# Hydrogen Fuel Aff

## 1AC

### Plan

#### Plan: The United States federal government should substantially increase its transportation infrastructure investment by providing ten-year, interest free loans for the construction of hydrogen refueling stations in the United States.

### 1AC Solvency

#### Private interest exists to build hydrogen refueling stations, but federal action is key to motivate action.

Peter Schwartz and Doug Randall, 2003, Wired, "how hydrogen can save America," <http://www.wired.com/wired/archive/11.04/hydrogen_pr.html>,

Of course, no one will drive a hydrogen-powered car off the lot unless they're confident they'll be able to get fuel when and where they need it. That's why the Bush administration must focus on infrastructure as well as vehicles. Like the car companies, oil producers have already taken steps toward an oil-free future. Over the past 15 years, corporations like Shell and Exxon have ceded their leadership in oil production to a dozen state-owned enterprises in countries such as Venezuela, Brazil, and Norway. Instead they've focused on adding value farther down the supply chain by refining crude into gasoline and distributing and selling it through filling stations. They know they could play the same role in a hydrogen economy, which is why Shell and BP have invested hundreds of millions of dollars in hydrogen storage and production technology. Indeed, BP, formerly British Petroleum, has rebranded itself Beyond Petroleum. The major oil companies are already extracting hydrogen from gasoline for industrial uses at nine refinery complexes throughout the United States. With a little push, these plants could serve as hubs for a nascent hydrogen-distribution network. Converting filling stations is bound to cost billions of dollars over several decades. But it should cost relatively little to retrofit clusters of stations in proximity to both a hydrogen-producing refinery and a population center where fuel cell vehicles are sold. Oil companies could meet initial demand by trucking hydrogen from refineries to these stations. As the number of fuel cell vehicles on the road rises, stations that aren't served by refinery hubs could install processors, called reformers, that use electricity to extract hydrogen from gasoline or water. The White House should ask for $5 billion - roughly $30,000 for each of the nation's 176,000 filling stations - to get the ball rolling. In the long run, a pipeline piggybacking on existing natural gas pipelines might deliver most of the fuel, either from high-volume plants or more widely distributed facilities. The administration should set aside $10 billion for incentives like interest-free loans to encourage oil companies to construct a national hydrogen pipeline. It might also grant five-to-ten-year monopoly rights to pipeline builders.

#### The plan solves for infrastructure – Germany empirically proves that a ten year investment by the federal government will be matched by private companies.

TN News, 3/18/2010, (ThomasNet News), "hydrogen, fuel cell leaders brief Senate on clean vehicle technology issues," <http://news.thomasnet.com/companystory/Hydrogen-Fuel-Cell-Leaders-brief-Senate-on-clean-vehicle-technology-issues-574328>,

On March 5th, 2010, hydrogen and fuel cell industry experts joined Senator Daniel Akaka of Hawaii to brief Senate staff on the balance needed between industry and government commitments as well as between different clean vehicle technologies. Daimler, General Motors, Linde and Dr. C.E. (Sandy) Thomas led the event on "Solving the Market's Dilemmas-Energy Infrastructure for Fuel Cell Electric Vehicles." Charles Freese, Executive Director of Fuel Cell Activities, General Motors spoke about the benefits of other electric technologies like pure battery electric vehicles which are very efficient for smaller, low speed and short range urban vehicles. However, said Freese, "hydrogen fuel cells are better suited than other electric technologies for some applications, like powering larger vehicles at highway speeds, and for larger family vehicles that can comfortably carry four or more passengers with heavier payloads." The Senate briefing occurred while Congress is reviewing the Fiscal Year 2011 Budget Request. Industry has invested billions of dollars to mature these technologies and remains extremely interested in pushing to commercialization. To underscore the commitments from industry, in just the last few months, many automakers have announced that they will commercialize fuel cell vehicles in 2015 in the regions that have hydrogen stations. Germany, Korea, Japan and California have plans and initial government investment for building the early network of hydrogen stations that will allow thousands of people to conveniently fuel their vehicles. Also, non-automotive applications for fuel cells, like materials handling and back-up power, are experiencing success because companies have noticed that even at their early commercial stage, these fuel cells can save companies money over incumbent technologies, while also reducing emissions. To justify industry's continued investment in hydrogen and fuel cells, members of the National Hydrogen Association and U.S. Fuel Cell Council say that the Federal government must also remain a committed, reliable partner. Until enough fuel cell vehicles are on the road so that station owners can sell enough hydrogen to be self-supporting, government needs to invest in stations. But funding hydrogen and fuel cell development and deployment should not occur at the expense of other technologies because it takes a balanced portfolio of advanced transportation alternatives to compete with incumbent liquid fuels. "It takes 4-5 years to develop a powertrain and vehicle and put it on the road," said Freese. "We need stable policy and to stay the course for putting these vehicles on the road. It's not something that can swing with the price at the pump or the political climate." Underscoring the readiness to build fueling stations, Michael McGowan, Head of Strategic Alliances, Alternative Energy Solutions for the Linde Inc. said "Linde and other hydrogen infrastructure providers have made significant improvements in hydrogen refueling. We have developed, and demonstrated, the ability to fill cars with hydrogen at pressures of either 350 or 700 bar in less than 3 minutes - all while reducing capital, operating, and maintenance costs." Sascha Simon, Head of Advanced Product Planning for Mercedes-Benz USA, spoke about German-organized coalitions that are moving forward on deployment with successful collaborations between industry and government partners-the kind worth replicating in the U.S. if an American leadership position for developing hydrogen fuel cell electric vehicles is desired. "We had a major breakthrough in Germany in September 2009. What we have been able to achieve is to come together as car companies, infrastructure providers, fueling station providers, and government with a coordinating function. About 1.4 billion euros have been committed for a 10-year program [to introduce cars and stations in a coordinated way]. Industry is doing its fair share, committing 700 million euros and government is committing 700 million euros."

#### Demand for hydrogen cars is increasing while costs are down, but a lack of refilling stations is the biggest barrier to H-car deployment.

Jim Motavalli, 12/6/11, New York Times, "In US, hydrogen cars may line up with few places to fill up," <http://wheels.blogs.nytimes.com/2011/12/06/in-u-s-hydrogen-cars-may-line-up-with-few-places-to-fill-up/>,

Last week at the Tokyo auto show, Toyota unveiled its FCV-R concept. According to a Toyota spokesman, John Hanson, the vehicle was designed to give the public an impression of the hydrogen-powered fuel-cell sedan it expected to make available in 2015. With a projected range of more than 400 miles, a production version of the FCV-R would surely dodge the range-anxiety stigma that afflicts battery electric vehicles. Fuel-cell cars are coming, and not just from Toyota. Daimler, Hyundai and Honda have all committed to production on the same approximate timetable. Fuel-cell performance has increased, costs have come down and the cars should be ready, automakers say. But will they be able to refuel? Hydrogen stations, which can cost more than $1 million to build, are few and far between in the United States, even in target states like California, which is creating bottlenecks for automakers that are rolling out or ramping up demonstration programs. Sascha Simon, head of advanced product planning at Mercedes-Benz USA, said in an interview that the company was able to utilize only two hydrogen stations in Los Angeles that were “publicly available and working right now.” As a result of fuel constraints, he said, Mercedes has leased only 22 of its B-Class F-Cell hydrogen cars there, and has another 20 sitting in a city parking lot. “There is a backlog on the construction of the stations that have been promised,” Mr. Simon said. “We’re working hard to overcome that.” Hyundai, which mounted a promotional cross-country drive of its Tucson FCEV in September, is another automaker that has expressed concern over the dearth of filling stations. “From an industry standpoint, vehicle deployment has been slowed due to a lack of infrastructure,” the company said in an e-mailed statement. Hyundai also noted in the statement that it planned to build 1,500 hydrogen cars for the global market between 2012 and 2014, and could produce another 2,000 during that period. “These vehicles will be active in both the United States and Europe,” Hyundai said. Hydrogen advocates say that an adequate number of stations will be ready in step with the cars, by 2014 or 2015. Catherine Dunwoody, executive director of the California Fuel Cell Partnership, a consortium of manufacturers, energy companies and government agencies, said in an interview that there was “a temporary bottleneck” in hydrogen fueling, which also affected rollouts in the San Francisco area. “It’s a big challenge when the auto companies have cars that are ready to go to customers,” she said. She added that three more stations were due to open in California “within months or sooner,” which would be followed by a few more in early 2012. The California Energy Commission had committed $15.7 million to finance the development of eight new stations and upgrades of three others, she said. “We are on track to have 20 stations in California by early 2013 and, with current funding, 30 by 2014,” she added. Mr. Hanson, the Toyota spokesman, said that having 30 to 35 hydrogen stations in California by middecade would certainly be better than the status quo, but it was too soon to know how effectively they would meet the fleet’s needs. “It’s probably close,” he said. “Will it be enough? We don’t know yet.” In an e-mail, Joan Ogden, a professor of environmental science and policy at the University of California, Davis, estimated that a California network of 60 to 100 hydrogen stations could support up to 50,000 vehicles in the 2017 to 2018 time frame. “There’s a lot of work that needs to be done on how many stations are needed and where they should be located,” she wrote.

#### Lack of fueling stations is a barrier to entry for H-Cars. Federal action draws private support and creates a self-sustaining system.

Steve LeVine, 5/17/12, Slate, "giving hydrogen fuel-cell cars another chance," <http://www.slate.com/articles/technology/future_tense/2012/05/hydrogen_fuel_cell_vehicles_and_the_obama_administration_.single.html>,

If Chu has changed his early hostility toward hydrogen fuel cells, he does so as a handful of major carmakers are readying models for as early as 2015. Toyota, Honda, Mercedes-Benz, and Daimler have announced plans for hydrogen fuel-cell propelled vehicles. General Motors says that as soon as 2016 it may release its own hydrogen fuel-cell vehicle, but it’s watching for the launch of supporting infrastructure—primarily new refueling stations. The lack of fueling stations is a major obstacle to the rollout of hydrogen fuel-cell vehicles. A mature fleet will require 11,000 stations coast to coast at a cost of $20 billion to $25 billion, according to General Motors. Unless forced by Washington, oil companies, which generally do not produce hydrogen, have no motivation to add rival hydrogen fueling to their gasoline stations. So the industry’s calculus is that by and large hydrogen must be sold at new, dedicated fueling stations. Another problem is cost. In order to spark the chemical reaction necessary to create electricity and propel a vehicle, fuel cells currently use platinum as a catalyst—and platinum, of course, is not cheap. John Voelcker, who runs the website Green Car Reports, told me that so much electricity is required to break down the chemical bonds in natural gas to create hydrogen that it is often more efficient simply to use the electricity directly in a vehicle—such as a battery-propelled electric car. Yet there are also two big pluses: Hydrogen fuel-cell vehicles can be refueled in as few as three minutes, then travel for 250 or 300 miles straight. Electrified cars, on the other hand, require about eight hours for complete recharging. Depending on the vehicle, they can go only 40 to 100 miles on pure battery, creating the dreaded “range anxiety.” When the first cars come out, they will cost more than electrics, whose price tag is currently substantially greater than gasoline-fueled engines. To help give consumers the confidence to take the hydrogen plunge, there will have to be a coordinated rollout of refueling stations, said Charles Freese, who runs the Detroit-based fuel-cell unit for General Motors. That is where public policy comes in: Government, fuel providers, infrastructure contractors, and the carmakers will have to work together to get the stations up and running. The cost of operating each station drops with every car it services. But there’s a “chicken or the egg dilemma," he says. "You need to have a number of stations in place so the customers have easy access to the fuel and have to have a minimum number of vehicles that start to deploy in [the] same time window so [you] can keep the throughput of fuel up at the station." Fuel-cell vehicles will start out not with mass deployment, but in targeted regions—especially islands. The first places in the United States will be Los Angeles and Hawaii, Freese thinks—Los Angeles because there are high population concentrations that can be served by just 50 or 55 refueling stations; Hawaii because driving patterns are predictable: along set coastal routes and around self-contained islands, so drivers can’t go too far afield and find themselves stranded without fuel. GM and the U.S. Army launched a test fleet of 16 hydrogen fuel-cell cars in Hawaii earlier this year. In California, the state government is already behind the allocation of funds for building hydrogen fueling stations. Twenty-six are either in place or funded. An industry-government collaboration called the California Fuel Cell Partnership has established equipment standards and permitting processes, and organized the training of emergency personnel in the case of an accident. In Hawaii, GM is teamed up with 13 companies, government agencies and university bodies in order to organize the rollout of infrastructure there. Abroad, the initial rollouts will be in Germany, Japan, and South Korea (the last being essentially an island, since no one can drive through North Korea). Private supporters of fuel cells appear to be hedging their own bets. After the Obama administration withdrew support, companies pulled back their initial efforts in some markets. Hofmeister noted that Shell has closed hydrogen refueling stations it established during the Bush era in New York, Washington, D.C., and elsewhere. But companies have also built up investment in what they regard as more promising areas—particularly those countries offering government funding. Shell, for instance, has added investment in Germany and Japan, which have poured hundreds of millions of dollars in public funds into the construction of hydrogen fuel cell infrastructure. "Government," said Hofmeister, "has to be in there in being the fixer, the solution, and not the obstacle, and maybe that will be happening."

#### The plan can solve within the decade

Peter Schwartz and Doug Randall, 2003, Wired, "how hydrogen can save America," <http://www.wired.com/wired/archive/11.04/hydrogen_pr.html>,

Many observers view as inevitable the transition from an economy powered by fossil fuels to one based on hydrogen. But that view presupposes market forces that are only beginning to stir. Today, power from a fuel cell car engine costs 100 times more than power from its internal combustion counterpart; it'll take a lot of R&D to reduce that ratio. More daunting, the notion of fuel cell cars raises a chicken-and-egg question: How will a nationwide fueling infrastructure materialize to serve a fleet of vehicles that doesn't yet exist and will take decades to reach critical mass? Even hydrogen's boosters look forward to widespread adoption no sooner than 30 to 50 years from now. That's three to five times too long. Adopting Kennedy's 10-year time frame may sound absurdly optimistic, but it's exactly the kick in the pants needed to jolt the US out of its crippling complacency when it comes to energy. A decade is long enough to make a serious difference but short enough that most Americans will see results within their lifetimes. The good news is that the technical challenges are issues of engineering rather than science. That means money can solve them. How much money? How about the amount spent to put a man on the moon: $100 billion in today's dollars. With that investment, the nation could shift the balance of power from foreign oil producers to US energy consumers within a decade. By 2013, a third of all new cars sold could be hydrogen-powered, 15 percent of the nation's gas stations could pump hydrogen, and the US could get more than half its energy from domestic sources, putting independence within reach. All that's missing is a national commitment to make it happen.

### 1AC Pollution Advantage

#### Cars are the largest source of pollution in the US

UCS 8

[The Union of Concerned Scientists, leading science-based nonprofit working for a healthy environment, “Cars, Trucks, and Air Pollution”, <http://www.ucsusa.org/clean_vehicles/why-clean-cars/air-pollution-and-health/cars-trucks-air-pollution.html>]

Transportation is the largest single source of air pollution in the United States. It causes over half of the carbon monoxide, over a third of the nitrogen oxides, and almost a quarter of the hydrocarbons in our atmosphere in 2006.[¹](http://www.ucsusa.org/clean_vehicles/vehicles_health/cars-trucks-air-pollution.html#1) With the number of vehicles on the road and the number of vehicle miles traveled escalating rapidly, we are on the fast lane to smoggy skies and dirty air. The Ingredients of Air Pollution Air pollution is associated with the full life-cycle of cars and trucks. This includes air pollution emitted during vehicle operation, refueling, manufacturing, and disposal. Additional emissions are associated with the refining and distribution of vehicle fuel. Motor vehicles cause both primary and secondary pollution. Primary pollution is emitted directly into the atmosphere; secondary pollution results from chemical reactions between pollutants in the atmosphere.

#### Hydrogen cars can replace gas powered cars

NSDL (National Science Digital Library), Global Warming: The Hydrogen Car, adapted from “What’s Up with the Weather?” (PBS), Feb. 04, <http://nsdl.org/resource/2200/20061002133409419T?verb=Search&hdl=2200/20061002133409419T&type%5B%5D=Audio/Visual> (Under “Background Essay”), SJ

Another possible source of energy for cars -- one that gives off non-toxic by-products -- is hydrogen. Because its by-products don't harm the environment, the hydrogen fuel cell, which produces electricity capable of powering cars and other vehicles, has been touted by many as a promising replacement for the internal combustion engine.

#### H-car fuel can be made from renewable sources, dramatically reducing pollution

Mulik, 2003

Katie Mulik, “The Future of Fuel,” The Science Reports, Online Newshour, October 20, 2003, <http://www.pbs.org/newshour/science/hydrogen/environment.html>, E.L.

In his State of the Union speech in January 2003, President Bush laid out his hopes for the future of hydrogen fuel cell cars."With a new national commitment, our scientists and engineers will overcome obstacles to taking these cars from laboratory to showroom, so that the first car driven by a child born today could be powered by hydrogen, and pollution-free."The administration pledged $1.7 billion for hydrogen research and development (R&D) over the next five years to make fuel cell cars a reality. With government funding secured, the race is on to overcome the obstacles involved in making hydrogen a viable energy source. Hydrogen fuel supporters cite its significant environmental benefits: unlike fossil fuels, hydrogen can be pollution-free and infinitely renewable through wind, solar and hydropower sources. President Bush's 2004 budget asks for more than $22 million for hydrogen research and development to be devoted to coal, nuclear power and natural gas, and $17 million for renewable sources.

#### Exhaust pollution will change the hydrological cycle reducing the availability of freshwater

A.E.I.R.C., American Embassy Information Resource Center 2001 “Text: Aerosol Pollution Could Threaten Earth's Water Supply,” 11/10/01 pg. Online @ http://www.usembassyjakarta.org/aerosol.html

U.S. researchers report that particles of human-produced pollution may be reducing rainfall and threatening the Earth's fresh water supplies. According to a December 6 press release, a new study by researchers at the Scripps Institution of Oceanography suggests that tiny aerosol particles of soot and other pollutants -- formed by fossil fuel combustion and the burning of forests and other biomass -- are having a far greater effect on the planet's hydrological cycle than previously realized. The study is based in part on new satellite data from the National Aeronautics and Space Administration and in part on the international Indian Ocean Experiment (INDOEX), a multiplatform analysis of the Indian Ocean using satellites, aircraft, ships and surface stations. When sunlight heats the ocean as part of the hydrological cycle, water escapes into the atmosphere and falls out as rain. Through INDOEX it was found that aerosol pollutants are cutting down the sunlight reaching the ocean and weakening the hydrological cycle. According to the study, if pollutants lead to reduced rain and snowfall, it could directly affect the replenishment of the world's major stores of freshwater, including lakes, groundwater supplies, glaciers and high elevation snow pack. The study not only warns about the role aerosols are playing on the regional and global water cycle, but also suggests that aerosol pollution increases the solar heating of the atmosphere, and reduces the solar heating of the surface of the planet. The researchers say these effects may be comparable to the global warming effects of greenhouse gases.

#### The impact is extinction plants, animals, and humans all rely on the hydrological cycle

ESA, 2001, (Ecological Society of America), Issues In Ecology, staff “Water in a Changing World,” Issues in Ecology, Number 9, Spring, pg. Online @ <http://www.biology.duke.edu/jackson/issues9.pdf>

Life on earth depends on the continuous flow of materials through the air, water, soil, and food webs of the biosphere. The movement of water through the hydrological cycle comprises the largest of these flows, delivering an estimated 110,000 cubic kilometers (km3) of water to the land each year as snow and rainfall. Solar energy drives the hydrological cycle, vaporizing water from the surface of oceans, lakes, and rivers as well as from soils and plants (evapotranspiration). Water vapor rises into the atmosphere where it cools, condenses, and eventually rains down anew. This renewable freshwater supply sustains life on the land, in estuaries, and in the freshwater ecosystems of the earth. Renewable fresh water provides many services essential to human health and well being, including water for drinking, industrial production, and irrigation, and the production of fish, waterfowl, and shellfish. Fresh water also provides many benefits while it remains in its channels (nonextractive or instream benefits), including flood control, transportation, recreation, waste processing, hydroelectric power, and habitat for aquatic plants and animals. Some benefits, such as irrigation and hydroelectric power, can be achieved only by damming, diverting, or creating other major changes to natural water flows. Such changes often diminish or preclude other instream benefits of fresh water, such as providing habitat for aquatic life or maintaining suitable water quality for human use.

#### Pollution kills bees

Janet Raloff, May 2008, Journal of Science News, "Environment: pollution may confuse pollinators: smog dilutes scents needed to guide floral foragers," Vol. 173, Issue 16,

Ozone and other constituents of smog destroy at least some of the floral perfumes that pollinators rely on to find their meals, scientists report. Bees might suffer from these smog constituents, which pollute urban and rural areas alike. But the foragers most likely to be confused by air pollution’s degradation of floral scents are pollinators that rely less on sight than bees do, such as moths and bats. Flower scent's vulnerability to ozone and other reactive chemicals is not new. Until now, though, no data existed on how quickly pollution extinguishes these natural perfumes, explains Jose Fuentes of the University of Virginia in Charlottesville. Fuentes' team recorded meteorological conditions at a snapdragon farm, then used a computer program to calculate chemical reactions between three common floral scent molecules used by pollinators and three fossil fuel combustion products: ozone, nitrate and hydroxyl radicals. Under pristine conditions, scent molecules could drift unchanged over a kilometer or more, the calculations showed. The strength and length of that plume diminished dramatically, however, in the presence of smog constituents. Within just 200 meters, half of the average intensity of a scent plume was lost, the researchers report in a recent issue of Atmospheric Environment. In some cases, the pollutant reactions chemically alter a perfume rather than rendering the air scent-free. Such dramatic scent changes or losses over short distances "was a real surprise," Fuentes says. The report by Fuentes' group "is certainly intriguing," says Laure Adams of the Pollinator Partnership, based in San Francisco. Its analyses help identify the potential for "many signals that nature depends on to go askew."

#### Honeybees are key to prevent extinction

John Clayton, 2002, (expert beekeper), "Castes: the many faces of the colony and communication of a social creature," www.beemaster.com/honeybee/caste.htm

Without the Honeybee, we too would die off eventually from critically low food resources of all kinds. Without crop pollination, the animals we eat, the fruit and vegetables we consume and the trees we get our air from would all disappear. Honeybee extinction could very well seal our own fate. It wouldn't take many generations for use to disappear either. Easily it could happen in our life time if honeybees are lost to their many parasites, diseases and element conditions. There is a real threat to the preservation of this important creature and mans intervention is crucial to their survival. Maybe someday, honeybees will have the success that they have had for millions of years.

### 1AC Oil Advantage

#### Hydrogen is plentiful – easy to get it domestically

Norman 2009 Ideas to Save the Planet, are Copyrighted © 2009 by Todd A. Norman

 Every nation can be converting to sustainable technologies, but especially developing nations can be developing without polluting the Planet. Coal fired power plants can be converted to burn hydrogen gas. All cars, trains, planes, and boats can be converted to burn hydrogen and then be cleaning the air as they operate. All homes and buildings can be converted to solar, wind, and hydrogen fuels cells. Also every nation can be getting their water and hydrogen fuel from the oceans that are raising all around us. There is more water and hydrogen, and more solar and wind on this planet than oil and coal. Every nation can be zero emission and energy independent, while providing for their people, ending hunger and thirst, and growing their economies. They just have to be educated about these possibilities, make living this way a priority, then be given the tools they need to utilize the abundance of energy that is all around them.

