, Inc. *(Lebanon, NH)*
Alstom Power (Windsor, CT)
Aspen Technology (Cambridge, MA)
Intergraph (Huntsville, AL)
West Virginia University (Morgantown, WV)

Begin building a "virtual simulation" system that would allow designers to model a fully functional Vision 21 plant on a computer

Computational Modeling and Virtual Simulation

Princeton University
(Princeton, NJ)



Computer software to simulate gas-particle flow in fluidized beds, including gasifiers, fluidized bed combustors, and pneumatic transport

Computational Modeling and Virtual Simulation

CFD Research Corp.
(Huntsville, AL)

UC-Berkeley
(Berkeley, CA)

Georgia Institute of Technology
(Atlanta, GA)

Industrial consortium (Siemens-Westinghouse, Pratt & Whitney, GE Power Systems, Solar Turbines, Honeywell, Coen Co., MTI Technologies, Vapor Power Group)

Advanced computational tool to design low-emission combustion systems for gas turbines

High-Temperature Materials

Huntington Alloys
(Huntington, WV)

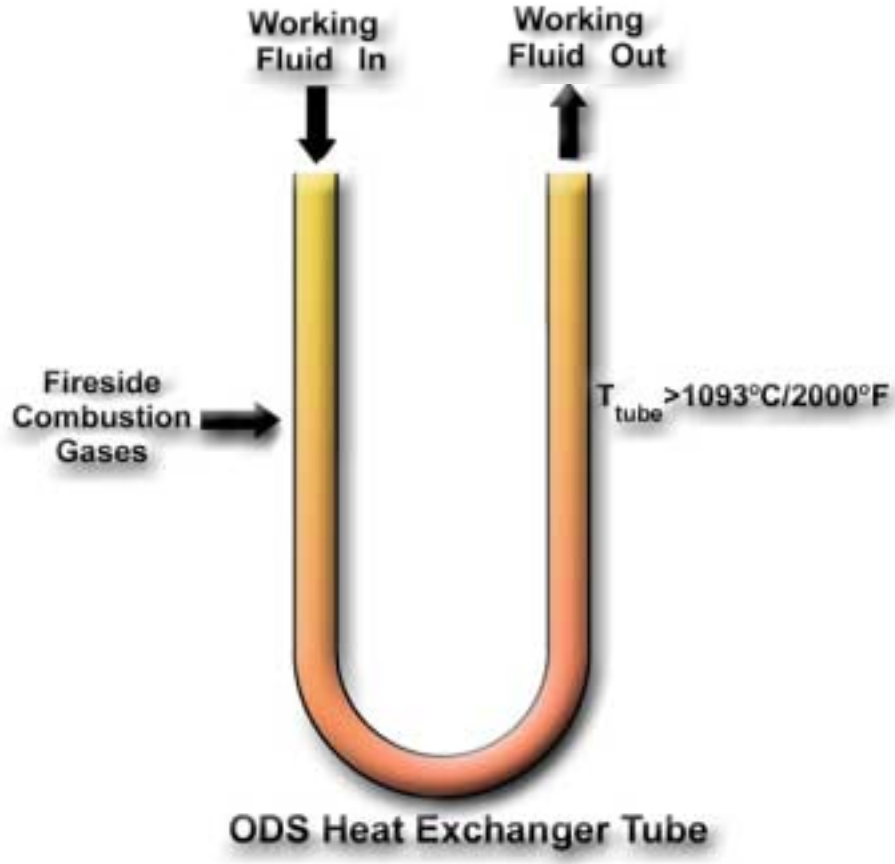
Foster Wheeler Development Corp.
(Livingston, NJ)

ORNL (Oak Ridge, TN)

University of California at San Diego

Michigan Technological University
(Houghton, MI)

Edison Welding Institute
(Columbus, OH)

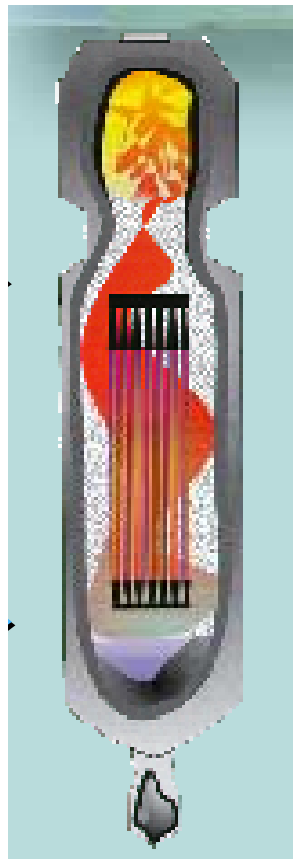


Stronger, corrosion-resistant, high-temperature oxide dispersion strengthened alloys for Vision 21 heat exchangers

VISION 21 Projects
Gasification and Combustion

Foster Wheeler Development Corp. *(Livingston, NJ)*
Nexant (San Francisco, CA)
Praxair (Danbury, CT)
REI (Salt Lake City, UT)
Corning (Elmira, NY)
ADA Technology (Livermore, CA)