#### H-cars can solve oil dependence

Peter Schwartz and Doug Randall, 2003, Wired, "how hydrogen can save America," <http://www.wired.com/wired/archive/11.04/hydrogen_pr.html>,

Four decades ago, the United States faced a creeping menace to national security. The Soviet Union had lobbed the first satellite into space in 1957. Then, on April 12, 1961, Russian cosmonaut Yuri Gagarin blasted off in Vostok 1 and became the first human in orbit. President Kennedy understood that dominating space could mean the difference between a country able to defend itself and one at the mercy of its rivals. In a May 1961 address to Congress, he unveiled Apollo - a 10-year program of federal subsidies aimed at "landing a man on the moon and returning him safely to the Earth." The president announced the goal, Congress appropriated the funds, scientists and engineers put their noses to the launchpad, and - lo and behold - Neil Armstrong stepped on the lunar surface eight years later. The country now faces a similarly dire threat: reliance on foreign oil. Just as President Kennedy responded to Soviet space superiority with a bold commitment, President Bush must respond to the clout of foreign oil by making energy independence a national priority. The president acknowledged as much by touting hydrogen fuel cells in January's State of the Union address. But the $1.2 billion he proposed is a pittance compared to what's needed. Only an Apollo-style effort to replace hydrocarbons with hydrogen can liberate the US to act as a world leader rather than a slave to its appetite for petroleum. Once upon a time, America's oil addiction was primarily an environmental issue. Hydrocarbons are dirty - befouling the air and water, possibly shifting the climate, and causing losses of biodiversity and precious coastal real estate. In those terms, the argument is largely political, one of environmental cleanliness against economic godliness. The horror of 9/11 changed that forever. Buried in the rubble of the World Trade Center was the myth that America can afford the dire costs of international oil politics. The price of the nation's reliance on crude has included '70s-style economic shocks, Desert Storm-like military adventures, strained relationships with less energy-hungry allies, and now terror on our shores. George W. Bush arrived in Washington, DC, as a Texan with deep roots in the oil business. In the days following September 11, however, he transformed himself into the National Security President. Today, his ambition to protect the United States from emerging threats overshadows his industry ties. By throwing his power behind hydrogen, Bush would be gambling that, rather than harming Big Oil, he could revitalize the moribund industry. At the same time, he might win support among environmentalists, a group that has felt abandoned by this White House. According to conventional wisdom, there are two ways for the US to reduce dependence on foreign oil: increase domestic production or decrease demand. Either way, though, the country would remain hostage to overseas producers. Consider the administration's ill-fated plan to drill in the Arctic National Wildlife Refuge. For all the political wrangling and backlash, that area's productivity isn't likely to offset declining output from larger US oil fields, let alone increase the total supply from domestic sources. As for reducing demand, the levers available are small and ineffectual. The average car on the road is nine years old, so even dramatic increases in fuel efficiency today won't head off dire consequences tomorrow. Moreover, the dynamism at the heart of the US economy depends on energy. Growth and consumption are inextricably intertwined. There's only one way to insulate the US from the corrosive power of oil, and that's to develop an alternative energy resource that's readily available domestically. Looking at the options - coal, natural gas, wind, water, solar, and nuclear - there's only one thing that can provide a wholesale substitute for foreign oil within a decade: hydrogen. Hydrogen stores energy more effectively than current batteries, burns twice as efficiently in a fuel cell as gasoline does in an internal combustion engine (more than making up for the energy required to produce it), and leaves only water behind. It's plentiful, clean, and - critically - capable of powering cars. Like manned space flight in 1961, hydrogen power is proven but primitive, a technology ripe for acceleration and then deployment. (For that, thank the Apollo program itself, which spurred the development of early fuel cells.)

#### Oil Dependence causes terrorism

Scire ‘8

Dr. John Scire Adjunct Professor of Political Science at UNR “*Oil dependency, national security*” February 10, 2008 http://www.nevadaappeal.com/article/20080210/OPINION/227691244

Oil dependency forces the U.S. to support oil regimes that oppress their citizens. As a result, other states and the citizens of oppressive oil regimes see the U.S. as their real enemy. It isn't surprising that Osama bin Laden's first Fatwah was against the U.S. for stationing troops in Saudi Arabia to protect the oppressive Saudi Royal Family. U.S. oil dependency also strengthens worldwide Islamist terror campaigns as funding for these groups comes primarily from Middle Eastern Islamic charities, located primarily in Saudi Arabia. Because of oil dependency, we both motivate the terrorists and provide the money to fund their attacks on us. American oil dependency also strengthens other states opposed to American foreign policy interests, such as Venezuela and Russia. Foreign policy options are further reduced when other oil importing countries, such as China, block our UN Security Council resolutions targeted at their sources of oil. This has already occurred in regard to Sudan and Myanmar.

#### Retaliation ensures extinction

Speice 2006 (JD Candidate Marshall-Wythe School of Law, College of William and Mary, ’06 (Patrick, February, “Negligence And Nuclear Nonproliferation: Eliminating The Current Liability Barrier To Bilateral U.S.-Russian Nonproliferation Assistance Programs” 47 Wm and Mary L. Rev. 1427, William and Mary Law Review, Lexis.)

The potential consequences of the unchecked spread of nuclear knowledge and material to terrorist groups that seek to cause mass destruction in the United States are truly horrifying. A terrorist attack with a nuclear weapon would be devastating in terms of immediate human and economic losses. n49 Moreover, there would be immense political pressure in the United States to discover the perpetrators and retaliate with nuclear weapons, massively increasing the number of casualties and potentially triggering a full-scale nuclear conflict. n50 In addition to the threat posed by terrorists, leakage of nuclear knowledge and material from Russia will reduce the barriers that states with nuclear ambitions face and may trigger widespread proliferation of nuclear weapons. n51 This proliferation will increase the risk of nuclear attacks against the United States  [\*1440]  or its allies by hostile states, n52as well as increase the likelihood that regional conflicts will draw in the United States and escalate to the use of nuclear weapons.

#### Oil dependence puts the US and China on a collision course – makes war inevitable

Hatemi**,** professor at the University of Nebraska-Lincoln andWedeman**,** associate professor and chair of Asian Studies at the University of Nebraska-Lincoln, 2007( Peter Hatemi is a professor at the University of Nebraska-Lincoln. Andrew Wedeman is associate professor and chair of Asian Studies at the University of Nebraska-Lincoln., China Security, Vol. 3 No. 3 Summer 2007, pp. 95 - 118 2007 World Security Institute, “Oil and Conflict in Sino-American Relations” accessed 6/27/11 <http://www.wsichina.org/cs7_5.pdf>

Although China is likely to reach regional military parity with the United States around the mid-2040s, this does not mean that China will necessarily challenge the status quo. The latter is only likely if China either opportunistically challenges the United States or if China believes that it is at such a disadvantage that it feels compelled to challenge the status quo. For conflict to become likely, not only must two states be in relative power parity, but there must also be some tangible antagonism in the relationship capable of triggering serious conflict. Lateral pressure theory and its focus on resource scarcity as a source of interstate conflict provides one possible motivation for two states to collide. 27 Because the economies of both the United States and China depend heavily on imported energy - primarily oil - the advent of a zero-sum situation where global demand exceeds supply could create a potential casus belli. Rising Chinese demand for oil imports will at some point create pressure on the global supply, and continued expansion of its imports will likely impinge on the U.S. ability to sustain its own import demand. 28 If a situation occurs where China thinks its national interests depend on its ability to increase its share of total imports and where the United States concludes that its national interests demand that it pre vent China from making further inroads into its share of total imports, conflict is likely. In some cases, the search for new resources will manifest itself in the form of imperial expansion with the state conquering neighboring territories and establishing overseas colonies. 29 In other cases the search may take a less overtly military form and manifest itself in efforts to open up new markets, dominate current markets, obtain critical supply concessions or establish new trade networks. So long as resources are finite, both efforts to seize control of new supplies or to obtain them through the market are likely to generate conflict. Lateral pressure increases the potential for major powers to come into conflict, especially when competing states’ spheres of influence in resource-rich peripheral regions begin to overlap. An important consequence of lateral pressure is the action-reaction process wherein one antagonistic activity (perceived or real) leads to a counteraction by the competing state. Activities that may be generated by one state due to considerations other than resource security, but that affect the resource security of another state, could also be perceived as a threat even though no threat was intended. The most important of these interactions is when the expanding activities and interests of two high-capability, high-lateral pressure states, such as the United States and China, collide. If the activities of either nation are perceived as threatening, the two may be caught in a security dilemma, wherein reciprocation of antagonistic actions may lead to war. 30

#### Escalatory nuclear war ensures extinction

Straits Times 00 Regional Fallout: No one gains in war over Taiwan, June 25 LEXIS

THE high-intensity scenario postulates a cross-strait war escalating into a full-scale war between the US and China. If Washington were to conclude that splitting China would better serve its national interests, then a full-scale war becomes unavoidable. Conflict on such a scale would embroil other countries far and near and -horror of horrors -raise the possibility of a nuclear war. Beijing has already told the US and Japan privately that it considers any country providing bases and logistics support to any US forces attacking China as belligerent parties open to its retaliation. In the region, this means South Korea, Japan, the Philippines and, to a lesser extent, Singapore. If China were to retaliate, east Asia will be set on fire. And the conflagration may not end there as opportunistic powers elsewhere may try to overturn the existing world order. With the US distracted, Russia may seek to redefine Europe's political landscape. The balance of power in the Middle East may be similarly upset by the likes of Iraq. In south Asia, hostilities between India and Pakistan, each armed with its own nuclear arsenal, could enter a new and dangerous phase. Will a full-scale Sino-US war lead to a nuclear war? According to General Matthew Ridgeway, commander of the US Eighth Army which fought against the Chinese in the Korean War, the US had at the time thought of using nuclear weapons against China to save the US from military defeat. In his book The Korean War, a personal account of the military and political aspects of the conflict and its implications on future US foreign policy, Gen Ridgeway said that US was confronted with two choices in Korea -truce or a broadened war, which could have led to the use of nuclear weapons. If the US had to resort to nuclear weaponry to defeat China long before the latter acquired a similar capability, there is little hope of winning a war against China 50 years later, short of using nuclear weapons. The US estimates that China possesses about 20 nuclear warheads that can destroy major American cities. Beijing also seems prepared to go for the nuclear option. A Chinese military officer disclosed recently that Beijing was considering a review of its "non first use" principle regarding nuclear weapons. Major-General Pan Zhangqiang, president of the military-funded Institute for Strategic Studies, told a gathering at the Woodrow Wilson International Centre for Scholars in Washington that although the government still abided by that principle, there were strong pressures from the military to drop it. He said military leaders considered the use of nuclear weapons mandatory if the country risked dismemberment as a result of foreign intervention. Gen Ridgeway said that should that come to pass, we would see the destruction of civilization.

### 1AC Warming Advantage

#### It is undeniable, global warming is occurring now and is anthropogenic. The data is on our side, CO2 emissions outweigh the alt causes.

Stefan Rahmstorf, 2008, Professor of Physics @ Potsdam University, Member of the German Advisory Council on Climate Change, ‘8

(Global Warming: Looking Beyond Kyoto, ed. Ernesto Zedillo, Prof. IR @ Yale, p. 42-49)

It is time to turn to statement B: human activities are altering the climate. This can be broken into two parts. The first is as follows: global climate is warming. This is by now a generally undisputed point (except by novelist Michael Crichton), so we deal with it only briefly. The two leading compilations of data measured with thermometers are shown in figure 3-3, that of the National Aeronautics and Space Administration (NASA) and that of the British Hadley Centre for Climate Change. Although they differ in the details, due to the inclusion of different data sets and use of different spatial averaging and quality control procedures, they both show a consistent picture, with a global mean warming of 0.8°C since the late nineteenth century. Temperatures over the past ten years clearly were the warmest since measured records have been available. The year 1998 sticks out well above the longterm trend due to the occurrence of a major El Nino event that year (the last El Nino so far and one of the strongest on record). These events are examples of the largest natural climate variations on multiyear time scales and, by releasing heat from the ocean, generally cause positive anomalies in global mean temperature. It is remarkable that the year 2005 rivaled the heat of 1998 even though no El Nino event occurred that year. (A bizarre curiosity, perhaps worth mentioning, is that several prominent "climate skeptics" recently used the extreme year 1998 to claim in the media that global warming had ended. In Lindzen's words, "Indeed, the absence of any record breakers during the past seven years is statistical evidence that temperatures are not increasing.")33 In addition to the surface measurements, the more recent portion of the global warming trend (since 1979) is also documented by satellite data. It is not straightforward to derive a reliable surface temperature trend from satellites, as they measure radiation coming from throughout the atmosphere (not just near the surface), including the stratosphere, which has strongly cooled, and the records are not homogeneous' due to the short life span of individual satellites, the problem of orbital decay, observations at different times of day, and drifts in instrument calibration.' Current analyses of these satellite data show trends that are fully consistent with surface measurements and model simulations." If no reliable temperature measurements existed, could we be sure that the climate is warming? The "canaries in the coal mine" of climate change (as glaciologist Lonnie Thompson puts it) ~are mountain glaciers. We know, both from old photographs and from the position of the terminal moraines heaped up by the flowing ice, that mountain glaciers have been in retreat all over the world during the past century. There are precious few exceptions, and they are associated with a strong increase in precipitation or local cooling.36 I have inspected examples of shrinking glaciers myself in field trips to Switzerland, Norway, and New Zealand. As glaciers respond sensitively to temperature changes, data on the extent of glaciers have been used to reconstruct a history of Northern Hemisphere temperature over the past four centuries (see figure 3-4). Cores drilled in tropical glaciers show signs of recent melting that is unprecedented at least throughout the Holocene-the past 10,000 years. Another powerful sign of warming, visible clearly from satellites, is the shrinking Arctic sea ice cover (figure 3-5), which has declined 20 percent since satellite observations began in 1979. While climate clearly became warmer in the twentieth century, much discussion particularly in the popular media has focused on the question of how "unusual" this warming is in a longer-term context. While this is an interesting question, it has often been mixed incorrectly with the question of causation. Scientifically, how unusual recent warming is-say, compared to the past millennium-in itself contains little information about its cause. Even a highly unusual warming could have a natural cause (for example, an exceptional increase in solar activity). And even a warming within the bounds of past natural variations could have a predominantly anthropogenic cause. I come to the question of causation shortly, after briefly visiting the evidence for past natural climate variations. Records from the time before systematic temperature measurements were collected are based on "proxy data," coming from tree rings, ice cores, corals, and other sources. These proxy data are generally linked to local temperatures in some way, but they may be influenced by other parameters as well (for example, precipitation), they may have a seasonal bias (for example, the growth season for tree rings), and high-quality long records are difficult to obtain and therefore few in number and geographic coverage. Therefore, there is still substantial uncertainty in the evolution of past global or hemispheric temperatures. (Comparing only local or regional temperature; as in Europe, is of limited value for our purposes,' as regional variations can be much larger than global ones and can have many regional causes, unrelated to global-scale forcing and climate change.) The first quantitative reconstruction for the Northern Hemisphere temperature of the past millennium, including an error estimation, was presented by Mann, Bradley, and Hughes and rightly highlighted in the 2001 IPCC report as one of the major new findings since its 1995 report; it is shown in figure 3\_6.39 The analysis suggests that, despite the large error bars, twentieth-century warming is indeed highly unusual and probably was unprecedented during the past millennium. This result, presumably because of its symbolic power, has attracted much criticism, to some extent in scientific journals, but even more so in the popular media. The hockey stick-shaped curve became a symbol for the IPCC, .and criticizing this particular data analysis became an avenue for some to question the credibility of the IPCC. Three important things have been overlooked in much of the media coverage. First, even if the scientific critics had been right, this would not have called into question the very cautious conclusion drawn by the IPCC from the reconstruction by Mann, Bradley, and Hughes: "New analyses of proxy data for the Northern Hemisphere indicate that the increase in temperature in the twentieth century is likely to have been the largest of any century during the past 1,000 years." This conclusion has since been supported further by every single one of close to a dozen new reconstructions (two of which are shown in figure 3-6).Second, by far the most serious scientific criticism raised against Mann, Hughes, and Bradley was simply based on a mistake. 40 The prominent paper of von Storch and others, which claimed (based on a model test) that the method of Mann, Bradley, and Hughes systematically underestimated variability, "was [itself] based on incorrect implementation of the reconstruction procedure."41 With correct implementation, climate field reconstruction procedures such as the one used by Mann, Bradley, and Hughes have been shown to perform well in similar model tests. Third, whether their reconstruction is accurate or not has no bearing on policy. If their analysis underestimated past natural climate variability, this would certainly not argue for a smaller climate sensitivity and thus a lesser concern about the consequences of our emissions. Some have argued that, in contrast, it would point to a larger climate sensitivity. While this is a valid point in principle, it does not apply in practice to the climate sensitivity estimates discussed herein or to the range given by IPCC, since these did not use the reconstruction of Mann, Hughes, and Bradley or any other proxy records of the past millennium. Media claims that "a pillar of the Kyoto Protocol" had been called into question were therefore misinformed. As an aside, the protocol was agreed in 1997, before the reconstruction in question even existed. The overheated public debate on this topic has, at least, helped to attract more researchers and funding to this area of paleoclimatology; its methodology has advanced significantly, and a number of new reconstructions have been presented in recent years. While the science has moved forward, the first seminal reconstruction by Mann, Hughes, and Bradley has held up remarkably well, with its main features reproduced by more recent work. Further progress probably will require substantial amounts of new proxy data, rather than further refinement of the statistical techniques pioneered by Mann, Hughes, and Bradley.Developing these data sets will require time and substantial effort. It is time to address the final statement: most of the observed warming over the past fifty years is anthropogenic. A large number of studies exist that have taken different approaches to analyze this issue, which is generally called the "attribution problem." I do not discuss the exact share of the anthropogenic contribution (although this is an interesting question). By "most" I imply mean "more than 50 percent.” The first and crucial piece of evidence is, of course, that the magnitude of the warming is what is expected from the anthropogenic perturbation of the radiation balance, so anthropogenic forcing is able to explain all of the temperature rise. As discussed here, the rise in greenhouse gases alone corresponds to 2.6 W/tn2 of forcing. This by itself, after subtraction of the observed 0'.6 W/m2 of ocean heat uptake, would Cause 1.6°C of warming since preindustrial times for medium climate sensitivity (3"C). With a current "best guess'; aerosol forcing of 1 W/m2, the expected warming is O.8°c. The point here is not that it is possible to obtain the 'exact observed number-this is fortuitous because the amount of aerosol' forcing is still very' uncertain-but that the expected magnitude is roughly right. There can be little doubt that the anthropogenic forcing is large enough to explain most of the warming. Depending on aerosol forcing and climate sensitivity, it could explain a large fraction of the warming, or all of it, or even more warming than has been observed (leaving room for natural processes to counteract some of the warming). The second important piece of evidence is clear: there is no viable alternative explanation. In the scientific literature, no serious alternative hypothesis has been proposed to explain the observed global warming. Other possible causes, such as solar activity, volcanic activity, cosmic rays, or orbital cycles, are well observed, but they do not show trends capable of explaining the observed warming. Since 1978, solar irradiance has been measured directly from satellites and shows the well-known eleven-year solar cycle, but no trend. There are various estimates of solar variability before this time, based on sunspot numbers, solar cycle length, the geomagnetic AA index, neutron monitor data, and, carbon-14 data. These indicate that solar activity probably increased somewhat up to 1940. While there is disagreement about the variation in previous centuries, different authors agree that solar activity did not significantly increase during the last sixty-five years. Therefore, this cannot explain the warming, and neither can any of the other factors mentioned. Models driven by natural factors only, leaving the anthropogenic forcing aside, show a cooling in the second half of the twentieth century (for an example, See figure 2-2, panel a, in chapter 2 of this volume). The trend in the sum of natural forcings is downward.The only way out would be either some as yet undiscovered unknown forcing or a warming trend that arises by chance from an unforced internal variability in the climate system. The latter cannot be completely ruled out, but has to be considered highly unlikely. No evidence in the observed record, proxy data, or current models suggest that such internal variability could cause a sustained trend of global warming of the observed magnitude. As discussed, twentieth century warming is unprecedented over the past 1,000 years (or even 2,000 years, as the few longer reconstructions available now suggest), which does not 'support the idea of large internal fluctuations. Also, those past variations correlate well with past forcing (solar variability, volcanic activity) and thus appear to be largely forced rather than due to unforced internal variability." And indeed, it would be difficult for a large and sustained unforced variability to satisfy the fundamental physical law of energy conservation. Natural internal variability generally shifts heat around different parts of the climate system-for example, the large El Nino event of 1998, which warmed, the atmosphere by releasing heat stored in the ocean. This mechanism implies that the ocean heat content drops as the atmosphere warms. For past decades, as discussed, we observed the atmosphere warming and the ocean heat content increasing, which rules out heat release from the ocean as a cause of surface warming. The heat content of the whole climate system is increasing, and there is no plausible source of this heat other than the heat trapped by greenhouse gases. ' A completely different approach to attribution is to analyze the spatial patterns of climate change. This is done in so-called fingerprint studies, which associate particular patterns or "fingerprints" with different forcings. It is plausible that the pattern of a solar-forced climate change differs from the pattern of a change caused by greenhouse gases. For example, a characteristic of greenhouse gases is that heat is trapped closer to the Earth's surface and that, unlike solar variability, greenhouse gases tend to warm more in winter, and at night. Such studies have used different data sets and have been performed by different groups of researchers with different statistical methods. They consistently conclude that the observed spatial pattern of warming can only be explained by greenhouse gases.49 Overall, it has to be considered, highly likely' that the observed warming is indeed predominantly due to the human-caused increase in greenhouse gases. ' This paper discussed the evidence for the anthropogenic increase in atmospheric CO2 concentration and the effect of CO2 on climate, finding that this anthropogenic increase is proven beyond reasonable doubt and that a mass of evidence points to a CO2 effect on climate of 3C ± 1.59C global-warming for a doubling of concentration. (This is, the classic IPCC range; my personal assessment is that, in-the light of new studies since the IPCC Third Assessment Report, the uncertainty range can now be narrowed somewhat to 3°C ± 1.0C) This is based on consistent results from theory, models, and data analysis, and, even in the absence-of any computer models, the same result would still hold based on physics and on data from climate history alone. Considering the plethora of consistent evidence, the chance that these conclusions are wrong has to be considered minute. If the preceding is accepted, then it follows logically and incontrovertibly that a further increase in CO2 concentration will lead to further warming. The magnitude of our emissions depends on human behavior, but the climatic response to various emissions scenarios can be computed from the information presented here. The result is the famous range of future global temperature scenarios shown in figure 3\_6.50 Two additional steps are involved in these computations: the consideration of anthropogenic forcings other than CO2 (for example, other greenhouse gases and aerosols) and the computation of concentrations from the emissions. Other gases are not discussed here, although they are important to get quantitatively accurate results. CO2 is the largest and most important forcing. Concerning concentrations, the scenarios shown basically assume that ocean and biosphere take up a similar share of our emitted CO2 as in the past. This could turn out to be an optimistic assumption; some models indicate the possibility of a positive feedback, with the biosphere turning into a carbon source rather than a sink under growing climatic stress. It is clear that even in the more optimistic of the shown (non-mitigation) scenarios, global temperature would rise by 2-3°C above its preindustrial level by the end of this century. Even for a paleoclimatologist like myself, this is an extraordinarily high temperature, which is very likely unprecedented in at least the past 100,000 years. As far as the data show, we would have to go back about 3 million years, to the Pliocene, for comparable temperatures. The rate of this warming (which is important for the ability of ecosystems to cope) is also highly unusual and unprecedented probably for an even longer time. The last major global warming trend occurred when the last great Ice Age ended between 15,000 and 10,000 years ago: this was a warming of about 5°C over 5,000 years, that is, a rate of only 0.1 °C per century. 52 The expected magnitude and rate of planetary warming is highly likely to come with major risk and impacts in terms of sea level rise (Pliocene sea level was 25-35 meters higher than now due to smaller Greenland and Antarctic ice sheets), extreme events (for example, hurricane activity is expected to increase in a warmer climate), and ecosystem loss. The second part of this paper examined the evidence for the current warming of the planet and discussed what is known about its causes. This part showed that global warming is already a measured and-well-established fact, not a theory. Many different lines of evidence consistently show that most of the observed warming of the past fifty years was caused by human activity. Above all, this warming is exactly what would be expected given the anthropogenic rise in greenhouse gases, and no viable alternative explanation for this warming has been proposed in the scientific literature. Taken together., the very strong evidence accumulated from thousands of independent studies, has over the past decades convinced virtually every climatologist around the world (many of whom were initially quite skeptical, including myself) that anthropogenic global warming is a reality with which we need to deal.

#### Gasoline powered cars are the leading cause of global warming

Shahan 10 August 9, 2010 By Zachary Shahan. Shahan has a B.A. in enviormental studies and a masters in city and regional planning. He is the editor of cleantechinica.com “Cars Cause Global Warming More than Planes, Study Finds”

<http://cleantechnica.com/2010/08/09/cars-cause-global-warming-more-than-planes-study-finds/>

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It is rather well-known now that transportation is one of the leading causes of global warming pollution in the world, and especially in the United States. NASA actually reported in February that motor vehicles are the largest net contributor to global warming pollution. Now, a new scientific finding in the journal Environmental Science & Technology shows that, counter to what most of us believe, driving a car causes more global warming pollution than flying the same distance in a plane. The study, “Specific Climate Impact of Passenger and Freight Transport,” finds that, in the short run, planes cause more global warming because they create more short-lived warming processes at high altitudes. However, when you take ‘everything’ — long- and short-lived gases, aerosols and cloud effects from transportation around the world — into account, an average car trip increases global temperatures more than an average flight the same distance. Furthermore, passenger trains and buses cause even four to five times less global warming pollution than automobiles per passenger mile. Of course, there are a lot of intricacies (i.e. the specific car or plane or bus used), but this is the general finding. “As planes fly at high altitudes, their impact on ozone and clouds is disproportionately high, though short lived. Although the exact magnitude is uncertain, the net effect is a strong, short-term, temperature increase,” lead author of the study, Dr. Jens Borken-Kleefeld, said. “Car travel emits more carbon dioxide than air travel per passenger mile. As carbon dioxide remains in the atmosphere longer than the other gases, cars have a more harmful impact on climate change in the long term.”

#### H-cars can massively reduce emissions

Scientific American ‘08. "Looking at Hydrogen to Replace Gasoline in Our Cars: Scientific American." Looking at Hydrogen to Replace Gasoline in Our Cars: Scientific American. Scientific American, 3 July 2008. Web. 25 June 2012. <http://www.scientificamerican.com/article.cfm?id=can-hydrogen-replace-gas>. PH

The benefits of ditching [fossil fuels](http://www.scientificamerican.com/topic.cfm?id=fossil-fuels) for hydrogen are many, or course. Burning fossil fuels like coal, natural gas and oil to heat and cool our buildings and run our vehicles takes a heavy toll on the environment, contributing significantly to both local problems like elevated particulate levels and global ones like a warming climate. The only by-product of running a hydrogen-powered fuel cell is oxygen and a trickle of [water](http://www.sciam.com/article.cfm?id=is-it-true-that-hot-water), neither of which will cause any harm to human health or the environment.

#### Warming is real, anthropogenic, and causes extinction.

Deibel ‘7 (Terry L. Deibel, professor of IR at National War College, 2007, Foreign Affairs Strategy)

Finally, there is one major existential threat to American security (as well as prosperity) of a nonviolent nature, which, though far in the future, demands urgent action. It is the threat of global warming to the stability of the climate upon which all earthly life depends. Scientists worldwide have been observing the gathering of this threat for three decades now, and what was once a mere possibility has passed through probability to near certainty. Indeed not one of more than 900 articles on climate change published in refereed scientific journals from 1993 to 2003 doubted that anthropogenic warming is occurring. “In legitimate scientific circles,” writes Elizabeth Kolbert, “it is virtually impossible to find evidence of disagreement over the fundamentals of global warming.” Evidence from a vast international scientific monitoring effort accumulates almost weekly, as this sample of newspaper reports shows: an international panel predicts “brutal droughts, floods and violent storms across the planet over the next century”; climate change could “literally alter ocean currents, wipe away huge portions of Alpine Snowcaps and aid the spread of cholera and malaria”; “glaciers in the Antarctic and in Greenland are melting much faster than expected, and…worldwide, plants are blooming several days earlier than a decade ago”; “rising sea temperatures have been accompanied by a significant global increase in the most destructive hurricanes”; “NASA scientists have concluded from direct temperature measurements that 2005 was the hottest year on record, with 1998 a close second”; “Earth’s warming climate is estimated to contribute to more than 150,000 deaths and 5 million illnesses each year” as disease spreads; “widespread bleaching from Texas to Trinidad…killed broad swaths of corals” due to a 2-degree rise in sea temperatures. “The world is slowly disintegrating,” concluded Inuit hunter Noah Metuq, who lives 30 miles from the Arctic Circle. “They call it climate change…but we just call it breaking up.” From the founding of the first cities some 6,000 years ago until the beginning of the industrial revolution, carbon dioxide levels in the atmosphere remained relatively constant at about 280 parts per million (ppm). At present they are accelerating toward 400 ppm, and by 2050 they will reach 500 ppm, about double pre-industrial levels. Unfortunately, atmospheric CO2 lasts about a century, so there is no way immediately to reduce levels, only to slow their increase, we are thus in for significant global warming; the only debate is how much and how serous the effects will be. As the newspaper stories quoted above show, we are already experiencing the effects of 1-2 degree warming in more violent storms, spread of disease, mass die offs of plants and animals, species extinction, and threatened inundation of low-lying countries like the Pacific nation of Kiribati and the Netherlands at a warming of 5 degrees or less the Greenland and West Antarctic ice sheets could disintegrate, leading to a sea level of rise of 20 feet that would cover North Carolina’s outer banks, swamp the southern third of Florida, and inundate Manhattan up to the middle of Greenwich Village. Another catastrophic effect would be the collapse of the Atlantic thermohaline circulation that keeps the winter weather in Europe far warmer than its latitude would otherwise allow. Economist William Cline once estimated the damage to the United States alone from moderate levels of warming at 1-6 percent of GDP annually; severe warming could cost 13-26 percent of GDP. But the most frightening scenario is runaway greenhouse warming, based on positive feedback from the buildup of water vapor in the atmosphere that is both caused by and causes hotter surface temperatures. Past ice age transitions, associated with only 5-10 degree changes in average global temperatures, took place in just decades, even though no one was then pouring ever-increasing amounts of carbon into the atmosphere. Faced with this specter, the best one can conclude is that “humankind’s continuing enhancement of the natural greenhouse effect is akin to playing Russian roulette with the earth’s climate and humanity’s life support system. At worst, says physics professor Marty Hoffert of New York University, “we’re just going to burn everything up; we’re going to het the atmosphere to the temperature it was in the Cretaceous when there were crocodiles at the poles, and then everything will collapse.” During the Cold War, astronomer Carl Sagan popularized a theory of nuclear winter to describe how a thermonuclear war between the Untied States and the Soviet Union would not only destroy both countries but possible end life on this planet. Global warming is the post-Cold War era’s equivalent of nuclear winter at least as serious and considerably better supported scientifically. Over the long run it puts dangers from terrorism and traditional military challenges to shame. It is a threat not only to the security and prosperity to the United States, but potentially to the continued existence of life on this planet.

## Inherency Extensions

### Gov Not Supporting H-Cars

#### Obama’s focusing on electric cars not h2.

Schiller, 2012 Ben Schiller, masters from the London School of Economics in the history of nationalism, staff writer, Co.Exist, “Gas Prices Too High? Have you considered sewage?”, <http://www.fastcoexist.com/1679580/gas-prices-too-high-have-you-considered-sewage>, April 13, 2012

Hyundai, Honda, Toyota, and Daimler are all taking part in the trial, and several are planning to launch fuel-cell vehicles in 2015. However, hydrogen transportation is hardly booming. GM, Ford, and Renault-Nissan, have pulled research projects, and the Obama administration has said electric vehicles are more feasible at the moment.

### Car Demand Increasing

#### Demand for hydrogen cars is increasing now

Peter Valdes-Dapena, 3/19/12, CNN Money, "Hydrogen cars: a zero-emission longshot?," <http://money.cnn.com/2012/03/15/autos/hydrogen-fuel-cell-cars/index.htm>,

Imagine an electric car that can be charged in about the time that it takes to fill a gasoline tank and which can then drive hundreds of miles. This is not a fantasy scenario. In fact, that pretty much describes the hydrogen fuel cell cars several major auto manufacturers, including Toyota (TM) and Hyundai, plan to have for sale. While those automakers will introduce the cars in small numbers and in limited markets, by 2015 or so, Honda and Mercedes-Benz are already leasing hydrogen fuel-cell powered cars to customers in Southern California. General Motors (GM, Fortune 500) also has about 100 fuel-cell powered crossover SUVs in customer hands. Some of GM's fuel cell vehicles are also being used by the military. Hydrogen fuel cell cars are electric cars but, instead of storing electricity in a batteries, they generate it on board in fuel cells. The fuel cells combine hydrogen gas with oxygen in a process that creates water and a stream of electricity. That electricity powers the car -- but without the long charging times. California's zero-emission vehicle sales requirements account for much of why automakers are interested in providing hydrogen vehicles. Meanwhile, initiatives in Washington to broaden financial support for alternative fuel vehicles could help off-set some of the additional costs.

#### Demands for hydrogen cars are increasing now.

http://search.proquest.com.proxy.kclibrary.org/docview/846730681/1378BD6627E1C45E1B/5?accountid=37396 “Landmark year for ITM Power” Snowdon, Ros. Journalist for The Yorkshire Post [Leeds (UK)] 20 Jan 2011. LSV

Clean fuel firm ITM Power said 2011 will be a transformational year for the company as it reported a fall in half-year losses. The Sheffield-based company said it reduced losses from Pounds 3.4m to Pounds 3m in the six months to October 31, which was in line with budget. ITM anticipates rolling out a number of new products over the next six months. It said that following clear commitments to hydrogen fuel made in both Germany and the US, hydrogen vehicles are increasing in popularity. ITM's chief executive Dr Graham Cooley said that the need for hydrogen infrastructure has never been greater. "2011 will be a transformational year for ITM Power," he said. "I am confident that the uptake of hydrogen will continue to gain momentum and that, with our range of energy storage and clean fuel products, the company is extremely well positioned." ITM also said that its HPac product has achieved CE certification. A CE mark is a mandatory conformance mark for products placed on the market in the European Economic Area. Total grant funds during the six months were Pounds 536,000, with Pounds 200,000 of this being allocated against the cost of constructing an HFuel unit for the Hydrogen On Site Trials. ITM recently announced that windscreen repair company Autoglass had joined its Hydrogen On Site Trials. The trials are testing ITM's new clean fuel technology, the transportable high pressure refueling unit (HFuel).

### Inherency – Demand Increasing/Stations Key

#### Car demand is increasing, but few stations are a barrier to entry

Drive Clean, 2012, "Hydrogen fuel cell," <http://www.driveclean.ca.gov/Search_and_Explore/Technologies_and_Fuel_Types/Hydrogen_Fuel_Cell.php>,

Most automakers have placed fuel cell vehicles with customers, and many plan to introduce fuel cell vehicles to the early commercial market around 2015. Transit agencies have been operating fuel cell buses in revenue service and are moving to next-generation technology. Customers have been fueling at private, fleet demonstration stations, and are awaiting a retail-ready network. For a detailed review of current hydrogen fuel cell progress in California, view the latest Progress Report from the California Fuel Cell Partnership (CaFCP).

### Inherency – Few Stations

#### Few hydrogen stations exist now

Peter Valdes-Dapena, 3/19/12, CNN Money, "Hydrogen cars: a zero-emission longshot?," <http://money.cnn.com/2012/03/15/autos/hydrogen-fuel-cell-cars/index.htm>,

The other big problem for hydrogen cars is "infrastructure" which, in this case, means hydrogen filling stations. Bottom line: If you don't live near Los Angeles, you'll probably have a tough time filling up. "The earliest the infrastructure becomes viable is 2015 or 2016," said GM's Freese, "and that's debatable." At least the fuel itself isn't hard to locate. It is, literally, everywhere. Hydrogen is the most abundant element in the universe. But, ordinarily, it doesn't just float around by itself. It has to pried out of molecules like those of water or natural gas.

### Inherency – AT Home Fueling Stations

#### Both home and public stations are needed

Dignan ‘10

(Larry Dignan, editor-in-chief of SmartPlanet, 27/1/10, “Honda’s home garage gadget: Here’s your solar hydrogen fueling station”, AD)

Honda said Tuesday that it has started operation of a next generation solar hydrogen station prototype. This home fueling system is designed to refuel fuel cell electric vehicles. Here’s the way it works: The single unit fits in a garage and produces enough hydrogen in an 8-hour overnight fill for a daily commute in a fuel cell vehicle. Honda said it simplified the previous hydrogen station, which required and electrolyzer and compressor to create high pressure hydrogen. The latest version ditches the compressor completely. By eliminating the compressor, Honda’s solar hydrogen station is 25 percent more efficient than the old one. Among other key details: Honda’s solar hydrogen station is compatible with smart grids; Users could refill the vehicle without storing hydrogen; The station could export power to the grid when not in use; The station is powered by a 48-panel 6.0KW solar array; The home system is designed to complement so-called “fast fill” hydrogen stations, which fuel up in 5 minutes. Honda is betting on hydrogen cars and fueling is the biggest hangup. With a combination of overnight home systems and fast fill public stations a network of hydrogen fueling areas could be created. What are your thoughts on hydrogen vehicles. Can the infrastructure be put in place and would you buy a home fueling system?

### Inherency/Solvency\*\*\*

#### **Auto industry lacks investment because of lack of stations**

Priddle ‘08

(Alisa Priddle, Alternative power writer for Car and Driver, “Hydrogen Stations Needed for Fuel-Cell Vehicles of the Future”, April 2008, <http://www.caranddriver.com/news/hydrogen-stations-needed-for-fuel-cell-vehicles-of-the-future-car-news>, AD)

The auto industry says it can’t justify continued spending on fuel-cell vehicles without evidence that there will be hydrogen stations to fill them up. Can you locate the hydrogen filling station closest to you? That, in a nutshell, is the crux of the problem for an auto industry at a critical juncture in developing fuel-cell vehicles (FCVs) where hydrogen is converted to electricity onboard and there are no emissions. The major automakers have been working on FCVs—some for more than a decade—and many have small test fleets on the road around the world with plans to ramp up volume over the next six or seven years. To justify the investment to take the next step for carmakers—putting about 1000 FCVs each on the road compared with less than 100 per company now—requires the involvement of all the stakeholders: carmakers, energy companies, the government, and the acceptance of consumers, says Larry Burns, GM’s vice-president of research and development and strategic planning. The auto industry is spending billions developing vehicles with zero-emissions propulsion systems, but widespread dissemination of FCVs is limited by the fact that there are few places to get the hydrogen. It is estimated that there are about 70 stations in the U.S., but not all are available to the public, nor are all upgraded to dispense the fuel as a gas compressed to 10,000 psi (approximately 700 bar), which would provide a range of about 160 miles. Stations that compress the gas to only 5000 psi (approximately 350 bar) give vehicles a range of only 60 to 70 miles per tank, GM officials say. The point was driven home at the National Hydrogen Association conference in Sacramento, California, where speakers from companies such as Chevron and Shell were able to list their individual stations. Time for the Government to Mandate Hydrogen Stations? If energy companies were to invest the $1 million to $4 million it costs for a single station (depending on the number and type of pumps) and concentrate them all in a major metropolitan area such as Los Angeles, Burns is convinced automakers would concentrate their fleets in the area. L.A. has about 12 stations now, he says, few of them pumping at 10,000 psi. He would like to see the government mandate that there be 40 in the region—much like the California Air Resources Board is mandating that carmakers put 7500 zero-emissions vehicles and 66,000 plug-in hybrids on the road in California from 2012 to 2014. Commercialization of FCVs Is on the Horizon At Toyota, the target for the start of higher volumes or commercialization of FCVs is 2015, says Taijo Kawai, general manager of Toyota’s fuel-cell-system engineering division. Toyota’s current FCV (in the previous-generation Highlander SUV) has been on the road since 2005. The automaker says it is still debating which vehicle it will use for its next-gen FCV. Holger Braess of the BMW Group sees the start of commercialization in the 2015-to-2020 timeframe. With automakers committed, Burns at GM lays down the gauntlet for energy providers. “There are 170,000 gas stations in the U.S., and we’re asking for 40 hydrogen stations to learn and grow,” Burns says, in what he sees as a modest request. Ideally, he would love to see 12,000 stations strategically placed in the 100 largest cities in the U.S. Daniel O’Connell, who oversees support and infrastructure for GM, says that many hydrogen stations would cover 70 percent of the population. Catherine Dunwoody of the California Fuel Cell Partnership says California needs 750 kilograms of hydrogen a day in the L.A. area. And she sees this as an opportunity to rethink the fuel station of the future, much like the iPod helped redefine the personal music experience.

## Solvency Extensions

### Solvency – All Advs

#### Hydrogen fuel can replace gasoline in cars. That solves oil dependence and warming, but building up the refueling infrastructure is key to motivate demand.

Joan **Ogden** and Edward S**. Rubin**. "The Outlook for Hydrogen Cars --- Weekly Policy Commentary -- **March 9, 2009."** *The Outlook for Hydrogen Cars --- Weekly Policy Commentary -- March 9, 2009*. N.p., 9 Mar. 2009. Web. 25 June 2012. <http://www.rff.org/Publications/WPC/Pages/03\_09\_09\_Outlook\_for\_Hydrogen\_Cars.aspx>.**JC**

While recent media coverage and political debates on alternative fuels have been dominated by a “fuel du jour” syndrome—waves of short-lived enthusiasm first for batteries, then fuel cells, ethanol, and plug-in hybrids—the consensus emerging among transportation energy analysts is that a portfolio strategy encompassing a variety of options is needed to nurture both near-term and longer-term technologies to address these problems. One of the most promising and challenging long-term options in this portfolio is hydrogen**.** Two recent studies by the National Academies assessed hydrogen as a potential replacement for gasoline in light duty vehicles**.** The 2004 report showed that hydrogen had the potential to dramatically reduce oil use and greenhouse gas emissionsfrom light duty transport by 2050, but only if an array of technical and transition barriers could be overcome. The 2008 report (in which we participated) examined a possible transition to hydrogen in detail, offering critical assessments of the timing and resources needed to bring fuel cell vehicles (FCVs) into widespread use. Fuel cells are at the heart of the hydrogen strategy. They are electrochemical devices, akin to batteries, that combine hydrogen and oxygen (from air) to generate electricity to fully power a vehicle. The only tailpipe emission is water vapor from the reaction of hydrogen and oxygen. While fuel cell technology has improved substantially in recent years, current devices have not yet achieved the performance and cost goals required for large-scale commercial production. The chief technical challenges are to make fuel cells as durable and cost-effective as today’s internal combustion engine, to reduce the use of costly materials such as platinum-based catalysts, and to develop a compact, low-cost hydrogen storage system capable of providing a driving range of 300 miles or more, which is what most consumers demand. Several auto companies, including General Motors, Honda, Daimler, and Toyota are currently introducing pre-commercial FCVs and hydrogen fueling stations in limited markets, notably in California and Germany. Iftechnical progress continues at its current pace, FCVs could be ready for mass production by 2015. Initial costs would be high, but should fall quickly as manufacturing volumes increase and vehiclescontinue to improve. Hydrogen for these vehicles can be produced from a variety of energy sources, including fossil fuels, renewables, and nuclear energy. In the near term, the most economical approach is to manufacture hydrogen from natural gas at individual refueling stations. The projected cost is about $1.50 per gallon of gasoline equivalent on a mile per gallon basis, but fuel cost would vary with natural gas prices. As the use of hydrogen grows, it can be produced more economically at large centralized plants and distributed to refueling stations via pipelines or trucks, much like gasoline supplies.

### Solvency – Stations/Federal Action Key\*\*\*

#### Demand for H-cars exist now, but other countries prove that government investments in infrastructures is key to commercialize the market.

Jill Terreri, 2011, Fuel Cell Dispatch, "GM site tries to keep US in fuel cell race," <http://www.fuelcelldispatch.com/AutomotivePower/tabid/2704/articleType/ArticleView/articleId/2307/GM-site-tries-to-keep-US-in-fuel-cell-race.aspx>

It may not capture popular imagination like the race to the moon, but the global competition to develop vehicles that don't rely on gasoline is just as intense, and it is playing out in Rochester's own backyard. Tucked in the village of Honeoye Falls down a quiet side street is a nondescript two-building campus where about 360 top scientists are developing hydrogen fuel cells for General Motors. They're locked in a high-stakes race with Japan, Germany and South Korea to bring zero-emissions vehicles to the public. If government investment is any barometer of future success, however, the United States could finish last: Japan, Germany and South Korea have boasted public-private partnerships and investments — some worth billions — while the United States' proposed federal investment in fiscal year 2012 is about $100 million. "We would like to be first, we would like to be out there with the best product," said Daniel O'Connell, who leads the fuel cell team at GM's Honeoye Falls facility. "Not getting as much support as we'd like isn't making it any easier on us. ... It's disappointing, but it's not slowing us down." Hydrogen is a leading resource in the development of vehicles that are kinder to the environment, and GM has successfully put 119 vehicles on the road during the last four years and spent more than $1 billion developing the technology. The vehicles — a version of the Chevy Equinox — drive just like a gasoline-powered car, maybe better, because with no transmission there is no delay in acceleration. The model reaches speeds of 100 miles per hour, can go for about 200 miles between fill-ups, has endured four winters and has logged just short of a combined 2 million miles. Proponents of fuel-cell technology say transportation must be revolutionized, pointing to gasoline prices, which have topped $4 per gallon, and the expensive defense of American interests in the Middle East, where the United States gets much of the oil it purchases. Environmental advocates note that fuel-cell cars generate no air pollution because they emit only water vapor. The cars themselves will only be affordable, however, if they are produced in large quantities. Car makers would like them to be priced competitively with traditional cars in the same vehicle class, and the price per mile, using hydrogen, could be cheaper than that of gasoline-powered cars. They will only be mass produced if there is demand, and there will only be demand if there are hydrogen fueling stations, experts have said. "From a national perspective, I think it is an exciting development," said Nabil Nasr, assistant provost at Rochester Institute of Technology, noting the progress GM has made on fuel-cell vehicles. Nasr is involved in RIT's fuel cell research, which is done in collaboration with GM. "At the same time, unfortunately, the government has totally lost interest in this area," he added. As other countries help their car manufacturers bring fuel-cell cars to market by building hydrogen stations, the United States has cut back its investment. The first company to bring its car to market will likely have an advantage over the competition, because it will be able to mass produce the cars more quickly, working out problems or reducing the cost of the vehicles, say experts, who compare the process to the cellphone market. "To be competitive you really need to get out there first," said Nasr, director of RIT's Center for Integrated Manufacturing Studies and the Golisano Institute for Sustainability. "It's very important for the U.S. to see this as a competitiveness issue." While GM has made strides in its fuel cell program, companies such as Honda, Toyota, Hyundai and Mercedes also are developing the cars. The local picture Sensing that it will be up to the states to begin development of a hydrogen infrastructure, Assemblyman Joseph Morelle, D-Irondequoit, will host a fuel cell summit in Albany on Monday and Tuesday as a way to persuade his colleagues in the Legislature to support such an initiative. He plans to give them an opportunity to drive the cars. New York is one of three states with a serious interest in developing a hydrogen infrastructure, the others being California and Hawaii. The state has just eight fueling stations, all private, including three in Monroe County — not nearly enough to make driving a fuel-cell car feasible. "We're developing that infrastructure that could become available to the public in some manner," said Michael Garland, director of the county Department of Environmental Services. Fuel cell supporters compare taxpayer investment in fueling stations to the development of railroads, the highway system or the Alaska pipeline. They say hydrogen producers are reluctant to invest in installing new stations because not enough cars are on the road. Meanwhile, people who have driven the test cars enjoy them, O'Connell said, but agree that there aren't enough hydrogen stations. This time of high costs for the vehicle and minimal availability of hydrogen stations creates a paradox the industry calls "the valley of death." "All the things on the car side, in our mind, are pretty much done," said O'Connell. "The big hurdle is on the infrastructure side. You don't see hydrogen stations all over the United States." After spending time in Honeoye Falls and speaking with fuel cell researchers at RIT, Morelle said he became convinced that fuel cells were a better alternative to battery-powered cars, which tend to be smaller and can only be driven so long before they need to be recharged, though battery developers are addressing both of those issues. Fuel cell proponents, meanwhile, say that weaning ground transportation off gasoline is going to require all types of technology, including hydrogen and batteries. Morelle is trying to send the message to his colleagues that car manufacturers will sell where the hydrogen fueling stations are, whether that's Hawaii, California, Germany or Japan. He is proposing an investment of $215 million in state and federal funds over five or six years with an investment matched in part by hydrogen producers. The proposal calls for fueling stations along the Albany-New York City corridor and along I-90, starting first in two locations, Rochester — because of the Honeoye Falls plant — and New York City. The proposal calls for spending $51 million in state funds with an investment of $152 million from hydrogen producers to fund 100 stations, and $164 million in federal and state funds for incentives for consumers, corporations and the government to purchase the cars. Gov. Andrew Cuomo didn't commit to investing in a hydrogen infrastructure in a campaign book he released on the environment, but has said that fuel cell development must be considered. Falling behind New York can be on the leading edge of the emerging technology, given the GM plant and the local supply of hydrogen, Morelle said. "I just think that this has the possibility of developing into a huge industry in the way oil and gas is a windfall to certain states," he said. Hydrogen is produced in the Buffalo area, and there is a possibility of creating hydrogen at wind farms in the Southern Tier and at Niagara Falls. The downside to taxpayer investment, of course, is that if fuel-cell vehicles don't catch on in the United States, there would be no cars to use the stations. Matt Fronk, who was instrumental in starting the fuel cell program at General Motors in 1999, credits former U.S. Rep. Eric Massa, who drove a fuel-cell car to his 2009 swearing-in, with helping to save the program during GM's bankruptcy that same year. Massa and Rep. Steve Israel met with GM management. "If he hadn't done that I'm sure it would have been easily cut," Fronk said. "He was the one guy who tried to make a difference." Fronk and others worry that the United States is falling behind on developing the infrastructure needed to make driving the cars feasible. The Obama administration's lack of support for fuel cell development has discouraged the industry: Funding was cut by more than half in the administration's first budget and then restored after outrage from lawmakers and other advocates. Another 40 percent cut is proposed in the administration's 2012 budget. Meanwhile, other countries are investing heavily, building a network of hydrogen stations to meet demand for the vehicles. Japan and Germany are rolling out stations with an eye on completion in 2015 to provide the infrastructure needed for fuel-cell cars being developed by Honda, Toyota, Hyundai and Daimler. Germany is proposing a $2 billion investment in developing hydrogen stations over the next 10 years, and Japan has plans for about 60 stations by 2015. "It's not a question of 'if' the commercial market will grow,' but 'where,'" said Pete Barkey, director of communications for the Fuel Cell and Hydrogen Energy Association in Washington, D.C. The hydrogen itself can be difficult to produce and store, but supporters say using it is still more efficient than fossil fuels. "Regardless of how you make the hydrogen you still come out much, much better than with an internal combustion engine," Nasr said. An explosion occurred last year while hydrogen was delivered to the hydrogen fueling station at the Greater Rochester International Airport, and two people were injured. GM maintains hydrogen is safe and notes that the Equinoxes on the road have been in accidents and no hydrogen has been released. The lack of stations is a greater problem, said James Winebrake, dean of the College of Liberal Arts at RIT, than producing and delivering the hydrogen.