Pressurized circulating fluidized bed partial gasification module that produces gaseous and solid fuels for use in fuel-flexible high-efficiency plants



Gasification

GE Energy & Environmental Research Corp. *(Irvine, CA)*
Southern Illinois University (Carbondale, IL)
California Energy Commission (Sacramento, CA)

Advanced combustion-gasification concept that produces hydrogen for fuel cells or combustion turbines and sequestration-ready CO_2

VISION 21 Projects
Gasification and Combustion

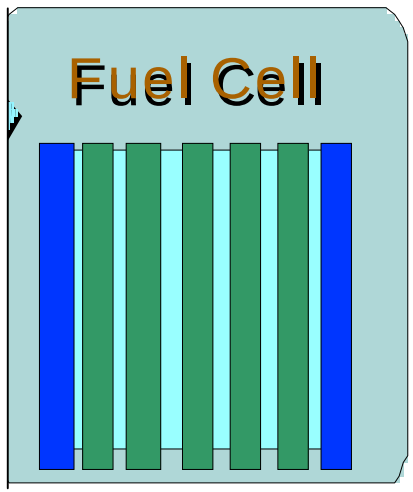
Clean Energy Systems
(Sacramento, CA)

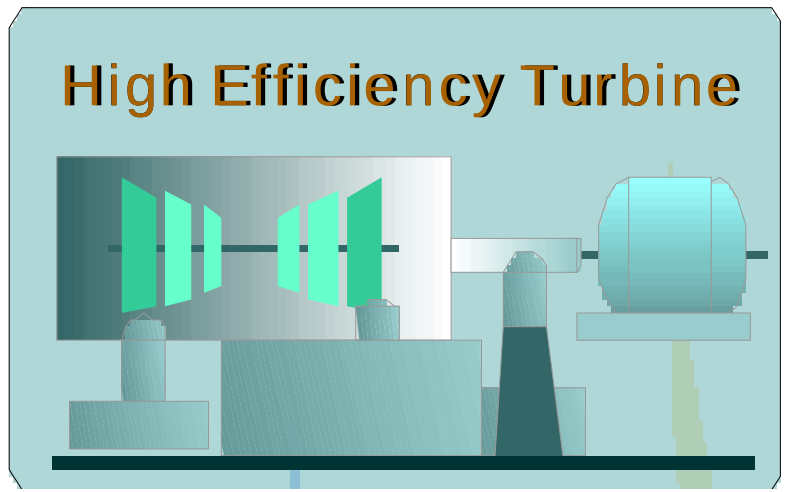
"Rocket engine" steam generator to power an advanced turbine, generating electricity and emitting only water and a stream of CO_2 ready for sequestration

VISION 21 Projects
Turbines & Fuel Cells

Fuel Cell Energy *(Danbury, CT)*
Capstone Turbine (Woodland Hills, CA)

Fuel cell/gas turbine "hybrid" power system with 65-80% efficiency





VISION 21 Projects
Advanced Separation Technology - Oxygen

Siemens Westinghouse Power Corporation
(Pittsburgh, PA)

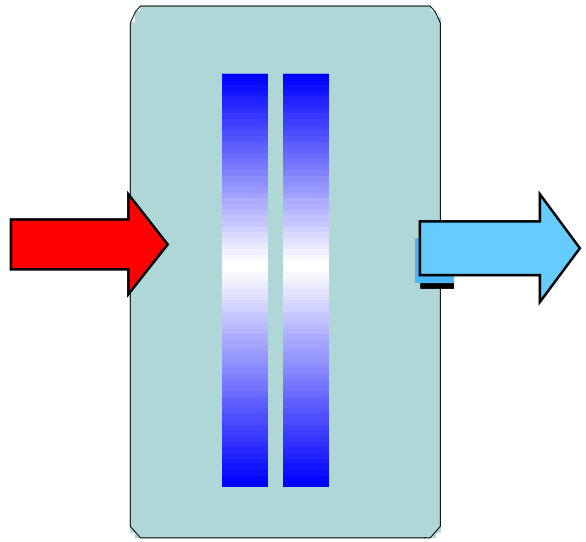
Praxair, Inc.
(Tonawanda, NY)

Zero emission power plant integrating solid oxide fuel cells with oxygen separation membranes

VISION 21 Projects
Advanced Separation Technology - Hydrogen

Eltron Research *(Boulder, CO)*
Chevron Chemical (Houston, TX)
Coors Ceramics (Golden, CO)
McDermott Int'l/F&W (Alliance, OH)
United Catalysts (Louisville, KY)
ANL (Argonne, IL)
ORNL (Oak Ridge, TN)

ITN Energy Systems *(Wheat Ridge, CO)*
INEL (Idaho Falls, ID)
Nexant (San Francisco, CA)
ANL (Argonne, IL)
Praxair, Inc. (Danbury, CT)



Ceramic membrane to separate hydrogen from gas streams