#### Federal funding for refueling infrastructure is key to get hydrogen cars by 2015

Motavalli 2009 Jim Motavalli, New York Times, “Betting Against Hydrogen,” 10/20/2009, <http://wheels.blogs.nytimes.com/2009/10/20/betting-against-hydrogen/>

Mr. Blencoe, whose company markets hydrogen pipeline and storage technology, declined the raising of the stakes. “It’s not about money,” he said in an interview. “I don’t care about that. What matters is getting the facts straight, and fuel-cell cars will absolutely be viable in 2015.” Mr. Blencoe said that higher gasoline prices and the short range of battery cars will send buyers to fuel-cell vehicles. He predicted adjusted-for-inflation hydrogen prices in 2015 at $6 to $8 a gallon equivalent (aided by fuel-cell vehicle fuel efficiency that he said was comparable to 60 miles per gallon). Hydrogen research money is now assured, but larger federal support for a national refueling network remains a big hurdle.

#### Government support crucial in transition to H- refueling infrastructure.

Ogden and Ruben 09

http://www.rff.org/Publications/WPC/Pages/03\_09\_09\_Outlook\_for\_Hydrogen\_Cars.aspx

Joan Ogden is Professor of Environmental Science and Policy at The University of California. Edward S. Ruben is Alumni Professor of Environmental Engineering and Science in the Engineering and Public Policy Department at Carnegie Mellon University. March 9, 2009. RFF Weekly Policy Commentary. A.G.

Development of the hydrogen refueling infrastructure is another critical step for hydrogen cars. Current strategies, developed in close coordination with vehicle manufacturers, focus on targeted introduction of FCVs and hydrogen infrastructure in a number of “lighthouse cities” such as Los Angeles, New York, and Houston. As a practical matter, the 2008 NRC report estimated that the maximum number of hydrogen-fueled vehicles on U.S. roads by 2020 would be no more than about 2 million, out of an estimated vehicle population of 280 million. This assumed that mass production of FCVs gets underway around 2015, all technology goals are met, and fuel cell vehicles rapidly gain market share, reaching 10 percent of new car sales by 2020. Under such favorable conditions—requiring government support during the transition period—hydrogen cars could become commercially competitive by about 2023. The number of vehicles could then grow rapidly, to 60 million in 2035 and 220 million in 2050—some 60 percent of the future fleet.

#### Market can’t cause the hydrogen transition – government action key.

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

Because hydrogen has few (if any) private benefits compared to petroleum-based fuels, widespread use will require either radically different market conditions or new policies. The combination of physical challenges to using hydrogen onboard vehicles, the widespread availability of less problematic substitutes for petroleum (e.g. efficiency improvements or bio-ethanol) suggests that market forces are unlikely to induce a switch to hydrogen for the next several decades (Lave et al., 2001; Weiss et al., 2000). Therefore, the introduction of hydrogen is likely to require forceful government action, such as mandates or substantial economic incentives. Unfortunately, this amounts to ‘picking a technological winner’ (hydrogen, in this case), which government often does quite poorly.

#### More ev –government key to create niche markets for hydrogen

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

The first dilemma concerns the difficulty in establishing niche markets (Norberg-Bohm and Rossi, 1998). In the commercialization of private goods, firms are able to charge more to “lead adopters,” consumers willing to pay a premium for the qualities that a new product possesses. Over time, the cost of successful products comes down, due to learning and economies of scale, allowing the market for the new product (i.e. the new technology) to expand. However, new technologies that are designed to provide public goods are unable to command a premium (by definition), and thus the development of niche markets is hindered. This suggests a role for government. If there were sufficient lead adopters, there would be no need for government to identify strategic niches (Kemp et al., 1998). Indeed, environmental regulation often causes technological change: firms frequently must develop processes and products to meet the new requirements while still meeting consumer demand (Faucheux et al., 1998; Skea, 1996). However, the need for government action sets up the second dilemma.

### Solvency – Stations k to H-cars

#### The support for hydrogen fuel infrastructure is high

Vagus, June 18, 2012

Stephen Vagus, “support structure of hydrogen transportation continues to show signs of progress”, Hydrogen fuel infrastructure grows with the help of H2 logic, June 18, 2012, <http://www.hydrogenfuelnews.com/hydrogen-fuel-infrastructure-grows-help-h2-logic/854281/> KSM

Infrastructure has emerged as one of the most important challenges facing the progress of hydrogen-powered vehicles today. The auto industry has been relentless in its push to make hydrogen transportation a common concept in the minds of consumers. throughout the world. The industry, as a whole, has been somewhat successful in this endeavor. Though battery-powered vehicles continue to steal the limelight, hydrogen-powered vehicles have managed to generate a great deal of hype over the years, which could translate into success for automakers. Without a hydrogen fuel infrastructure, however, the success of hydrogen transportation will be severely limited.

#### The plan is key to a hydrogen car economy by streamlining environmentally friendly refueling stations

Jim Motavalli, 4/14/10, The Daily Green, "hydrogen highway for fuel-cell cars coming to east coast," <http://www.thedailygreen.com/living-green/blogs/cars-transportation/hydrogen-highway-460410>,

If he builds it, will they come? It's a question worth asking a fellow named Tom Sullivan, who says that, through his companies SunHydro and Proton Energy, he will build an East Coast "hydrogen highway" to compete with the still-underdeveloped West Coast version announced by Governor Arnold Schwarzenegger. Sullivan, who made his fortune with Lumber Liquidators stores (the largest retailer of hardwood floors is now in 180 locations), bought the Connecticut-based Proton Energy fuel-cell company for $10.2 million last summer. And it's at Proton's Wallingford, Connecticut headquarters that the state's first public hydrogen refueling station will open in June. Although Connecticut has only one United Technologies fuel-cell bus plying a route in Hartford, plus some visiting Chevy Equinox hydrogen cars, the $2 to $3 million station will be capable of generating 65 kilograms of hydrogen (enough for refueling 10 to 15 vehicles) daily. It may be some years before there's that kind of volume on state roads. Only California has fuel-cell cars in any abundance, and there we're talking a few hundred at most. And Connecticut (home to several fuel-cell companies) has a virtual abundance of them compared to other East Coast metropolises. Nonetheless, this ambitious highway is rolling out. Ten to 15 stations will be built by SunHydro along the East Coast corridor, approximately 300 miles apart. Within two years, the companies plan to install them in such cities as Portland, Maine, Braintree, Massachusetts, Hackensack, New Jersey, Claymont, Delaware, Richmond Virginia, Charlotte, North Carolina, Atlanta and Savannah, Georgia, and Orlando and Miami in Florida. This plan demonstrates, if nothing else, amazing confidence in a technology that is as old as the hills (first demonstrated by a barrister and amateur scientist in the 1830s) but never successfully commercialized. But both Honda and Toyota plan to put fuel-cell cars in consumers' hands by 2015, and General Motors is working on it, too. Pike Research has estimated that almost three million hydrogen cars will be sold by 2020, but that is an extremely optimistic assessment. Mercedes-Benz is fielding a small demonstration fleet of F-Cell fuel-cell cars this year, but like other manufacturers it prefers hydrogen-friendly California. In 1999 and 2000, Daimler fuel-cell chief Ferdinand Panik was predicting that there would be 100,000 Mercedes-Benz fuel-cell cars on the road by 2004, and the hydrogen highway did look imminent (as I wrote in my book of that period, Forward Drive: The Race to Build Clean Cars for the Future). I rode in a Benz fuel-cell car, and it sure seemed like the future to me. But infrastructure is king--we now have companies building electric charging stations commercially. If there are other Tom Sullivans out there, the hydrogen dream can indeed be reborn instead of remaining always 20 years in the future. Mike Grey, president of SunHydro, envisions a motorist, just a few years hence, driving from Maine to Miami on hydrogen. He said the stations will be entirely environmentally friendly, using his company's solar panels to power electrolysis technology from Proton Energy. The result: very low-emission hydrogen made from water. Rob Friedland, president of Proton, said his company has reached break-even status selling 1,200 electolyzers for commercial applications since 1996. It will shortly release its first small hydrogen re-fueler, a scaled-down $250,000 version of the Wallingford station that can produce two kilograms of hydrogen daily. Fuel-cell cars are "full" with four kilos on board, so that's enough to top off maybe two to three fuel-cell cars weekly, Friedland said.

#### Hydrogen vehicle sales are suffering because of a lack of refueling stations

http://search.proquest.com.proxy.kclibrary.org/docview/904642465/1378BDD29FE3F94F693/21?accountid=37396 “Full hybrids intelligence service.” just - auto. Will **Johnston** Publisher (Nov 2011) **jun. 20 2011** LSV

Hydrogen market projections Some of the development effort being devoted by automakers to battery electric and range-extended electric vehicles will benefit any future hydrogen fuel-cell vehicles. Indeed, a fuel-cell vehicle is essentially a range-extended electric car with the fuel cell taking the place of a combustion engine. The electric traction motor and lithium-ion battery (used to buffer power delivery and provide extra power under heavy loads) are quite similar to electric-car components. On a global level, however, we think the prospects for volume production of hydrogen fuel-cell cars before 2020 are dim. Current test programs, starting in 2007 with GM's Project Driveway and including the current Honda FCX Clarity and Mercedes-Benz B-Class F-CeIl fleets, seem to top out at 200 vehicles. Perhaps by 2015, some manufacturer- either Toyota or Daimler- will begin offering fuel-cell cars in carefully chosen regions with aggressive emissions limits, zero-emission center-city zones, and a network of operating hydrogen fueling stations. We would still expect volumes to be low, from 1,000 to 5,000 per year per manufacturer in the first through third years (2015 to 2017). In the fourth through sixth years (2018 to 2020), we could see volumes of 10,000 to 15,000 per year from as many as six global makers, bringing annual production close to 100,000. Likely first rollout regions include the greater Los Angeles area in the U.S. and perhaps the New York metropolitan region; in Europe, primarily Germany; Japan; South Korea; and possibly one or more urban regions in China. We do not expect fuel-cell cars to have any impact in India or South America. By 2020, total production of plug-in electric cars is likely to be above 1 million per year, and they may offer ranges up to 200 miles. For hydrogen vehicles to achieve significant volume, two things must happen: Regional networks of hydrogen filling stations will have to be put in place before the cars arrive, with large-scale hydrogen production to supply them; and hydrogen manufacturing must have a carbon profile competitive with plug-ins, natural gas vehicles, and far more efficient petrol and diesel cars. Given the hundreds of programs across Europe, Asia, and North America to build public electric-car recharging infrastructure -and at a far lower cost per installation- we think large-scale rollout of hydrogen fueling infrastructure is increasingly unlikely. And absent that fueling infrastructure, we think hydrogen fuel-cell vehicles will play a negligible role in vehicle production until 2025 or later.

#### Lack of infrastructure leads to less hydrogen cars on the road

Motavalli Decemeber 6, 2011

Jim Motavalli, environmental writer and speaker of the NY Times, “In U.S., Hydrogen Cars may line up with few places to fill up, 12/6/11, <http://wheels.blogs.nytimes.com/2011/12/06/in-u-s-hydrogen-cars-may-line-up-with-few-places-to-fill-up/> KSM

Fuel-cell cars are coming, and not just from Toyota. Daimler, Hyundai and Honda have all committed to production on the same approximate timetable. Fuel-cell performance has increased, costs have come down and the cars should be ready, automakers say. But will they be able to refuel? Hydrogen stations, which can cost more than $1 million to build, are few and far between in the United States, even in target states like California, which is creating bottlenecks for automakers that are rolling out or ramping up demonstration programs. Sascha Simon, head of advanced product planning at Mercedes-Benz USA, said in an interview that the company was able to utilize only two hydrogen stations in Los Angeles that were “publicly available and working right now.” As a result of fuel constraints, he said, Mercedes has leased only 22 of its B-Class F-Cell hydrogen cars there, and has another 20 sitting in a city parking lot. “There is a backlog on the construction of the stations that have been promised,” Mr. Simon said. “We’re working hard to overcome that.” Hyundai, which mounted a promotional cross-country drive of its Tucson FCEV in September, is another automaker that has expressed concern over the dearth of filling stations. “From an industry standpoint, vehicle deployment has been slowed due to a lack of infrastructure,” the company said in an e-mailed statement. Hyundai also noted in the statement that it planned to build 1,500 hydrogen cars for the global market between 2012 and 2014, and could produce another 2,000 during that period. “These vehicles will be active in both the United States and Europe,” Hyundai said. Hydrogen advocates say that an adequate number of stations will be ready in step with the cars, by 2014 or 2015.

#### Hydrogen cars are available. All we need is fueling infrastructure

Squatriglia 2008

Chuck Squatriglia, expert in alt energy, “Hydrogen cars are here. Now we just need a fueling infrastructure, March 12, 2008, <http://www.wired.com/autopia/2008/03/hydrogen-cars-a/> KSM

Hydrogen cars and their promise of a zero-emission, petroleum-free future are no longer the stuff of science fiction. Automakers have the technology largely nailed down and say vehicles like the Chevrolet Equinox FCEV and Honda FCX Clarity are poised to take us beyond gasoline. There’s just one hitch. Where do we get the hydrogen? There are 36 hydrogen fueling stations in the United States, and two thirds of them are in California. Increasing that number in any meaningful way remains the biggest – and most pressing – challenge keeping us from traveling the hydrogen highway.

#### Refueling infrastructure key to transition away from petroleum fuels.

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

Petroleum-based fuels dominate the transportation sector, largely because some of their basic physical characteristics make them relatively easy (and therefore inexpensive) to use onboard vehicles. Key characteristics include compatibility with internal combustion engines and turbines (which have high power to weight ratios and simple operating characteristics suitable for vehicle use), easy handling and storage, and very high-energy densities. In addition to these purely physical factors, there is a significant problem associated with the introduction of a new fuel (sometimes called the “chicken and egg” problem) of coordinating between investments in hydrogen vehicles and refueling infrastructure (Jensen and Ross, 2000; Winebrake and Farrell, 1997). Simply put, consumers and businesses are reluctant to buy vehicles for which no refueling infrastructure exists while investors are reluctant to build refueling infrastructure for which there is no demand. These difficulties have plagued efforts to introduce alternative fuels less exotic than hydrogen, such as natural gas, because both refueling infrastructure and vehicle conversion remained unprofitable (Flynn, 2002). “The primary barriers for alternative-fuel vehicles are cost, market acceptance, and deployment because a variety of proven technologies are already commercially available” (US Department of Energy, 2000, pp. 4–48).

#### Publicly available refueling infrastructure is key to transitioning.

Flynn 2002 P.C. Flynn, Department of Mechanical Engineering, Poole Chair in Management for Engineers, University of Alberta, “Commercializing an alternate vehicle fuellessons learned from natural gas for vehicles”, Energy Policy, 30 (2002), pp. 613–619

CNG-FS discovered that the majority of sales were not to large fleets, which would hardly ever commit to a block purchase without an introductory trial. Leading purchasers of new fuels are by definition innovative purchasers, and CNG-FS found these in very small commercial fleets and single high mileage commuters. Over 90% of conversion sales in Canada were to such customers, who required refueling in public facilities. Thus, the first challenge in commercializing an alternate fuel was to create an infrastructure of public refueling. This was most often done through partnerships with existing fuel sellers (gasoline retailers) and sometimes with gas utilities. Public refueling through existing fuel sellers also requires that equipment maintenance be available. The typical fuel retail outlet is either a franchise or company owned; in either case, the owner or manager is not capable of doing maintenance on sophisticated new equipment (in the case of NGV, maintenance of a highpressure compressor and storage facility). Those promoting the new fuel must ensure that public retailers have easy access to an affordable source of equipment maintenance. Any new thermal alternate transportation fuel will face the same issues: small scale purchasers, who are often innovative early adopters and willing to try a new fuel, require public refueling because of the diseconomy of scale of small dedicated refueling equipment. Public refueling stations will in turn require reliable third-party maintenance. Only electricity, which is already available in homes, can avoid this issue through affordable home repowering.

### Solvency – Stations k to H-cars (Canada Proves)

#### Refueling infrastructure is key to transition to new fuels – Canada proves.

Flynn 2002 P.C. Flynn, Department of Mechanical Engineering, Poole Chair in Management for Engineers, University of Alberta, “Commercializing an alternate vehicle fuellessons learned from natural gas for vehicles”, Energy Policy, 30 (2002), pp. 613–619

In the mid-1980s, unique conditions in Canada favored the adoption of a compressed natural gas as an alternate transportation fuel. This work focuses on the factors that limited acceptance of the fuel, and that ultimately held the rate of adoption below a critical level which would enable healthy suppliers to survive in a competitive market. The main barrier was a lack of infrastructure to support converted vehicles. Lack of refueling facilities was particularly critical; failure of existing refueling stations to achieve profitability stalled further investment, which in turn depressed sales of vehicle conversions. Other problems in the industry included excessive parts markup by conversion dealers, exaggerated claims for environmental and economic benefits, and poor design of promotional programs. Fundamental shifts in the relative values of oil and natural gas in the late 1980s removed momentum from sales of conversions. Major players, who had not achieved profitability, exited the market, and natural gas as a vehicle fuel has since remained on the fringe in Canada and the US. Today, new technologies and driving forces are creating conditions that favor different alternate transportation fuels, including electricity and hydrogen. Many of the issues regarding growth to commercial viability, in particular, the need to build a supporting infrastructure, will be the same as with natural gas.

### AT Cars Are Too Expensive

#### H-cars will be affordable

Tollefson ’10 , Jeff. "Hydrogen Vehicles: Fuel of the Future?" *Nature.com*. Nature Publishing Group, 29 Apr. 2010. Web. 25 June 2012. <http://www.nature.com/news/2010/290410/full/4641262a.html>. PH

These and other advances translate into price reductions. The Department of Energy estimates that fuel-cell costs per kilowatt of power dropped by nearly 75% between 2002 and 2008, based on cost projections for high-volume manufacturing. Companies won't discuss retail prices except to say that the vehicles slated to appear by the middle of the decade will be priced competitively. "I've been doing this for 10 years, and the numbers even surprise and shock me," says Craig Scott, manager of Toyota's advanced technologies group in Torrance, California. "It is definitely going to be a car that is in reach of a lot of people."

#### H-Cars are getting cheaper

Peter Valdes-Dapena, 3/19/12, CNN Money, "Hydrogen cars: a zero-emission longshot?," <http://money.cnn.com/2012/03/15/autos/hydrogen-fuel-cell-cars/index.htm>,

The good news is that they are, at least, much less expensive than they used to be. Both General Motors and Toyota say that they've chopped the cost of building their experimental fuel cell vehicles down to a tenth of what it used to be. So that means that vehicles that used to cost $1 million to build a few years ago now cost $100,000. That's still way too much for commercial viability. Toyota sees further cost cuts on the horizon before it begins selling its hydrogen-powered sedan in 2015. "The target is in the $50,000 range in order to interest enough customers to make the thing work," Toyota spokesman John Hanson said.

#### H-fuel is getting cheaper and will be cost competitive

Jim Motavalli and Peter Hoffman, 2/2/12, New York Times, "Questions for Peter Hoffman: A hydrogen advocate whose time may have come," <http://www.nytimes.com/2012/02/02/automobiles/wheels/a-hydrogen-advocate-whose-time-has-come.html>,

Q. Will the cost of hydrogen come down? A. It will be competitive with gasoline eventually. At Stuttgart Airport in Germany, a station was selling it recently for $12 a kilogram. Since a kilo of hydrogen is the energy equivalent of a gallon of gas, and a fuel cell is twice as efficient as an internal-combustion engine, you could translate that into approximately $6 a gallon. That’s roughly what gasoline costs in Europe. Of course, hydrogen is probably subsidized at that price, but it indicates the potential for price reductions. The price will come down as more fuel providers get into the field, as production methods such as electrolysis and other forms evolve, and as storage and compression technology is made more efficient.

#### Price of Cars and Production Inversely Related to Demand

Ogden and Ruben 09

http://www.rff.org/Publications/WPC/Pages/03\_09\_09\_Outlook\_for\_Hydrogen\_Cars.aspx

Joan Ogden is Professor of Environmental Science and Policy at The University of California. Edward S. Ruben is Alumni Professor of Environmental Engineering and Science in the Engineering and Public Policy Department at Carnegie Mellon University. March 9, 2009. RFF Weekly Policy Commentary. A.G.

Several auto companies, including General Motors, Honda, Daimler, and Toyota are currently introducing pre-commercial FCVs and hydrogen fueling stations in limited markets, notably in California and Germany. If technical progress continues at its current pace, FCVs could be ready for mass production by 2015. Initial costs would be high, but should fall quickly as manufacturing volumes increase and vehicles continue to improve. Hydrogen for these vehicles can be produced from a variety of energy sources, including fossil fuels, renewables, and nuclear energy. In the near term, the most economical approach is to manufacture hydrogen from natural gas at individual refueling stations. The projected cost is about $1.50 per gallon of gasoline equivalent on a mile per gallon basis, but fuel cost would vary with natural gas prices. As the use of hydrogen grows, it can be produced more economically at large centralized plants and distributed to refueling stations via pipelines or trucks, much like gasoline supplies.

### AT Unsafe – General

#### Hydrogen cars being tested for safety, includes indestructible features

Greg Blencoe, October 2009, Moving beyond oil begging in 2015, Hydrogen Car Revolution, <http://www.h2carblog.com/?p=261>, SJ

Hydrogen vehicles are on the road today, because they are safe. Here is some information from several car companies about the safety of hydrogen fuel cell vehicles. The following excerpt from a SearchChicago [article](http://searchchicago.suntimes.com/autos/research/ciminillo/752046%2Csrch-auto-JC012208_2.article) published in January 2008 discusses GM’s effort to make their high-pressure hydrogen tanks safe: “The idea is to make the tanks virtually indestructible. During testing, the tanks have been shot and dropped out of airplanes among other things to ensure overall safety.” Furthermore, Toyota mentions on page 6 of the [Toyota FCHV book](http://www.toyotaaruba.com/toyota/readBlob.do?id=134) that: “Crash testing of the Toyota FCHV was particularly rigorous, with the addition of new safety confirmation tests for high voltage components and for protection against hydrogen leakage. If a collision occurs, sensors in the Toyota FCHV’s front, rear and sides detect impact and instantly shut the valves on the high-pressure hydrogen tanks. For additional safety, the valves are also closed if leakage is detected by any of the hydrogen sensors placed at multiple locations within the vehicle, namely, on the Toyota FC (fuel cell) Stack, the upper end of the hood, the high-pressure hydrogen tanks and the cabin ceiling. The high-pressure hydrogen tanks are designed for maximum safety to avoid rupture even if the vehicle suffers a rear-end collision.” Steve Ellis, Honda manager of alternative fuel vehicles, made the following [comment](http://www.hybridcars.com/hydrogen/honda-fcx-interview.html) about the safety of hydrogen cars in a HybridCars interview in January 2007: “People need to understand that hydrogen fuel cell vehicles are safe. We wouldn’t have handed the keys to the hydrogen car to an ordinary family if we didn’t think it was safe.” And here is some information on Honda’s [website](http://automobiles.honda.com/fcx-clarity/safety.aspx) about the safety of the Honda FCX Clarity hydrogen fuel cell car which includes the following excerpt: “We believe high safety standards can apply to all vehicles—even the groundbreaking ones. And the FCX Clarity [Hydrogen Cars] passed the same tests—those required by NHTSA and U.S. federal safety standards—as other Honda models have endured. So you can drive the FCX Clarity [Hydrogen Cars] with confidence.” Moreover, here is an excerpt from a Galway Independent (Ireland) [article](http://www.galwayindependent.com/motoring/motoring/kia-plans-fuel-cell-cars-for-2012-/) that was published in July that discusses the safety of Kia hydrogen fuel cell vehicles: “Kia has successfully completed front, side and rear crash-safety tests with fuel cell versions of the Sportage and Borrego. It has also satisfactorily tested cars for fire safety.” Furthermore, the following [link](http://www.evworld.com/article.cfm?storyid=482) (you will need to scroll down a little) has pictures of a gasoline car and a hydrogen car on fire. You can decide for yourself which one is safer.

#### Manufacturers are designing even safer H-cars

Drive Clean, 2012, "Hydrogen fuel cell," <http://www.driveclean.ca.gov/Search_and_Explore/Technologies_and_Fuel_Types/Hydrogen_Fuel_Cell.php>,

Fuel cell vehicles are being developed with levels of safety, comfort, and cost comparable to those of a conventional vehicles. Like all fuels, hydrogen has energy and needs to be treated with respect. Because hydrogen is lighter than air it disperses very quickly. Manufacturers are committed to building fuel cell vehicles that meet or exceed safety standards.

### AT Unsafe – Hindenburg Example

#### The Hindenburg example is wrong – H-cars are safe

Jim Motavalli and Peter Hoffman, 2/2/12, New York Times, "Questions for Peter Hoffman: A hydrogen advocate whose time may have come," <http://www.nytimes.com/2012/02/02/automobiles/wheels/a-hydrogen-advocate-whose-time-has-come.html>,

Q. What about the safety issue? The Hindenburg disaster still looms large for many. A. From what I understand, these cars are as safe as they can be — as safe as gasoline cars. Even if hydrogen tanks leak, the gas just evaporates into the air, and there are extensive safety and warning devices built into the cars. In an accident, the hydrogen supply is cut off and valves automatically vent it in case of a pressure build-up. The concern will always be there, let’s face it, because hydrogen is very flammable. But the automakers tell me it won’t be an issue. I remember seeing a BMW film in the 1980s in which they dropped hydrogen tanks off a gantry, cooked them over a fire and tried to pierce them with a device. Nothing happened.

### AT No Pipelines

#### The plan will encourage private companies to build fuel pipelines

Richard Lai, 5/11/11, Engadget, "Shell opens America's first pipelined hydrogen-fueling station in Southern California," <http://www.engadget.com/2011/05/11/shell-opens-americas-first-pipelined-hydrogen-fueling-station-i/>,

Residents of SoCal's Torrance should consider themselves lucky, as they're now living in America's first-ever city to have a pipelined hydrogen-fueling station. You can thank Shell and Toyota for picking up this government-funded green project. Sure, while the few other hydrogen stations still rely on delivery by supply truck (presumably running on diesel, ironically), this nevertheless marks a new milestone for our squeaky clean fuel, and it's only a matter of time before more stations get piped up to Air Products' hydrogen plants. If there's any indication of a time frame, Wired reminds us that 2015 should see the arrival of many new mass-market hydrogen cars from Toyota, Honda, and Mercedes-Benz. Not long to go now, fellow tree huggers.

#### The number of pipelines is increasing now

DOE 2008

(Department of Energy), EERE, “Current Technology”, Pipeline

12/12/2008, <http://www1.eere.energy.gov/hydrogenandfuelcells/delivery/current_technology.html>, A.F.

Approximately 700 miles of hydrogen pipelines are currently operating in the United States (compared to more than one million miles of natural gas pipelines nationwide). Owned by merchant hydrogen producers, these pipelines are located where large hydrogen users, such as petroleum refineries and chemical plants, are concentrated (for example, in the Gulf Coast region). Transporting gaseous hydrogen via existing pipelines is currently the lowest-cost option for delivering large volumes of hydrogen. The high initial capital costs of new pipeline construction, however, constitute a major barrier to expanding hydrogen pipeline delivery infrastructure. Research is also focused on overcoming other technical concerns related to pipeline transmission, including the potential for hydrogen to embrittle the steel and welds used to fabricate the pipelines; the need to control hydrogen permeation and leaks; and the need for lower cost, more reliable, and more durable hydrogen compression technology. One possibility for rapidly expanding the hydrogen delivery infrastructure is to adapt part of the natural gas delivery infrastructure to accommodate hydrogen. Converting natural gas pipelines to carry a blend of natural gas and hydrogen (up to about 20% hydrogen) may require only modest modifications to the pipeline; converting existing natural gas pipelines to deliver pure hydrogen may require more substantial modifications. Current research and analyses are examining both approaches. Another possible delivery process involves producing a liquid hydrogen carrier at a central location, pumping it through pipelines to distributed refueling stations, and processing the carrier on-site to produce hydrogen for dispensing at the station. Ethanol, made from renewable resources with near-zero net greenhouse gas emissions, is among the hydrogen carriers under consideration. Liquid hydrogen carriers offer the potential of using existing pipeline and truck infrastructure technology for hydrogen transport.

#### Existing pipelines could be used

 [Amory Lovins, CEO of Rocky Mountain Institute. "Twenty Hydrogen Myths". 20 June 2003](http://www.rmi.org/images/PDFs/Energy/E03-05_20HydrogenMyths.pdf) - JC

"Myth #5. Hydrogen can’t be distributed in existing pipelines, requiring costly new ones. If remote, centralized production of hydrogen eventually did prove competitive or necessary, as this myth assumes, then existing gas transmission pipelines could generally be converted to hydrogen service, e.g. by adding polymer-composite liners, similar to those now used to renovate old water and sewer pipes, plus a hydrogen-blocking metallized coating or liner (analogous to those used in composite hydrogen tanks), and by converting the compressors."

### AT Short Range

#### H-cars have a range of 300 miles on a single fill-up

Jim Motavalli and Peter Hoffman, 2/2/12, New York Times, "Questions for Peter Hoffman: A hydrogen advocate whose time may have come," <http://www.nytimes.com/2012/02/02/automobiles/wheels/a-hydrogen-advocate-whose-time-has-come.html>,

Q. Will consumers accept fuel-cell cars? A. The people who have driven them are happy, but of course they tend to be hydrogen supporters. They say the cars are smooth and convenient to use, accelerate well and refuel very quickly, which is a big selling point. The one issue that disappoints people about battery electrics is range, and that’s not an issue for fuel-cell cars, which often travel 300 miles on a tank of hydrogen.

### AT No Demand – Unpopular

#### Hydrogen fuel cells are gaining popularity

“Hydrogen could be used as an effective energy storage method” By Erin **Kilgore** editor at hydrogen fuel news .com – **June 5, 2012** <http://www.hydrogenfuelnews.com/hydrogen-could-be-used-as-an-effective-energy-storage-method/854068/> LSV

Issue of storage begins to attract more attention Efficient energy storage has long been an issue that has kept the progress of alternative energy stagnant. As alternative energy gains more attention, the issue of storage is becoming a more important subject. Researchers all over the world have begun to tackle the issues that relate to storage and while many have found success through various methods, efficient storage still remains a problem. A new report from Frost & Sullivan, a research and consulting firm, suggests that hydrogen may be the key to solving the problem of energy storage. Report suggests that the inherent properties of hydrogen make it a viable energy storage mechanism There are currently four options that have emerged as effective energy storage methods. Hydrogen is the least efficient among these options but may be the most effective. The report notes that hydrogen has automatic controls built into it, allowing it to respond to changes in environment quickly. This inherent feature of hydrogen enabled the rapid storage and release of energy. It also means that hydrogen has the potential to correct problems in energy storage systems as it has a response time of less than one minute. Hydrogen boasts of various uses apart from energy production Hydrogen has been growing in popularity recently, mostly because of the increased popularity of hydrogen fuel cells. Fuel cells have taken the auto industry by storm, where they are being used to power new vehicles. Fuel cells produce hydrogen gas through a process known as electrolysis. After its production, the gas is often used to generate electricity, but this is not the only use of hydrogen. The gas can also be used in utility-scale storage of energy. Efficient storage expected to bring rapid growth to alternative energy If the issue of efficient energy storage can be resolved, alternative energy is expected to experience rapid acceleration in terms of application and development. The hydrogen market could experience growth as a result of heightened attention for its uses in storage as well. Until efficient storage is accomplished, however, the growth of alternative energy is expected to be sluggish.

### AT Cost – Materials/Metals

#### Material costs for H-cars is decreasing

 Tollefson ’10 , Jeff. "Hydrogen Vehicles: Fuel of the Future?" *Nature.com*. Nature Publishing Group, 29 Apr. 2010. Web. 25 June 2012. <http://www.nature.com/news/2010/290410/full/4641262a.html>. PH

Engineers are also cutting back on the use of expensive catalysts. General Motors' fuel-cell assembly uses roughly 80 grams of platinum to split electrons and protons from hydrogen atoms. At the current platinum price of about US$60 per gram, this totals some $4,800. But General Motors officials say that their next fuel cell will use less than 30 grams of platinum, thanks to using ever thinner coats of the metal. And the company's scientists are continuing to experiment with measures such as increasing the surface area of the catalyst by introducing more texture at the nanoscale. Within a decade, they expect to get platinum use to below 10 grams, which would make the fuel cells competitive with today's catalytic converters in terms of precious-metal use.

### AT Not Feasible – Germany Proves

#### Hydrogen infrastructure and Hydrogen based economy empirically feasible

CimateWire,2011(Scientific American, “Will Germany Become First Nation with a Hydrogen Economy?”)-JW

Germany will become the first country completely accessible to fuel cell vehicles in 2015, when carmaker Daimler and the Linde technology group will build 20 new hydrogen filling stations. The result will quadruple the number of public stations available and make it possible for a fuel cell vehicle to reach any location in the country. Daimler's plans to start mass-producing fuel cell vehicles next year were severely limited by the lack of public hydrogen filling stations in Germany. The carmaker realized that if its vision of battery-powered electric vehicles gaining mass appeal in tandem with fuel cell electrics was to come true, it needed to so something about the lack of hydrogen infrastructure. Installation of the hydrogen refueling pumps will begin next year at existing gas stations currently operated by various oil companies. Daimler and Linde said their investment would be "in the tens of millions of euros," declining to be more specific. They said they were open to teaming up with other potential partners in the fuel, energy and automotive industry."The time is ripe for electric vehicles powered by [fuel cells](http://www.scientificamerican.com/topic.cfm?id=fuel-cells), and we must now address the subject of the relevant infrastructure," said Dieter Zetsche, Daimler's chairman and the director of its Mercedes-Benz Cars unit. "Car drivers can only benefit from the advantages of technology if there are enough hydrogen filling stations available: long ranges, short refueling times and no local emissions.”Fuel cell vehicles are essentially a different kind of electric car. Fuel cells generate electricity in a chemical reaction between hydrogen and oxygen, which yields only pure [water](http://www.scientificamerican.com/topic.cfm?id=water) vapor. In a battery electric, the electricity is already stored in the battery. In both cases, the electricity powers the vehicle's engine. Of the 30 hydrogen filling stations operating now in Germany, only seven are available to the public. According to Daimler, you would need at least five to 10 filling stations to supply a major city. While building 20 new stations over three years won't accomplish that, it will allow the connection of major cities like Berlin, Hamburg, Stuttgart and Munich with hydrogen filling stations along main traffic routes. This will make it possible for a fuel cell vehicle to reach any distant corner of Germany without fear of running out of hydrogen before finding another refueling station. It is as close as it gets, for now, to a comprehensive network of hydrogen filling stations and will mean that Germany will have the most advanced hydrogen infrastructure in the world.

### AT Hydrogen Inefficient

#### Hydrogen is efficient - the tech exists and works.

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

Hydrogen is a not a resource (like petroleum), it is an energy carrier that must be manufactured (or derived) from a primary energy resource. Hydrogen is relatively inexpensive to manufacture at large scales; it can be produced from natural gas or coal at a cost on par with the price of petroleum. Steam reforming of methane is currently the cheapest and (therefore) most common way to manufacture hydrogen. Electricity can be used to create hydrogen via electrolysis. Emissions from steam methane reforming are essentially limited to carbon dioxide, but even these could be mitigated by sequestering the carbon dioxide underground in geological formations (Herzog et al., 2000; Parson and Keith, 1998). Onboard energy conversion of hydrogen can be accomplished several ways. Hydrogen-powered gas turbines have been investigated since the mid-1950s and commercial versions are now available. Internal combustion engines that use hydrogen have been tested. These technologies vary only slightly from commercial natural gas engines and present no significant technological challenges (Das, 2002; Van Blarigan, 1998). An interesting feature of these two technologies is that each can operate on a mixture of hydrogen and natural gas (sometimes called hythane), which is another method for introducing hydrogen as a transportation fuel, assuming natural gas vehicles (Norbeck et al., 1999; Sierens and Rosseel, 2000). Lastly, of course, fuel cells can create usable energy from hydrogen fuel at great efficiencies, although their costs are very high (Hanisch, 2000; Lave et al., 2000). Direct-hydrogen fuel cells have essentially no emissions other than water, while hydrogen-powered turbines and engines have extremely low emissions.

### Alt Solvency Mechanism?

#### Starting small is key to ensuring market efficiency – weeds out uncompetititive technologies – must come BEFORE investment in infrastructure.

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

One way to reduce the cost of the introduction of hydrogen fuel is to limit it to a single mode, in line with the notion of strategic niche management discussed above. If an entire mode shifts to hydrogen, competitive pressures will act to reduce costs and improve performance. Before commitments in vehicles and infrastructure are made for a wide range of transportation modes, it would be better to start small, to let innovation and competition weed out lower-performance technologies before risking broader disruptions of the transportation system.

#### Starting with only HDV infrastructure is key to market efficiency – solves better over the long run

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

4.3. Infrastructure One of the largest and most obvious issues for hydrogen fuel is to minimize the costs of the delivery system. In general, larger refueling sites would be preferable, especially those close to the point of hydrogen production, which today are refineries. The more intensively these sites are used, the greater their cost is spread over different users and the lower the marginal cost for any individual user. In addition, the fewer the number of refueling sites that an application needs the better. Vehicles that operate either within a very small geographic area or only along well-defined point-to-point routes tend to need smaller refueling infrastructures. Commercial vehicles (e.g. a local courier-delivery fleet) sometimes use a single, centralized fueling facility (although this is becoming less common, see Nesbitt and Sperling, 1998) or utilize a small number of automated, “key-lock” stations designed for large vehicles and operated under contract.

#### Limiting the size of refueling infrastructure is key – Investing in limited HDV infrastructure first solves better in the long term.

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

A key aspect of any strategy to introduce hydrogen as a transportation fuel first in HDV freight modes would be the potential spillovers of technological innovation into other modes while keeping costs low, mainly by limiting the size of the refueling infrastructure. While the marine freight mode appears to be a particularly good candidate for the reasons given in this analysis, a more general conclusion is that freight modes are uniformly more likely to be lower-cost avenues for hydrogen fuel introduction than LDVs. Technological solutions to the fuel handling and storage problems of hydrogen would be particularly valuable. This strategy would also address part of the “chicken and egg” issue—it would result in a sparse but nation-wide hydrogen fuel infrastructure at truckstops that automobile drivers could rely on for long-distance trips. Thus, the lowest-cost approach to hydrogen-powered automobiles may in fact start with the deployment of ships, trains, and trucks that use the fuel first.

#### Infrastructure Niches like HDV’s are key to prevent social disruption and technological inefficiency – CP solves the aff better and avoids economy turns.

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

Our review suggests that the overarching goal of introducing hydrogen as a transportation fuel should be to develop the cluster of technologies and practices associated with its use at least public cost and social disruption. This will reduce the cost and other social disruptions of wide-scale use, should that be the outcome of either market or policy choices. In committing public funds and political will to introducing hydrogen fuel vehicles and infrastructure for a wide range of transportation modes, the best strategy would be to start with protected niches, and to let innovation and competition weed out lower-performance technologies before risking broader disruptions of the transportation system. A protected niche would allow for companies to learn by doing in the design and operation of hydrogen-fueled vehicles. Relying on demonstration projects alone to spur the necessary technological innovation is inadequate because insufficient incentive or experience exists to achieve real learning by doing and advance the hydrogen technology cluster effectively. The guidelines developed here suggest that the cost of introducing hydrogen fuel can be minimized by selecting a mode that uses a small number of relatively large vehicles, which are owned by a small number of technologically sophisticated firms and operated by professional crews, and which are used intensively along a limited number of point-to-point routes or operated within a small geographic area. In addition, technological innovation in vehicle design will take place most quickly in modes where individual vehicles are produced to order and each receives significant engineering attention (not those manufactured in vast quantities on assembly lines). The immediate environmental benefits of introducing hydrogen fuel will occur in modes that have little or no pollution regulations applied to them. These results suggest that heavy-duty modes would be a less costly way to introduce hydrogen as a transportation fuel and a more effective way to advance hydrogen-related technologies so that they could be used widely in light-duty vehicles. Using the example of international marine freight, we identify interesting opportunities as well as considerable barriers. Similar complex trade-offs are likely to appear for every mode, and these need to be more systematically evaluated. More generally, freight modes appear to be more consistent than LDV with a strategic approach for early public efforts to introduce hydrogen into transportation.

## Global Warming Adv

### UQ – Emissions Increasing

#### Carbon emissions are at an all-time high

Simon Rogers and Fiona Harvey, Simon Rogers is an editor for guardian.co and Fiona Harvey is a writer for guardian.co and used to be a writer for Financial Times Thursday 21 June 2012 “Global carbon emissions rise is far bigger than previous estimates New analysis by the Guardian shows the world emitted a record 31.8bn tonnes of carbon from energy consumption in 2010” http://www.guardian.co.uk/environment/2012/jun/21/global-carbon-emissions-record

Carbon dioxide emissions have risen by even more than previously thought, according to new data analysed by the Guardian, casting doubt on whether the world can avoid dangerous climate change. The data has emerged as governments met in Rio de Janeiro to finalise the outcome of the Rio+20 conference, aimed at ensuring that economic growth does not come at the expense of irreparable environmental degradation, but which activists say has not achieved enough to stave off severe environmental problems. Global carbon emissions from energy are up 48% on 1992, when the original Earth summit took place in Rio – a historic summit at which governments agreed to limit emissions in order to prevent dangerous climate change. In 2010, the latest year for which figures have been compiled, the US Energy Information Administration (EIA) said the world emitted 31.8bn tonnes of carbon from energy consumption. That represents a climb of 6.7% on the year before and is significantly higher than the previous best estimate, made by the International Energy Agency last year, that in 2010 a record 30.6 gigatonnes of carbon dioxide were released from burning fossil fuel. Increases in fossil fuel use of this magnitude are likely to carry the world far beyond the temperature rise of 2C by 2050 that scientists have estimated is the limit of safety, beyond which climate change is likely to become catastrophic and irreversible. According to the new EIA data, carbon dioxide emissions from the US have resumed their rise, after a brief blip caused by the financial crisis and recession in 2008. That increase came despite the much-vaunted switch from coal to shale gas – with its lower emissions than coal when burned for energy.

### Global Warming Adv – Solvency

#### H-cars would solve warming

Scientific American ‘08. "Looking at Hydrogen to Replace Gasoline in Our Cars: Scientific American." Looking at Hydrogen to Replace Gasoline in Our Cars: Scientific American. Scientific American, 3 July 2008. Web. 25 June 2012. <http://www.scientificamerican.com/article.cfm?id=can-hydrogen-replace-gas>. PH

The benefits of ditching [fossil fuels](http://www.scientificamerican.com/topic.cfm?id=fossil-fuels) for hydrogen are many, or course. Burning fossil fuels like coal, natural gas and oil to heat and cool our buildings and run our vehicles takes a heavy toll on the environment, contributing significantly to both local problems like elevated particulate levels and global ones like a warming climate. The only by-product of running a hydrogen-powered fuel cell is oxygen and a trickle of [water](http://www.sciam.com/article.cfm?id=is-it-true-that-hot-water), neither of which will cause any harm to human health or the environment.

#### H-cars produce zero emissions – even if coal is used to produce the hydrogen fuel it is still better than gasoline

Drive Clean, 2012, "Hydrogen fuel cell," <http://www.driveclean.ca.gov/Search_and_Explore/Technologies_and_Fuel_Types/Hydrogen_Fuel_Cell.php>,

When operating directly with hydrogen, there are no polluting emissions and no greenhouse gases from a fuel cell – only water and heat. If the hydrogen is generated by reforming fossil fuels, some greenhouse gases are released, but much less than the amount produced by conventional vehicles. In addition to these benefits, fuel cells could dramatically reduce urban air pollution, decrease oil imports, reduce the trade deficit and produce American jobs.

#### Hydrogen fuel key to eliminating problems caused by current exhaust

Jacobson, 2005

M. Jacobson, Department of Civil and Environmental Engineering, Stanford University, Cleaning the Air and Improving Health with Hydrogen Fuel-Cell Vehicles, *Science Magazine*, Vol. 308 no. 5730, 18 May 2005, pp. 1901-1905, <http://www.sciencemag.org/content/308/5730/1901.short>, E.L.

Converting all U.S. onroad vehicles to hydrogen fuel-cell vehicles (HFCVs) may improve air quality, health, and climate significantly, whether the hydrogen is produced by steam reforming of natural gas, wind electrolysis, or coal gasification. Most benefits would result from eliminating current vehicle exhaust. Wind and natural gas HFCVs offer the greatest potential health benefits and could save 3700 to 6400 U.S. lives annually. Wind HFCVs should benefit climate most. An all-HFCV fleet would hardly affect tropospheric water vapor concentrations. Conversion to coal HFCVs may improve health but would damage climate more than fossil/electric hybrids. The real cost of hydrogen from wind electrolysis may be below that of U.S. gasoline.

#### Hydrogen fuel readily available and environment friendly

**Koroneos, 2004**

C. Koroneos, Laboratory of heat transfers and environmental engineering, Aristotle University of Thessaloniki, “Life Cycle Assessment of Hydrogen Fuel Production Processes,” *International Journal of Hydrogen Energy,* Volume 29 Issue 14, 8 March 2004, pp. 1443-1450, <http://www.sciencedirect.com/science/article/pii/S0360319904000655>, E.L.

Hydrogen is anticipated to join electricity as the foundation for a globally sustainable energy system using renewable energy. Hydrogen can be produced safely, is environmentally friendly, and versatile, and has many potential energy uses, including powering non-polluting vehicles, heating homes and offices, and fueling aircraft. Hydrogen is the lightest and most abundant element in the universe. The element is very reactive chemically and occurs as a free element only in trace amounts. It is found in water (H2O), fossil fuels and all plants and animals. Hydrogen gas (H2) is not a primary fuel in the same sense as natural gas, oil, and coal. No wells produce hydrogen gas from geologically identified deposits. Rather, hydrogen is an energy carrier, like electricity. Hydrogen is a secondary form of energy, produced using other primary energy sources, such as natural gas, coal, or solar technologies. More than 8 million tons of hydrogen are consumed in the United States each year, primarily by the chemical and petroleum industries. While use of hydrogen in space shuttle missions is today the only significant fuel application, this use represents only about 0.1% of the hydrogen consumed. Production of hydrogen from water—either through electrolysis or direct photochemical reactions—is the most likely long-term source. No carbon is involved, so using hydrogen produced from renewable or nuclear energy as an energy resource would eliminate carbon monoxide and CO2 emissions and reduce greenhouse warming. Direct burning of hydrogen may still produce small amounts of nitrogen oxides, however.

#### Hydrogen gas solves harmful emissions

"Fuel Cell Vehicles." *Fuel Cell Vehicles***.** U.S Department of Energy, **June**-July 2012**.** Web. 25 June 2012. <http://www.fueleconomy.gov/feg/fuelcell.shtml>. **JC**

Fuel cell vehicles (FCVs) have the potential to significantly reduce our dependence on foreign oil and lower harmful emissions that cause climate change**.** FCVs run on hydrogen gas rather than gasoline and emit no harmful tailpipe emissions**.** Several challenges must be overcome before these vehicles will be competitive with conventional vehicles, but the potential benefits of this technology are substantial.

### Global Warming Adv – AT Making Hydrogen Increases Emissions

#### Natural gas is used to make H-fuel – that means very low emissions

Drive Clean, 2012, "Hydrogen fuel cell," <http://www.driveclean.ca.gov/Search_and_Explore/Technologies_and_Fuel_Types/Hydrogen_Fuel_Cell.php>,

Hydrogen can be produced from many domestic feed stocks, such as natural gas and renewable resources like water, using electrolysis. While the most common method of making hydrogen, using natural gas reformation, results in fewer smog-forming and greenhouse gas emissions than traditional vehicles, California is working to increase use of renewable production sources.

#### AT “H-production from Coal -> Warming”

#### Even if H-fuel comes from coal it is still produces less emissions

US Department of Energy 12

[US Department of Energy, The official U.S. government source for fuel economy information, “Benefits and Challenges”, http://www.fueleconomy.gov/feg/fcv\_benefits.shtml]

Highway vehicles emit a significant share of the air pollutants that contribute to smog and harmful particulates in the U.S. FCVs powered by pure hydrogen emit no harmful pollutants. If the hydrogen is produced from fossil fuels, some pollutants are produced, but much less than the amount generated by conventional vehicle tailpipe emissions. Reduced Oil Dependence FCVs could [reduce our dependence](http://www.fueleconomy.gov/feg/oildep.shtml) on foreign oil since hydrogen can be derived from domestic sources, such as natural gas and coal, as well as renewable resources such as water. That would make our economy less dependent on other countries and less vulnerable to oil price shocks from an increasingly volatile oil market.

#### Coal plants are adopting carbon capture tech – means no additional pollution

Worldwatch Institute, 2011, "hydrogen: Fuel for our future?," http://www.worldwatch.org/node/4516,

On July 18, BP and GE announced plans to jointly develop up to 15 new hydrogen power plants for generating electricity over the coming decade. The hydrogen will be derived from fossil fuels, including coal and natural gas. While the plants will emit greenhouse gases, the companies will employ carbon capture technologies they claim will reduce carbon dioxide (CO2) emissions by 90 percent. Although the operations will not be pollution-free, some environmentalists welcome the companies’ investment in hydrogen technology as a key development in bringing about a hydrogen economy.

### Turn – Positive Feedback Loop

#### H-cars emit water vapor – that will trigger a positive feedback loop and worsen warming

NOAA, 2005, National Oceanic and Atmospheric Administration, Greenhouse Gases,

December 1, 2005

http://lwf.ncdc.noaa.gov/oa/climate/gases.html

Water Vapor is the most abundant greenhouse gas in the atmosphere, which is why it is addressed here first. However, changes in its conentration is also considered to be a result of climate feedbacks related to the warming of the atmosphere rather than a direct result of industrialization. The feedback loop in which water is involved is critically important to projecting future climate change, but as yet is still fairly poorly measured and understood. As the temperature of the atmosphere rises, more water is evaporated from ground storage (rivers, oceans, reservoirs, soil). Because the air is warmer, the relative humidity can be higher (in essence, the air is able to 'hold' more water when its warmer), leading to more water vapor in the atmosphere. As a greenhouse gas, the higher concentration of water vapor is then able to absorb more thermal IR energy radiated from the Earth, thus further warming the atmosphere. The warmer atmosphere can then hold more water vapor and so on and so on. This is referred to as a 'positive feedback loop'. However, huge scientific uncertainty exists in defining the extent and importance of this feedback loop. As water vapor increases in the atmosphere, more of it will eventually also condense into clouds, which are more able to reflect incoming solar radiation (thus allowing less energy to reach the Earth's surface and heat it up). The future monitoring of atmospheric processes involving water vapor will be critical to fully understand the feedbacks in the climate system leading to global climate change. As yet, though the basics of the hydrological cycle are fairly well understood, we have very little comprehension of the complexity of the feedback loops. Also, while we have good atmospheric measurements of other key greenhouse gases such as carbon dioxide and methane, we have poor measurements of global water vapor, so it is not certain by how much atmospheric concentrations have risen in recent decades or centuries, though satellite measurements, combined with balloon data and some in-situ ground measurements indicate generally positive trends in global water vapor.

### AT Alt Cause: Other Countries – Modeling Solves

#### BY TAKING ACTION, THE US WILL ENCOURAGE OTHER COUNTRIES TO DO THE SAME

Gingrich and Maple, 2008(Newt Gingrich, former speaker of the U.S. House of Representatives, and Terry L. Maple, Professor of Conservation of Behavior at the Georgia Institute of Technology, “Forging a New, Bipartisan Environmental Movement”, “Issues in Science and Technology”, Jan 9 2008, http://www.issues.org/24.2/p\_gingrich.html#, Accessed June 25 2008)

We believe that many if not all environmental challenges can be resolved by developing new and better technology and by generating best practices in environmental stewardship. By leading the world in the production of innovative environmental tools, the United States will produce the renewable technology that will eventually provide clean energy to the rest of the world. Developing nations, especially China and India, need U.S. expertise to help solve their escalating emissions problems. With the Olympic Games approaching, the Chinese government is frantic to deliver clean air to the world’s best athletes and the masses of visiting spectators. It is likely that China’s struggle to control ambient environmental quality will dominate the daily news as the Olympic competition unfolds. Likewise, the United States’ reputation as a global leader depends on decisive leadership on many pressing environmental fronts, including the pursuit of new international agreements that are more realistic and effective than the Kyoto Accords.

### AT Irreversible

#### Even if they are 100% right, top climate scientists say we should air on the side of curbing emissions

Richard Harris, 1/26/09, NPR, "global warming is irreversible, study says," <http://www.npr.org/templates/story/story.php?storyId=99888903>

Climate change is essentially irreversible, according to a sobering new scientific study. As carbon dioxide emissions continue to rise, the world will experience more and more long-term environmental disruption. The damage will persist even when, and if, emissions are brought under control, says study author Susan Solomon, who is among the world's top climate scientists. "We're used to thinking about pollution problems as things that we can fix," Solomon says. "Smog, we just cut back and everything will be better later. Or haze, you know, it'll go away pretty quickly." That's the case for some of the gases that contribute to climate change, such as methane and nitrous oxide. But as Solomon and colleagues suggest in a new study published in the Proceedings of the National Academy of Sciences, it is not true for the most abundant greenhouse gas: carbon dioxide. Turning off the carbon dioxide emissions won't stop global warming. "People have imagined that if we stopped emitting carbon dioxide that the climate would go back to normal in 100 years or 200 years. What we're showing here is that's not right. It's essentially an irreversible change that will last for more than a thousand years," Solomon says. This is because the oceans are currently soaking up a lot of the planet's excess heat — and a lot of the carbon dioxide put into the air. The carbon dioxide and heat will eventually start coming out of the ocean. And that will take place for many hundreds of years. Solomon is a scientist with the National Oceanic and Atmospheric Administration. Her new study looked at the consequences of this long-term effect in terms of sea level rise and drought. If we continue with business as usual for even a few more decades, she says, those emissions could be enough to create permanent dust-bowl conditions in the U.S. Southwest and around the Mediterranean. "The sea level rise is a much slower thing, so it will take a long time to happen, but we will lock into it, based on the peak level of [carbon dioxide] we reach in this century," Solomon says. The idea that changes will be irreversible has consequences for how we should deal with climate change. The global thermostat can't be turned down quickly once it's been turned up, so scientists say we need to proceed with more caution right now. "These are all ... changes that are starting to happen in at least a minor way already," says Michael Oppenheimer of Princeton University. "So the question becomes, where do we stop it, when does all of this become dangerous?" The answer, he says, is sooner rather than later. Scientists have been trying to advise politicians about finding an acceptable level of carbon dioxide in the atmosphere. The new study suggests that it's even more important to aim low. If we overshoot, the damage can't be easily undone. Oppenheimer feels more urgency than ever to deal with climate change, but he says that in the end, setting acceptable limits for carbon dioxide is a judgment call. "That's really a political decision because there's more at issue than just the science. It's the issue of what the science says, plus what's feasible politically, plus what's reasonable economically to do," Oppenheimer says. But despite this grim prognosis, Solomon says this is not time to declare the problem hopeless and give up. "I guess if it's irreversible, to me it seems all the more reason you might want to do something about it," she says. "Because committing to something that you can't back out of seems to me like a step that you'd want to take even more carefully than something you thought you could reverse."

### GW Bad: Ice Age

#### Warming will cause an ice age by shutting down the North Atlantic Current

ZALESKI ‘04

[Rob, Capital Times, LN, 3/13]

Now, a flurry of controversial articles - including one in Fortune magazine titled "Climate Collapse: The Pentagon's Weather Nightmare" and another on Commondrearns.org by international commentator Thom Hartmann -- suggests we may be facing those consequences far sooner than anyone imagined. How much sooner? Well, in the worst case scenario, maybe two years, *according* to Hartmann. (Seriously, folks.) It's a complicated thesis, but the abbreviated version goes like this: "If enough cold. fresh water coming from the melting polar ice caps and the melting glaciers of Greenland flows into the northern Atlantic," Hartmann maintains. "it will shut down the Gulf Stream, which keeps Europe and northeastern North America warm. `The worst-case scenario would be a full-blown return of the last ice age - in a period as short as two to three years from its onset. And the mid-case scenario would be a period like the little ice age' of a few centuries ago that disrupted worldwide weather patterns, leading to extremely harsh winters, droughts, worldwide desertification, crop failures and wars around the world."

#### Ice age causes extinction

Phil Chapmen (Staff writer for the Australian, 4/23/08, “Sorry to ruin the fun, but an ice age cometh,” http://www.theaustralian.news.com.au/story/0,25197,23583376-7583,00.html)

The bleak truth is that, under normal conditions, most of North America and Europe are buried under about 1.5km of ice. This bitterly frigid climate is interrupted occasionally by brief warm interglacials, typically lasting less than 10,000 years. The interglacial we have enjoyed throughout recorded human history, called the Holocene, began 11,000 years ago, so the ice is overdue. We also know that glaciation can occur quickly: the required decline in global temperature is about 12C and it can happen in 20 years. The next descent into an ice age is inevitable but may not happen for another 1000 years. On the other hand, it must be noted that the cooling in 2007 was even faster than in typical glacial transitions. If it continued for 20 years, the temperature would be 14C cooler in 2027. By then, most of the advanced nations would have ceased to exist, vanishing under the ice, and the rest of the world would be faced with a catastrophe beyond imagining.

### AT Not Human Caused

## Oil Adv

### UQ – Dependent Now

#### Transportation in the squo is very reliant on foreign oil

McFarlane 2012

Robert McFarlane, Journalist, The Washington Post. “Flexible fuel to end foreign oil dependence”

The Washington Post. 05/30/2012. <http://www.washingtontimes.com/news/2012/may/30/flexible-fuel-to-end-foreign-oil-dependence/>

YA

Our entire transportation system - that is, the vast majority of anything that moves anything from Point A to Point B (i.e., aircraft, trucks, ships and your family automobile) runs on a petroleum product. Oil has become a strategic commodity - a good that if priced extravagantly or if its supply is disrupted literally can bring down the global economy. Yet this year, we will send $400 billion overseas to buy oil whose price is set by the [Organization of the Petroleum Exporting Countries](http://www.washingtontimes.com/topics/organization-of-petroleum-exporting-countries/) ([OPEC](http://www.washingtontimes.com/topics/organization-of-petroleum-exporting-countries/)). In addition, we also will spend an additional $150 billion (about one-third of the [Pentagon](http://www.washingtontimes.com/topics/pentagon/)’s budget) to keep this nonsensical arrangement working. Think how many soldiers’ lives could be saved and jobs created at home if we solved this problem. In sum, for the past 40 years, our country has endured this outrageous national security, economic and environmental problem, all the while whistling past the graveyard, hoping that we will muddle through somehow. And the outrage is on course to persist into the future as far as the eye can see.

### Solvency – Oil Dependence

#### Hydrogen cars can solve our oil dependence

Shepardson 2012

David Shepardson, Journalist, Detroit News. “German, Japan carmakers tout hydrogen fuel at D.C. summit” The Detroit News. 06/19/2012. <http://www.detroitnews.com/article/20120619/AUTO01/206190433/1121/auto01/German--Japan-carmakers-tout-hydrogen-fuel-at-D.C.-summit>

YA

German and Japanese automakers expressed optimism Tuesday about the prospects for hydrogen fuel-cell vehicles as the long-term solution to replacing vehicles that run on oil. At the Washington Fuel Cell Summit in Washington, advocates said the key issue is ensuring enough hydrogen fueling stations, and making sure they serve enough vehicles in a single day. Some stations currently can only fill six vehicles before they need to be refueled. But some stations can get larger tanks that could fuel up to 100 vehicles before needing to refilled. Automakers also must bring costs down for the technology dramatically. By the end of the year there should be eight stations in the Los Angeles area, up from five. "We have to have enough stations," said Sascha Simon, director of advanced product planning for Mercedes-Benz USA. "We want to ensure that this technology is here and ready for prime time." By contrast, there are about 180,000 gas stations nationwide. The [San Francisco](http://www.detroitnews.com/article/20120619/AUTO01/206190433/1121/auto01/German--Japan-carmakers-tout-hydrogen-fuel-at-D.C.-summit) area is about to get its first hydrogen station, which will allow Mercedes-Benz to lease more B-Class F-Cell vehicles. Simon said the company has about 120 fuel cell vehicles worldwide, including 44 in California. Daimler has spent more than $2 billion on fuel cell research since 1994.Simon said the next generation of fuel-cell vehicles coming out in 2015 from Daimler will be more efficient and bigger, and they expect to sell "thousands" in that time frame. Honda Motor Co.'s vice president for government relations, Ed Cohen, said electric vehicles are a "niche" product mainly aimed at urban drivers with short trips. But fuel cells — which have similar refueling times and drive much like gasoline-powered vehicles — are the best solution long-term "as long as the infrastructure is there," he said.

### Dependence Bad – National Security

#### Foreign Oil Dependency Causes The U.S. to Fuel “Dangerous or Unstable Nations”

Lefton and Weiss 10

[Rebecca Lefton, Daniel Weiss, Journalists for AmericanProgress.org, “Oil Dependency Is a Dangerous Habit”, <http://www.google.com/search?client=safari&rls=en&q=union+of+concerned+scientists&ie=UTF-8&oe=UTF-8>]

The United States imported 4 million barrels of oil a day—or 1.5 billion barrels total—from “dangerous or unstable” countries in 2008 at a cost of about $150 billion. This estimate excludes Venezuela, which is not on the State Department’s “dangerous or unstable” list but has maintained a distinctly [anti-American](http://www.washingtonpost.com/wp-dyn/content/article/2007/01/22/AR2007012200178.html) foreign and energy policy. Venezuela is one of the top five oil exporters to the United States, and we imported 435 million barrels of oil from them in 2008. As a major contributor to the global demand for oil the United States is paying to finance and sustain unfriendly regimes. Our demand drives up oil prices on the global market, which oftentimes benefits oil-producing nations that don’t sell to us. The Center for American Progress finds in “[Securing America’s Future: Enhancing Our National Security by Reducing oil Dependence and Environmental Damage](http://www.americanprogress.org/issues/2009/08/pdf/energy_security.pdf),” that “because of this, anti-Western nations such as Iran—with whom the United States by law cannot trade or buy oil—benefit regardless of who the end buyer of the fuel is.” Further, the regimes and elites that economically benefit from rich energy resources rarely share oil revenues with their people, which worsens economic disparity in the countries and at times creates resource-driven tension and crises. The State Department cites oil-related violence in particular as a danger in [Nigeria](http://travel.state.gov/travel/cis_pa_tw/tw/tw_928.html), where more than 54 national oil workers or businesspeople have been kidnapped at oil-related facilities and other infrastructure since January 2008. Attacks by insurgents on the U.S. military and civilians continue to be a danger in [Iraq](http://travel.state.gov/travel/cis_pa_tw/tw/tw_921.html). Our oil dependence will also be increasingly harder and more dangerous to satisfy. In 2008 the United States consumed 23 percent of the world’s petroleum, 57 percent of which was [imported](http://tonto.eia.doe.gov/energy_in_brief/foreign_oil_dependence.cfm). Yet the United States [holds less than 2 percent of the world’s oil reserves](http://www.eia.doe.gov/emeu/international/reserves.html). Roughly 40 percent of our imports came from Canada, Mexico, and Saudi Arabia, but we can’t continue relying on these allies. The majority of Canada’s oil lies in [tar sands](http://greeninc.blogs.nytimes.com/2009/02/19/obama-and-canadas-controversial-oil-patch/), a very dirty fuel, and Mexico’s main oil fields are projected [dry up within a decade](http://www.americanprogress.org/issues/2009/08/pdf/energy_security.pdf). Without reducing our [dependence on oil](http://www.americanprogress.org/issues/2009/08/pdf/energy_security.pdf) we’ll be forced to increasingly look to more antagonistic and volatile countries that pose direct threats to our national security.

### Dependence Bad – Hurts Growth

#### Reducing Oil Dependency Stimulates The Economy

Williford 10

[Sam Williford, 11/9/10, writer for Economic Crisis, “Foreign Oil Dependency Cripples U.S. Economy”’, http://economyincrisis.org/content/foreign-oil-dependency-crippling-us-economy]

Mired in wars to protect our oil supply, faced with high energy costs, and confronted by a massive trade imbalance, reducing our dependency on foreign oil would help stimulate the economy.

“Our oil problems are only going to get worse. Our trade balance is only going to get worse. So we have to slow the growth of U.S. oil consumption, particularly imported oil consumption,” said former Rep. Sherwood Boehlert according to [testimony (pdf file)](http://archives.energycommerce.house.gov/reparchives/108/Hearings/05032006hearing1854/Boehlert.pdf) given to the Energy and Commerce Committee in 2006.   During the first six months of 2010, crude oil consumption averaged 18.9 million barrels per day.  Every year oil imports account for hundreds billions of dollars sent to foreign countries.  In fact, energy imports account for about one-fourth of the trade deficit.  Money being sent overseas is not just dangerous for the economy. For example, when Dubai tried to buy several ports in 2006, it was proven that their money was not being used to buy American goods, but rather America itself.

### Dependence Bad – Resource Wars

#### Lack of Resource Increase Conflict

**Heinberg, 2003** (Richard Heinberg, core faculty member at New College of California, The Party’s Over: Oil, War and the Fate of Industrial Societies, 2003, p. 191

Just as political rivalries within nations will be exacerbated by the energy transition, so those between nations will be heated to the boiling point. Resource conflicts are nothing new. Pre-state societies often fought over agricultural land, fishing or hunting grounds, horses, cattle, waterways, and other resources. As we saw in Chapter 2, most of the wars of the 20th century were also fought over resources — in some cases, oil. But those wars took place during a period of expanding resource extraction; the coming decades of heightened competition over fading energy resource supplies will likely see even more frequent and deadly conflicts.

### AT Oil Dependence Good/Backstopping DA – Heg Turn

#### 1. Oil dependence crushes hegemony

Scire ‘8

Dr. John Scire Adjunct Professor of Political Science at UNR “*Oil dependency, national security*” February 10, 2008 http://www.nevadaappeal.com/article/20080210/OPINION/227691244

DoD's dependency on oil as a primary motor fuel makes military operations much more costly than if it had alternative fuels. Oil dependency also requires that we dedicate military forces to the Persian Gulf area, reducing our ability to use those forces in other places. Furthermore, the U.S. military presence in the Middle East raises the potential for military conflicts with other importing nations as world demand increases and supplies decrease. Our oil dependency also strains military alliances, such as NATO, as members compete for oil. Witness the French and Germans working with the Iranians to increase oil production and Pakistan building a port to import Iranian natural gas while we are trying to stop the Iranian nuclear program. Their need for oil and gas trumps our need to stop Iran from obtaining nuclear weapons. The last and perhaps most serious impact on national security of our oil dependency is that the chronic weakening of the U.S. economic base will inevitably weaken our military; we cannot sustain a strong military with a weak economy.

#### 2. We’ll isolate two impacts:

#### A. Primacy solves their scenarios

Walt 2 (Stephen, Professor of International Affairs at Harvard's Kennedy School of Government. "American Primacy: Its Prospects and Pitfalls." Naval War College Review, Vol. 55, Iss. 2. pg. 9 (20 pages) Spring 2002.

Proquest)

A second consequence of U.S. primacy is a decreased danger of great-power rivalry and a higher level of overall international tranquility. Ironically, those who argue that primacy is no longer important, because the danger of war is slight, overlook the fact that the extent of American primacy is one of the main reasons why the risk of great-power war is as low as it is. For most of the past four centuries, relations among the major powers have been intensely competitive, often punctuated by major wars and occasionally by all-out struggles for hegemony. In the first half of the twentieth century, for example, great-power wars killed over eighty million people. Today, however, the dominant position of the United States places significant limits on the possibility of great-power competition, for at least two reasons. One reason is that because the United States is currently so far ahead, other major powers are not inclined to challenge its dominant position. Not only is there no possibility of a "hegemonic war" (because there is no potential hegemon to mount a challenge), but the risk of war via miscalculation is reduced by the overwhelming gap between the United States and the other major powers. Miscalculation is more likely to lead to war when the balance of power is fairly even, because in this situation both sides can convince themselves that they might be able to win. When the balance of power is heavily skewed, however, the leading state does not need to go to war and weaker states dare not try.8 The second reason is that the continued deployment of roughly two hundred thousand troops in Europe and in Asia provides a further barrier to conflict in each region. So long as U.S. troops are committed abroad, regional powers know that launching a war is likely to lead to a confrontation with the United States. Thus, states within these regions do not worry as much about each other, because the U.S. presence effectively prevents regional conflicts from breaking out. What Joseph Joffe has termed the "American pacifier" is not the only barrier to conflict in Europe and Asia, but it is an important one. This tranquilizing effect is not lost on America's allies in Europe and Asia. They resent U.S. dominance and dislike playing host to American troops, but they also do not want "Uncle Sam" to leave.9 Thus, U.S. primacy is of benefit to the United States, and to other countries as well, because it dampens the overall level of international insecurity. World politics might be more interesting if the United States were weaker and if other states were forced to compete with each other more actively, but a more exciting world is not necessarily a better one. A comparatively boring era may provide few opportunities for genuine heroism, but it is probably a good deal more pleasant to live in than "interesting" decades like the 1930s or 1940s.

#### B. Loss of hegemony causes extinction

Niall Ferguson, July/August 2004. professor of history at Harvard University, senior fellow at the Hoover Institution at Stanford University. “A World Without Power” Foreign Policy http://www.mtholyoke.edu/acad/intrel/afp/vac.htm

So what is left? Waning empires. Religious revivals. Incipient anarchy. A coming retreat into fortified cities. These are the Dark Age experiences that a world without a hyperpower might quickly find itself reliving. The trouble is, of course, that this Dark Age would be an altogether more dangerous one than the Dark Age of the ninth century. For the world is much more populous—roughly 20 times more—so friction between the world's disparate “tribes” is bound to be more frequent. Technology has transformed production; now human societies depend not merely on freshwater and the harvest but also on supplies of fossil fuels that are known to be finite. Technology has upgraded destruction, too, so it is now possible not just to sack a city but to obliterate it. For more than two decades, globalization—the integration of world markets for commodities, labor, and capital—has raised living standards throughout the world, except where countries have shut themselves off from the process through tyranny or civil war. The reversal of globalization—which a new Dark Age would produce—would certainly lead to economic stagnation and even depression. As the United States sought to protect itself after a second September 11 devastates, say, Houston or Chicago, it would inevitably become a less open society, less hospitable for foreigners seeking to work, visit, or do business. Meanwhile, as Europe's Muslim enclaves grew, Islamist extremists' infiltration of the EU would become irreversible, increasing trans-Atlantic tensions over the Middle East to the breaking point. An economic meltdown in China would plunge the Communist system into crisis, unleashing the centrifugal forces that undermined previous Chinese empires. Western investors would lose out and conclude that lower returns at home are preferable to the risks of default abroad. The worst effects of the new Dark Age would be felt on the edges of the waning great powers. The wealthiest ports of the global economy—from New York to Rotterdam to Shanghai—would become the targets of plunderers and pirates. With ease, terrorists could disrupt the freedom of the seas, targeting oil tankers, aircraft carriers, and cruise liners, while Western nations frantically concentrated on making their airports secure. Meanwhile, limited nuclear wars could devastate numerous regions, beginning in the Korean peninsula and Kashmir, perhaps ending catastrophically in the Middle East. In Latin America, wretchedly poor citizens would seek solace in Evangelical Christianity imported by U.S. religious orders. In Africa, the great plagues of AIDS and malaria would continue their deadly work. The few remaining solvent airlines would simply suspend services to many cities in these continents; who would wish to leave their privately guarded safe havens to go there? For all these reasons, the prospect of an apolar world should frighten us today a great deal more than it frightened the heirs of Charlemagne. If the United States retreats from global hegemony—its fragile self-image dented by minor setbacks on the imperial frontier—its critics at home and abroad must not pretend that they are ushering in a new era of multipolar harmony, or even a return to the good old balance of power. Be careful what you wish for. The alternative to unipolarity would not be multipolarity at all. It would be apolarity—a global vacuum of power. And far more dangerous forces than rival great powers would benefit from such a not-so-new world disorder.

### AT No Risk of Nuclear Terrorism

#### Terrorists have the drive to acquire nuclear weapons

Matthew Bunn, 4/2/08, Committee on Homeland and Security and Governmental Affairs (US Senate), "the risks of nuclear terrorism - and next steps to reduce the danger," p. 2-3

Do terrorists want nuclear weapons? For a small set of terrorists, the answer is clearly “yes.” Osama bin Laden has called the acquisition of nuclear weapons or other weapons of mass destruction a “religious duty.”2 Al Qaeda operatives have made repeated attempts to buy nuclear material for a nuclear bomb, or to recruit nuclear expertise – including the two extremist Pakistani nuclear weapon scientists who met with bin Laden and Ayman al-Zawahiri to discuss nuclear weapons. Before al Qaeda, the Japanese terror cult Aum Shinrikyo also made a concerted effort to get nuclear weapons. With at least two groups going down this path in the last 15 years, we must expect that others will in the future. Is it plausible that a sophisticated terrorist group could make a crude nuclear bomb if they got HEU or separated plutonium? The answer here is also “yes.” Making at least a crude nuclear bomb might well be within the capabilities of a sophisticated group, though a nuclear bomb effort would be the most technically challenging operation any terrorist group has ever accomplished. One study by the now-defunct congressional Office of Technology Assessment summarized the threat: “A small group of people, none of whom have ever had access to the classified literature, could possibly design and build a crude nuclear explosive device... Only modest machine-shop facilities that could be contracted for without arousing suspicion would be required.”3 Indeed, even before the revelations from Afghanistan, U.S. intelligence concluded that “fabrication of at least a ‘crude’ nuclear device was within al-Qa’ida’s capabilities, if it could obtain fissile material.”4 A terrorist cell of relatively modest size, with no large fixed facilities that would draw attention, might well be able to pull off such an effort – and the world might never know until it was too late.5 Could a terrorist group plausibly get the material needed for a nuclear bomb? Unfortunately, the answer here is also “yes.” Nuclear weapons or their essential ingredients exist in hundreds of buildings in dozens of countries, with security measures that range from excellent to appalling – in some cases, no more than a night watchman and a chain-link fence. No specific and binding global standards for how these stockpiles should be secured exist. Remarkably, another thing that does not exist is a comprehensive, prioritized list of which nuclear stockpiles around the world pose the highest risks of nuclear theft – though the Nuclear Material Information Program (NMIP), led by one of your earlier witnesses, Rolf Mowatt-Larsen, is working to create one. Based on the information we do have in the public domain, I believe the highest risks of nuclear theft today are in the former Soviet Union, in Pakistan, and at HEU-fueled research reactors around the world.

## Pollution Adv

### Gas Cars = Substantial Pollution

#### Personal cars are the greatest polluter

Stephen J. Gislason MD. 2011.Air and Breathing. Alpha Education Books. <http://www.nutramed.com/environment/carsepa.htm> ZP

In cities across the globe, the personal automobile is the single greatest polluter, as emissions from a billion vehicles on the road add up to a planet-wide problem. Driving a private car is a typical citizen's most air polluting activity. The negative effects of automotive emissions are maximum when you sit in traffic surrounded by cars, their engines idling. Everyone sitting in a traffic jam is getting poisoned.

#### **Car exhaust creates a triple blow to h2o, hydropower, and wind**

Brahic 2007 Surprising downsides of car pollution 11:02 24 January 2007 by Catherine Brahic <http://www.newscientist.com/article/dn11017-surprising-downsides-of-car-pollution.html> ZP

Particles from car exhausts generate more persistent and longer-lasting clouds but - paradoxically - less rain, new research suggests. Furthermore, putting more of these particles into the atmosphere reduces the low-level winds, which could reduce the amount of wind power available in very polluted regions. The result is that arid but populated regions could suffer a triple blow as a result of vehicle pollution: less water, less hydropower and less wind energy. The US state of California is a prime example. It is home to many of the biggest cities in the US, has tens of millions of cars, has suffered energy cuts and drought, and relies on wind power for 1.5% of its energy. Yet Mark Jacobson of Stanford University in California says that aerosol pollution could be causing a 2% to 5% reduction in water supply. "The aerosol pollution in California could be causing an annual loss of water supply equivalent to the storage in the planned upper San Joaquin River dam," says Jacobson. The dam is one of two proposed by California governor Arnold Schwarzenegger to help address the state's water scarcity. The reason, he explains, is that particles floating in the atmosphere block energy from the Sun, preventing it from warming the surface of the Earth. Cooler surface temperatures during the day means the low-level and slow moving air does not rise up and mix with the faster winds at higher altitudes. Slower winds also inducing less evaporation from oceans, rivers and lakes. And, finally, once clouds have formed, they dump less moisture in the form of rain. This is because raindrops form around small particles - dust, for instance, or pollution. With more particles in the atmosphere, it takes longer for enough water to condense onto a particle to form a raindrop. And if the cloud of fine droplets moves to a drier area before its would-be rain can fall, the moisture evaporates once more and the cloud disappears.

### Solves Pollution

#### H-cars dramatically decrease air pollution

CaFCP 09’

California Fuel Center Partnership, “Hydrogen Fuel Cell Vehicle and Station Deployment Plan: A Strategy for Meeting the Challenge Ahead”, CaFCP

2009, p.4, <http://www.cafcp.org/sites/files/Action%20Plan%20FINAL.pdf>, A.F.

Hydrogen fuel cell vehicles are one of the few vehicle technologies that can significantly reduce greenhouse gas emissions and local air pollutants, while also diversifying our energy sources to reduce petroleum dependency. A recent study from the National Research Council5 found that that levels of petroleum use and greenhouse gases continued to decrease for scenarios with larger numbers of hydrogen fuel cell vehicles, but leveled off after just a few decades for scenarios that emphasized hybrids and biofuels. In their analysis, NRC found that hydrogen FCVs resulted in the deepest cuts to oil use and GHGs in 2040. The study found that commercialization can begin in 2015 and could result in a maximum of two million FCVs on the road by 2020. The National Hydrogen Association recently evaluated the potential for hydrogen fuel cell vehicles to meet goals for reducing oil consumption, greenhouse gas emissions, and local air pollution6. Figures 3 and 4 demonstrate that FCVs are essential to meet our long-term goals. To achieve these goals, hydrogen and FCVs immediately need targeted investments and supportive policies.

#### Hydrogen Cars Release no harmful chemicals

HubPages 12

[HubPages, “Electric Cars vs Hydrogen Cars Part 1”, <http://ev-electric-cars.hubpages.com/hub/Hydrogen-Cars-vs-Electric-Cars>]

Although the idea of cars running on hydrogen might sound a little farfetched, like something out of a science fiction story, it is indeed in the works. Hydrogen cars have not yet been released for commercial use, but if you would like to have a feel for it, a few companies now have models for you to test drive and experience. Hydrogen cars do not emit byproducts which are harmful to your health or the environment. By not being gasoline powered, instead of producing exhaust fumes they produce steam instead. Sounds like a dream come true, and engineers are still tweaking here and there to finalize the hydrogen car model. Experts believe that in time we will see hydrogen cars being used on the roads replacing petrol engine cars. Hydrogen cars use a technology called a fuel cell in which hydrogen is converted into electricity to power the car. However, there are a few issues that need to be finalized such as how much will the end product cost, where can you refuel your cell, how can we economically produce hydrogen fuel, and will it work in the long run?

### Pollution Impact – Kills Billions

#### Air pollution causes extinction

David Driesen, Law Prof @ Syracuse, Fall/Spring 2003, Buffalo Environmental Law Journal, p ln

Air pollution can make life unsustainable by harming the ecosystem upon which all life depends and harming the health of both future and present generations. The Rio Declaration articulates six key principles that are relevant to air pollution. These principles can also be understood as goals, because they describe a state of affairs [\*27] that is worth achieving. Agenda 21, in turn, states a program of action for realizing those goals. Between them, they aid understanding of sustainable development's meaning for air quality. The first principle is that "human beings. . . are entitled to a healthy and productive life in harmony with nature", because they are "at the center of concerns for sustainable development." n3 While the Rio Declaration refers to human health, its reference to life "in harmony with nature" also reflects a concern about the natural environment. n4 Since air pollution damages both human health and the environment, air quality implicates both of these concerns. n5

#### Pollution threatens billions of people

**Roberts**, Earth Policy Insitute, September 17, 20**02**(<http://www.earth-policy.org/Updates/Update17.htm>)

The World Health Organization reports that 3 million people now die each year from the effects of air pollution. This is three times the 1 million who die each year in automobile accidents. A study published in The Lancet in 2000 concluded that air pollution in France, Austria, and Switzerland is responsible for more than 40,000 deaths annually in those three countries. About half of these deaths can be traced to air pollution from vehicle emissions. In the United States, traffic fatalities total just over 40,000 per year, while air pollution claims 70,000 lives annually. U.S. air pollution deaths are equal to deaths from breast cancer and prostate cancer combined. This scourge of cities in industrial and developing countries alike threatens the health of billions of people.

### Pollution Impact – Weather Patterns

#### Pollution causes serious consequences to the Environment – droughts, floods and other Extreme weather events

Kloosterman 2012 (Karin Kloosterman January 26, 2012, A joint American-Israeli research project demonstrates for the first time how tiny particles of pollution dangerously affect the clouds. http://israel21c.org/environment/can-car-exhaust-cause-tornados/ ZP

The effects of pollution reduce rainfall in cool and dry areas, like Israel in the winter, and on the flipside cause worsening storms and floods in warmer, wetter regions such as Thailand or the eastern half of the United States. The researchers believe that their findings have serious implications, giving policy-makers more knowledge about water use and management — not only for dry regions like the Middle East, but for anywhere around the world that may be at risk of drought, flooding and other extreme weather events. While the development of new power plants in industrializing countries can help grow the GDP, the long-term effects of local climate could offset the perceived gains, the researchers say. Both the National Science Foundation of the United States and the Chinese Ministry of Science and Technology provided funding for this research, which comes on the heels of another recent urban study that showed how summer storms worsen on weekdays in the eastern United States when there is more pollution emitted into the air.

#### Erratic weather patterns cause food prices to skyrocket

Reuters, 1/31/12, "global food prices easing, volatility still high: world bank," <http://ca.reuters.com/article/topNews/idCATRE80U13V20120131>

The World Bank said prices have declined steadily but volatility has increased, including among staples like wheat, maize and rice. In some countries, domestic food prices are higher than levels in 2010, keeping pressure on poor households that spend the bulk of their income on food. The World Bank increased its monitoring of global food prices in 2009 during a food and energy price crisis that hit food-importing countries the hardest and highlighted the chronic underinvestment in agriculture in developing countries. The World Bank said its 2011 annual food price index shows prices are still 24 percent higher than in 2010 despite some decline. Global prices fell 8 percent in the three months from September to December 2011, ending the year 7 percent below December 2010 levels. "The worst food price increases may be over but we must remain vigilant," said Otaviano Canuto, the World Bank Group's vice president for Poverty Reduction and Economic Management. "Prices of certain foods remain dangerously high in many countries, leaving millions of people at risk of malnutrition and hunger." The Bank warned, however, that the steady decline in global food prices could be halted if weather patterns change, or if world oil prices rise, pushing up price volatility and demand for biofuels.

#### Foods security outweighs all other impacts – it makes every impact inevitable

Trudell, J.D. Candidate 2006, 05 (Robert H., Fall, Food Security Emergencies And The Power Of Eminent Domain: A Domestic Legal Tool To Treat A Global Problem, 33 Syracuse J. Int'l L. & Com. 277, Lexis)

Today, more than 842 million people - nearly three times the population of the United States - are chronically hungry. 43 "Chronic hunger is a profound, debilitating human experience that affects the ability of individuals to work productively, think clearly, and resist disease. It also has devastating consequences for society: it drains economies, destabilizes governments, and reaches across international boundaries." 44 The enormous number of chronically hungry people conjures up a critical question: how can we feed these people? While the rate of population growth has been leveling off in the developed, wealthy countries of the world, the populations of the poorest countries and regions of the world still grow at an alarming pace. 45 Population statisticians refer to this phenomenon as population momentum. 46 Of the seventeen countries whose women average six or more births in a lifetime, all but two are in Africa. 47 In sub-Saharan Africa, millions are undernourished and millions more live on a dollar a day, making it the most poverty-stricken region in the world today. 48 [\*285] Chronic hunger and poverty are the rock-and-a-hard-place in between which the people of sub-Saharan Africa find themselves today. One tragedy endlessly feeds upon and exacerbates the other because a person needs money to buy food, but she (or he) cannot earn money when she is chronically hungry. 49 The food security issues of this region are a global concern. Silvio Berlusconi, Prime Minister of Italy, and Chairperson of the 2002 World Food Summit in Rome said, "Together with terrorism, hunger is one of the greatest problems the international community is facing." 50 Human security is a value which can be broadly defined as both the "freedom from fear" and the "freedom from want." 51 Until recently, security was largely a concern arising out of the conflict among states, i.e. state security, which can be summed up in the phrase "military preparedness." 52 Today, it is recognized that the achievement of freedom from want is as important a goal as the achievement of freedom from fear and countries must arm themselves against such fear by addressing food insecurity. 53 In an editorial in the Economist, Kofi Annan, Secretary General of the United Nations, wrote that today's threats to security - terrorism, food security and poverty - are all interrelated so that no one country can tackle them alone. 54 For example, keeping our food supply secure plays a direct role in achieving freedom from fear. The State Department has been studying the possibilities of food-borne bioterrorism, introducing the national security element to food security concerns. 55 Likewise, in December [\*286] 2004, during his resignation announcement, Tommy Thompson, the former Secretary of the Health and Human Services Department, stated: "For the life of me, I cannot understand why the terrorists have not attacked our food supply, because it is so easy to do." 56 Yet it is a mistake to think of global security only in military terms. 57 Food security deserves its place in any long-term calculation regarding global security. Widespread chronic hunger causes widespread instability and debilitating poverty and decreases all of our safety, for example from the increased threat from global terrorism. 58 Widespread instability is an unmistakable characteristic of life in sub-Saharan Africa. 59 Food insecurity, therefore, causes global insecurity because widespread instability in places like sub-Saharan Africa threatens all of our safety. Food insecurity in the unstable regions of the world must be taken on now lest we find ourselves facing some far worse danger in the days to come.

### AT “Producing Hydrogen Fuel Increases Pollution”

#### H-fuel can come from clean sources

PoweringNow 10’

PoweringNow.ca, “Where does Hydrogen Come From” H2I

<http://www.poweringnow.ca/where-does-hydrogen-come-from>, A.F.

Hydrogen is the most abundant element in the universe, and there are a number of ways to turn it into a fuel. It can be produced from natural gas, coal, biomass and oil, or from renewable energy sources such as wind, solar, geothermal and hydroelectric power. Waste stream hydrogen is also available for capture from a variety of industrial processes. Communities can choose whichever resources make the most sense to make hydrogen, environmentally and economically. Hydrogen can also be produced locally, at large central plants or in small distributed units located at or near the point of use. This means that every community, even remote areas, can become an energy producer. When produced using renewable energy sources and powering highly efficient fuel cells, the environmental benefits of hydrogen are even greater. Plus, hydrogen can be produced and stored using off-peak energy produced by renewable energy technologies such as solar, wind and tidal generation. When used with energy efficient fuel cells, hydrogen will play an important role in extending our current energy supplies as we move forward to a clean energy future.

#### Momentum is building for wind-powered hydrogen refueling stations

Liane Yvkoff, 2/3/12, Cnet, "a hydrogen fueling station powered by the wind," <http://reviews.cnet.com/8301-13746_7-57371352-48/a-hydrogen-fueling-station-powered-by-the-wind/>,

By building a wind turbine to power a hydrogen production and fueling station, a little hamlet in Long Island is positioning itself as the bellwether for carbon-neutral transportation. The town of Hempstead, N.Y., on Long Island erected a 121-foot-tall turbine last December on the township's Department of Conservation and Waterways land to take advantage of powerful Atlantic winds and power the hydrogen and natural gas fueling station it built in 2009. The turbine can generate up to 180 megawatts of power per year, and presents an estimated hydrogen fuel and energy cost savings of $40,000 per year. For the moment the hydrogen-powered vehicle fleet consists of two Toyota FCHV fuel cell Highlanders and a hydrogen/gas-powered bus. However, the township is working with other unnamed manufacturers of fuel cell vehicles to expand its fleet. Being the only wind-powered hydrogen production and fueling station in the New York metro area will make it an attractive testing ground for the nascent hydrogen car market, which is expected to grow in 2015 when manufacturers introduce production vehicles to consumers. Until then, any excess energy generated by the wind turbine that doesn't get used creating hydrogen will be fed into the Long Island Power Authority grid, lowering all residents' carbon footprint.

### AT Bee Decline Inevitable – Mites

#### Biotech solves mites

The Age, 6/26/12, "this mite be the bee's worst enemy," <http://www.theage.com.au/technology/sci-tech/this-mite-be-the-bees-worst-enemy-20120626-20z6u.html>

''Biotechnology can knock out critical genes that the mite needs for its survival. If this is achieved, then control might be possible,'' he explains. ''Our work could assist research being carried out in Britain on a shoestring budget, which is still a long way from completion.'' Once the genome sequence is complete, researchers will create and scour databases of all the Varroa genes in a bid to identify those that can be used to disable the mites before they do their damage.

## Hydrogen Economy Advantage

### 2AC Hydrogen Economy Add-On

#### Commercialization of H-cars is the bridge to a Hydrogen Economy

Silverstein 2012

Ken Silverstein, Editor, Energy Central. “Hydrogen-Powered Vehicles Could Emerge From Traffic”, Forbes. 06/06/2012. <http://www.forbes.com/sites/kensilverstein/2012/06/06/hydrogen-powered-vehicles-could-emerge-from-traffic/>

YA

The “hydrogen economy” is taking a back seat to the “green economy,” which essentially means that today’s prevailing automotive technologies are pushing the purest energy forms further down the road. In other words, the latest hybrid vehicles and all-electric cars are already here. So the use of [hydrogen in fuel cells](http://www.energybiz.com/article/11/05/hydrogens-hope) to run cars, buses and trucks are still stuck in traffic. But maybe not for too much longer. A lot of smart people are working to commercialize the effort and to produce ultra-clean vehicles that could run 300 miles before they would need to re-juice. In fact, both the national energy labs as well as the auto companies are laboring, with Toyota saying it wants to have a hydrogen-powered sedan ready next decade. “The hydrogen economy has a high degree of environmental friendliness,” says Bryan Pivovar, acting director for hydrogen projects at the [National](http://www.nrel.gov/hydrogen/proj_tech_validation.html)[Energy](http://www.forbes.com/energy/) Renewable Laboratory, in a phone conversation with this reporter. “But it comes down to questions of economics: Hybrids are here now while fuel cell-powered vehicles will initially emerge in small numbers and then gradually expand.” The paradox is, however, that no one wants to construct hydrogen fueling stations if hydrogen vehicles are not mass produced, he adds. But they won’t be built until the infrastructure exists. That dilemma is being addressed. Notably, Toyota, [Daimler](http://www.forbes.com/companies/daimler/) and Hyundai all have projects in the mix. The vehicles will trickle out at first but may eventually start to flow. “We are preparing to be able to produce tens of thousands per year in the 2020s,” says Didier Leroy, head of Toyota’s European operations, in a formal statement at a car show. Obstacles, though, are standing in the way. Hydrogen does not sit alone in nature and must therefore be separated from oxygen. To break it out, however, requires energy produced by other fuels. If fossil fuels are used, the process then consumes more energy than is produced, and the result is likely more pollution. If renewable or nuclear sources are used, the procedure is more benign. But questions arise as to whether it is more efficient to make hydrogen or just directly burn the associated fuels. Abundant shale gas resources could be used. Such unconventional natural gas releases about half the emissions as coal. But the problem is that it takes a lot of natural gas to isolate the hydrogen, leaving many to say that it would be more productive to just combust the natural gas in a conventional engine. “Initially, hydrogen will likely come from the steam reforming of natural gas, as this is the most economic route,” says the renewable lab’s Pivovar. It is also difficult to store hydrogen — something the [U.S. Department of Energy](http://www.fueleconomy.gov/feg/fuelcell.shtml) has said is the top priority when it comes to commercializing fuel cell vehicles. There is a further need to develop a pipeline infrastructure that can deliver the product. Pipelines that move hydrogen are said to be 30 percent more expensive than those that carry natural gas. While the production of hydrogen results in lost energy, Pivovar says that the use of hydrogen in a fuel cell vehicle provides much more oomph than gasoline. That would help compensate for those efficiency losses during the generation process. [Fuel](http://blogs.forbes.com/christopherhelman/) cells are now being adopted in the area of materials handling equipment that includes fork lifts as well as in the [field of telecommunications](http://www.energybiz.com/article/12/05/fuel-cells-arent-spewing-hot-air), says Pivovar. As for the automotive sector, he says that the first fuel cells will also include a battery. With that, he goes on to say that today’s hybrid vehicles will evolve and serve as a bridge to the ultimate hydrogen economy. The know-how exists but the cost of creating a new hydrogen-powered auto sector is now prohibitive. That’s why the immediate focus will remain on improving those hybrid technologies that are firmly planted. All-electrics are next in line while hydrogen-fueled vehicles are a few car lengths behind.

#### That shift is key to solve extinction

James Provenzano and Geoffery Holland, 2007, "The Hydrogen Age: Empowering a Clean-Energy Future," p. 107-8,

Until the last few decades, enough energy has been extracted to meet the needs of a growing society without impinging on the planet's biological capital. Now, we are at a point where life on Earth is out of balance. The human consumption of the planet's resources exceeds substantially the net-energy revenue delivered by the sun. We are rapidly drawing down the biological annuity that has been built up on Earth over billions of years. Man has taken on the role of a parasite, feeding on and totally dependent on the health of the host organism. The health of our planetary host is now failing. We humans, all 6.6 billion of us (and growing), are the reindeer of St. Matthews Island. We are sapping the life out of our one and only biosphere. The canons that define nature's way as outlined by author Janine Benyus reflect the only path capable of sustaining human life on Earth over the long term. Amory Lovins calls it the "Soft Path." It recognizes that the planet's living systems are finite and the rate of resource extraction must be reduced to sustainable levels. Where energy is concerned, Lovins's Soft Path encourages the transition to renewables, with hydrogen as the storage medium. Equal attention is given to employing conservation and in maximizing resource and process efficiency in just the same way biology gets the most from the least through natural selection. The biosphere functions as a complex series of closed loops in which the waste of one natural process becomes the food for another. The next stage in the evolution of humanity is being built on design principles that reflect that kind of closed-loop kinship with nature. As in nature, hydrogen will serve the common link.

### Peak Oil Coming

#### Peak oil coming by the end of the decade

Robert Rapier, 9/13/2010, Consumer Enerrgy Report, "Maxwell forecasts peak oil in seven years," <http://www.consumerenergyreport.com/2010/09/13/maxwell-forecasts-peak-oil-in-seven-years/>

Respected oil analyst and oil industry veteran Charles Maxwell (nicknamed the “Dean of Oil Analysts”) has forecast peak oil by 2017 or 2018: His prediction is not so remarkable, as is where he made his prediction. The prediction was in Forbes, which has often scoffed at the notion of a near-term peak. Some of Maxwell’s comments: A bind is clearly coming. We think that the peak in production will actually occur in the period 2015 to 2020. And if I had to pick a particular year, I might use 2017 or 2018. That would suggest that around 2015, we will hit a near-plateau of production around the world, and we will hold it for maybe four or five years. On the other side of that plateau, production will begin slowly moving down. By 2020, we should be headed in a downward direction for oil output in the world each year instead of an upward direction, as we are today.

### AT Not Feasible/H-cars are key

#### Transition to an h2 economy is feasible and the plan is key.

Guido 2009, Gianluigi Guido, prof of Economy @ U of Salento, Behind Ethical Consumption: Purchasing Motives and Marketing Strategies for Organic Food Products, Non-GMOs, Bio-Fuels, 2009, 125-126

Against these benefits, there are serious disadvantages that represent barriers to the diffusion of hydrogen cars and other transportation technologies. According to McDowall and Eames (2006), the main obstacles to the development of a hydrogen economy regard: (i) the absence of hydrogen refueling infrastructures; (ii) the high costs associated with hydrogen production and delivery; and (iii) the immaturity of the related technologies used in the manufacture of hydrogen cars and their on-board storage systems (i.e., fuel cells). Other re- searchers agree with this assessment. Blanchctte (2008), for example, indicates similar barriers to the diffusion of these technologies, but also stresses how the transition to the hydrogen economy needs active involvement on the part of national governments. In accordance with this conclusion, Farrell, Keith and Corbett (2003) posit that, for hydrogen to become of common use in civil transportation, actual market conditions should change and central authorities should adopt appropriate energy policies. On the other hand, Zerta et af. (2008) agree on the existence of such barriers, but provide a more optimistic view by maintaining that such a transition is feasible and suggest that hydrogen is among the best alternatives to fossil fuels in civil transportation.

### AT Nitrogen Turn

#### Catalytic converters solve

Stager 2011 Curt Stager, ecologist, paleoclimatologist, and science journalist with a Ph.D. in biology and geology from Duke University, The Hydrogen Economy’s Dirty Secret, Co.Exist, 6/29/2011 http://www.fastcoexist.com/1678206/the-hydrogen-economys-dirty-secret

There are ways to reduce NOx production from hydrogen-driven vehicles, or so I'm told by experts who know a lot more about this sort of thing than I do. Catalytic converters help, for example, as do certain engine designs. But I've not yet heard much discussion of this problem in the sustainable energy community, which tends to treat hydrogen like a flawless panacea.

### AT Water Wars Turn

#### New Tech makes H2 water efficient.

Zyga 2007 Lisa Zyga, “First Analysis of the Water Requirements of a Hydrogen Economy” 10/18/2007, http://phys.org/news111926048.html

By 2050, the NRC report predicts that hydrogen demand could exceed 100 billion kg—nearly twice the 60 billion kg that Webber’s estimates are based on. By then, researchers may find better ways of producing hydrogen, with assistance from the DOE’s large-scale investments, which will exceed $900 million in 2008. “That most of the water use is for cooling leaves hope that we can change the way power plants operate, which would significantly ease up the potential burden on water resources, or that we can find other means of power production at a large scale to satisfy the demands of electrolysis,” said Webber.

### Impact: Poverty/Oil Shocks

#### The fossil-fuel economy is unsustainable. Failure to transition to a hydrogen economy exacerbates the global wealth gap and makes oil shocks inevitable.

Jeremy Rifkin, 2003, The Hydrogen Economy, p. 7-8.

It is no wonder that controlling fossil -fuel energy reserves has been the central preoccupation of governments and industry for more than a century. Geopolitics has been, to a great extent, synonymous with the politics of oil for five generations. Those countries, companies, and peoples that have successfully controlled the flow of oil have enjoyed unparalleled wealth, while those who have been denied favored access to the wealth -generating potential of what geologists call "black gold" have slipped further into poverty and have been the subject of increasing exploitation and marginalization. Consider, for example, the rise in oil prices in the 1970s and '80s, which was a major cause of the escalating debt crisis in Third World countries. Unable to afford the high price of oil on world markets, developing nations were forced to secure billions of dollars in commercial and institutional loans to pay for more expensive oil imports and the increasing costs of all the other activities associated with higher oil hills. The debt burden has worsened in recent years as developing countries have become even more dependent on foreign oil to modernize their manufacturing economies and meet the needs of growing urban populations. Many of the world's poorest countries are now spending more money to pay back past loans than they are spending on basic human services. The result is an irreversible down ward cycle of ever -deepening poverty and despair. Protesters at recent global- development forums have zeroed in on the Third World debt crisis as the most visible sign of the inequities created by globalization and are demanding a cancellation of debts owed by poor countries. The fossil -fuel energy regime, then, is both the vital force that makes globalization possible and one of the factors most responsible for the growing divide between the rich and poor nations of the world. Now, however. the global infrastructure created to exploit fossil fuels and manage industrial activity is aging and beginning to crack at the seams. The fissures are everywhere, and there is mounting concern that the infrastructure might not hold together much longer. Some geologists are beginning to suggest that the system itself could collapse. 'to be unprepared for what might come. Say the worriers, would be foolhardy. But what does "prepared" really mean? If the fossil -fuel era is passing. What can replace it? A new energy regime lies before us whose nature and character are as different from that of fossil fuels as the latter was different from the wood- burning energy that proceeded it. Hydrogen is the lightest and most ubiquitous element found in the universe. When harnessed as a form of energy, it becomes "the forever fuel."' It never runs out, and, because it contains not a single carbon atom, it emit% no carbon dioxide. Hydrogen is found everywhere on Earth, in water, fossil fuels, and all living things. Yet, it rarely exists free -floating in nature. Instead, it has to be extracted from natural sources.

### Impact: Solves Colonialism (Global/Local)

#### A global hydrogen economy would empower local communities and break the chains of colonial oppressors.

Jeremy Rifkin, 2003, The Hydrogen Economy, p. 243.

Today, as we begin our journey into the hydrogen age, the demand for universal access to energy ought to inspire a new generation of activists to help lay the groundwork for establishing sustainable communities. If that were to happen, we could begin to reglobalize power along wholly new lines. This time, power would flow laterally from home to home, neighborhood to neighborhood, and community to community, creating a vast decentralized energy infrastructure that would promote both the values of self-sufficiency and interdependence. Were all individuals and communities in the world to become the producers of their own energy, the result would be a dramatic shift in the configuration of power: no longer from the top down but from the bottom up. Local peoples would be less subject to the will of far off centers of power. Communities would be able to produce many of their own goods and services and consume the fruits of their own labor. But, because they would also be connected via the worldwide communications and energy webs, they would be able to share their unique commercial skills, products, and services with other communities around the planet. This kind of economic self -sufficiency becomes the starting point for global commercial interdependence and is a far different economic reality than that in colonial regimes of the past, in which local peoples were made subservient to and dependent on powerful forces from the outside. Economically sustainable local communities make possible more than just material well- being. Empowering local communities also helps preserve the rich cultural diversity of the human family. Economic self -sufficiency provides the material security that a people needs to maintain a sense of social cohesion and to preserve its cultural largesse. At the same time, embeddedness in larger global communications and energy networks frees people from the xenophobia that traditionally accompanied a more isolated geographic existence. In the new global context, local culture becomes less of a possession to defend and more of a gift to share with the world. Cultural exchange once again reasserts itself and becomes as powerful an expression of human interaction as commercial exchange.

## Topicality

### TI = Fueling Stations

#### Refueling stations are an essential component of transportation infrastructure

RITA, 05

Research and Innovative Technology Administration, U.S. Department of Transportation, “Road 2—Infrastructure Development and Deployment”, DOT’s Hydrogen Roadmap 2005, 2005, <http://www.rita.dot.gov/publications/hydrogen_roadmap/html/road_02.html>, DY

Infrastructure is the backbone of the Nation’s transportation system. It includes the highways used by automobiles, trucks, and buses; the rail lines used by passenger and freight trains; the inland and coastal waterways; as well as long-haul and local distribution pipelines. It also includes the National Airspace System (NAS) used by private and commercial airplanes. Essential components of the Nation’s transportation system include the collection of maintenance and refueling facilities used by individual vehicles, and the pipeline and energy transportation and distribution infrastructure.

#### Transportation Infrastructure includes fueling stations

Mashable, 2012, "Transportation" (Original Source: Freebase), (Mashable is a leading source for news, information and resources), <http://mashable.com/follow/topics/transportation/followers/?page=25654>

Transport or transportation is the movement of people, animals and goods from one location to another. Modes of transport include air, rail, road, water, cable, pipeline, and space. The field can be divided into infrastructure, vehicles, and operations. Transport is important since it enables trade between peoples, which in turn establishes civilizations. Transport infrastructure consists of the fixed installations necessary for transport, and may be roads, railways, airways, waterways, canals and pipelines, and terminals such as airports, railway stations, bus stations, warehouses, trucking terminals, refueling depots (including fueling docks and fuel stations), and seaports. Terminals may be used both for interchange of passengers and cargo and for maintenance.

**Transportation infrastructure includes fuel stations**

**Beeferman 8** (Larry W., Director of the Pensions and Capital Stewardship Project in the Labor and Worklife Program – Harvard Law School, “Pension Fund Investment in Infrastructure: A Resource Paper”, Capital Matters, No. 3, December, http://www.law.harvard.edu/programs/lwp/pensions/publications/occpapers/occasionalpapers3. pdf)

A. Infrastructure: definitions The term infrastructure can be defined in various ways. One approach is to describe it largely in functional terms; that is, in terms of the uses of the facilities and services involved. For example, some analysts use the category of economic infrastructure to describe essential services such as toll-roads, bridges, tunnels, airports, seaports, and rail networks, as well as common utilities such as gas distribution networks, electricity and renewable energy production and distribution, and water treatment and distribution facilities.8 They distinguish those from social infrastructure such as schools, health care facilities, prisons and intra-city railroads.9 **A** somewhat **more detailed definition** divides infrastructure into three categories**:** transportation, utilities, and social infrastructure. The first category includes toll roads, bridges, tunnels, parking facilities, railroads, rapid transit links, airports, refueling facilities, seaports. The second encompasses electricity generation and transmission, gas and water distribution, sewage treatment, broadcast and wireless towers, telecommunication, cable networks, and satellite networks. The third covers courthouses, hospitals, schools, correctional facilities, stadiums, and subsidized housing.10

### H-Stations = TI

#### Refueling stations are a form of transportation infrastructure

Anstrom 2005

Joel Anstrom, Ph.D., is director of Penn State's Hybrid and Hydrogen Vehicle Research Center at the Pennsylvania Transportation Institute, “Hydrogen,” June 8, 2005, http://www.rps.psu.edu/hydrogen/fill.html

Joel Anstrom is thinking ahead. In his view, the long term goal of the project is to reduce reliance on petroleum by introducing a hydrogen infrastructure at gas-competitive prices. Anstrom, director of Penn State's Hybrid and Hydrogen Vehicle Research Center (HHVRC) at the Pennsylvania Transportation Institute (PTI), heads the vehicle fleet and assists Bohdan Kulakowski, professor of mechanical engineering, with the fueling station. He is optimistic that Penn State's hydrogen fueling station is an interim step towards future savings and independence for American drivers. Says Anstrom, "We want to demonstrate a safe, reliable, and affordable hydrogen transportation infrastructure that can be placed at filling stations across the country."

#### The government recognizes H-refueling stations as part of transportation infrastructure

Valley, April 27

Lehigh Valley, “U.S. Department of Energy Awards California Hydrogen-Based Transportation Infrastructure Project to Comprehensive Team”, PR Newswire: United Business Media, April 27, 2012, <http://www.prnewswire.com/news-releases/us-department-of-energy-awards-california-hydrogen-based-transportation-infrastructure-project-to-comprehensive-team-72685127.html>, DY

A project team led by Air Products (NYSE: APD) including automakers, an energy company, two California universities, and a public agency will work together to further demonstrate and validate advancements in hydrogen-based transportation infrastructure. This ambitious five-year program will be funded in part by a grant announced today by the United States Department of Energy (DOE), as part of its national Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project. The project team had submitted a request for a $91 million program. The hydrogen infrastructure project team to work on this endeavor includes Air Products and automakers Toyota Motor Sales USA, American Honda Motor Co., Inc., Nissan North America Inc., BMW, energy company ConocoPhillips, the National Fuel Cell Research Center at the University of California at Irvine, the University of California at Davis, and the California South Coast Air Quality Management District. "DOE should be applauded for initiating this far-reaching developmental project to sustain the world's energy supply," said Chris Sutton, vice president and general manager of Energy Industries at Air Products. "This is the first significant funding at the national level since President Bush's stated goal of supporting establishment of a hydrogen economy. On behalf of the entire project team, we are all excited about this opportunity to take a leadership role in the continuing development and commercialization of the global hydrogen economy. This is a step toward the goal of having key entities work together to solve important and critical issues and direct resources to gain real-world experience on fueling stations and feedback on vehicle infrastructure and hydrogen delivery technologies." Working together, the project team plans to make substantial commitments to establish and demonstrate hydrogen infrastructure in California. Over the five-year program, up to 24 fueling station locations using multiple approaches to producing hydrogen and providing fueling infrastructure could be developed. These include a fueling station located on a pipeline, relocatable stations placed at existing retail gasoline stations including ConocoPhillips sites, as well as municipal locations. These fueling stations will be supported by hydrogen produced from both natural gas and renewable energy sources. Some of these stations will also have dual dispensing capability of gaseous and liquid hydrogen.

### Investment Def

#### Definition of Investment

Merriam Webster Dictionary 2012

Merriam Webster, All Merriam-Webster products and services are backed by the largest team of professional dictionary editors and writers in America, and one of the largest in the world, ”Investment” 2012, Pg. 1, <http://www.merriam-webster.com/info/index.htm>, LO

: the outlay of money usually for income or profit : capital outlay; also : the sum invested or the property purchased

## Aff Answers

### 2AC AT Dedev – Frontline

#### Commercialization of H-cars is the bridge to a Hydrogen Economy

Silverstein 2012

Ken Silverstein, Editor, Energy Central. “Hydrogen-Powered Vehicles Could Emerge From Traffic”, Forbes. 06/06/2012. <http://www.forbes.com/sites/kensilverstein/2012/06/06/hydrogen-powered-vehicles-could-emerge-from-traffic/>

YA

The “hydrogen economy” is taking a back seat to the “green economy,” which essentially means that today’s prevailing automotive technologies are pushing the purest energy forms further down the road. In other words, the latest hybrid vehicles and all-electric cars are already here. So the use of [hydrogen in fuel cells](http://www.energybiz.com/article/11/05/hydrogens-hope) to run cars, buses and trucks are still stuck in traffic. But maybe not for too much longer. A lot of smart people are working to commercialize the effort and to produce ultra-clean vehicles that could run 300 miles before they would need to re-juice. In fact, both the national energy labs as well as the auto companies are laboring, with Toyota saying it wants to have a hydrogen-powered sedan ready next decade. “The hydrogen economy has a high degree of environmental friendliness,” says Bryan Pivovar, acting director for hydrogen projects at the [National](http://www.nrel.gov/hydrogen/proj_tech_validation.html)[Energy](http://www.forbes.com/energy/) Renewable Laboratory, in a phone conversation with this reporter. “But it comes down to questions of economics: Hybrids are here now while fuel cell-powered vehicles will initially emerge in small numbers and then gradually expand.” The paradox is, however, that no one wants to construct hydrogen fueling stations if hydrogen vehicles are not mass produced, he adds. But they won’t be built until the infrastructure exists. That dilemma is being addressed. Notably, Toyota, [Daimler](http://www.forbes.com/companies/daimler/) and Hyundai all have projects in the mix. The vehicles will trickle out at first but may eventually start to flow. “We are preparing to be able to produce tens of thousands per year in the 2020s,” says Didier Leroy, head of Toyota’s European operations, in a formal statement at a car show. Obstacles, though, are standing in the way. Hydrogen does not sit alone in nature and must therefore be separated from oxygen. To break it out, however, requires energy produced by other fuels. If fossil fuels are used, the process then consumes more energy than is produced, and the result is likely more pollution. If renewable or nuclear sources are used, the procedure is more benign. But questions arise as to whether it is more efficient to make hydrogen or just directly burn the associated fuels. Abundant shale gas resources could be used. Such unconventional natural gas releases about half the emissions as coal. But the problem is that it takes a lot of natural gas to isolate the hydrogen, leaving many to say that it would be more productive to just combust the natural gas in a conventional engine. “Initially, hydrogen will likely come from the steam reforming of natural gas, as this is the most economic route,” says the renewable lab’s Pivovar. It is also difficult to store hydrogen — something the [U.S. Department of Energy](http://www.fueleconomy.gov/feg/fuelcell.shtml) has said is the top priority when it comes to commercializing fuel cell vehicles. There is a further need to develop a pipeline infrastructure that can deliver the product. Pipelines that move hydrogen are said to be 30 percent more expensive than those that carry natural gas. While the production of hydrogen results in lost energy, Pivovar says that the use of hydrogen in a fuel cell vehicle provides much more oomph than gasoline. That would help compensate for those efficiency losses during the generation process. [Fuel](http://blogs.forbes.com/christopherhelman/) cells are now being adopted in the area of materials handling equipment that includes fork lifts as well as in the [field of telecommunications](http://www.energybiz.com/article/12/05/fuel-cells-arent-spewing-hot-air), says Pivovar. As for the automotive sector, he says that the first fuel cells will also include a battery. With that, he goes on to say that today’s hybrid vehicles will evolve and serve as a bridge to the ultimate hydrogen economy. The know-how exists but the cost of creating a new hydrogen-powered auto sector is now prohibitive. That’s why the immediate focus will remain on improving those hybrid technologies that are firmly planted. All-electrics are next in line while hydrogen-fueled vehicles are a few car lengths behind.

#### Only a hydrogen economy solves sustainability

Jeremy Rifkin, 2003, "The Hydrogen Economy," p. 253,

French scientist Rene Dubos captured the new sense of security that emerges from our new scientific understanding of how the Earth functions when he urged his fellow human beings "to think global and act locally." The Internet and the creation of the World Wide Web give us an electronically mediated "central nervous system" to connect everyone and everything within the biosphere so that we can, for the first time, really "think global and act locally." At the same time, the hydrogen energy web gives us a new, non-polluting energy regime that decentralizes and democratizes energy so that human populations can live in smaller, more dispersed communities that are less likely to stress the biosphere beyond its limits. The mass depopulation of the countryside and the migration to mega-cities with populations in the millions - which is the defining social feature of the fossil-fuel era - are simply unsustainable from a thermodynamic perspective. Because hydrogen energy is ubiquitous and fuel-cell power plants can be put anywhere and connected in extended energy webs, we can bypass the hierarchical and centralized architecture of the oil age. In the hydrogen economy, industrial and commercial activity can be spread out in a more ecologically sustainable manner, allowing for a more balanced mix in the density of human settlement.

#### We’re on the brink of exponential growth which will solve their impact turns

Barker ‘00 (Brent, electrical engineer, and manager of corporate communications for the Electric Power Research Institute and former industrial economist and staff author at SRI International and as a commercial research analyst at USX Corporation, “Technology and the Quest for Sustainability.” EPRI Journal, Summer, infotrac)

The rate of innovation is especially critical to sustainability. The roadmap participants have concluded that a "2% solution" is needed to support a sustainable future. By this, they mean that productivity improvements in a range of areas--including global industrial processes, energy intensity, resource utilization, agricultural yield, emissions reduction, and water consumption--have to occur at a pace of 2% or more per year over the next century. If the advances are distributed on a global basis, this pace should be sufficient to keep the world ahead of growing social and environmental threats. It will also generate the global wealth necessary to progressively eliminate the root cause of these threats and will provide the means to cope with the inevitable surprises that will arise. For example, a 2% annual increase in global electricity supply, if made broadly available in developing countries, would meet the goal of providing 1000 kWh per year to every person in the world in 2050. This means extending the benefits of electricity to 100 million new users every year. Maintaining a 2% pace in productivity improvements for a century will be formidable. It is in line with the cumulative advancement in the United States during the twentieth century, but at least twice the world average over that period. The disparity has been particularly great in the past 25 years, as population growth has outstripped economic development in many parts of the world. The result has been massive borrowing to maintain or enhance short-term standards of living. Staying ahead of population-related challenges is now in the enlightened self-interest of all the world's peoples, and the 2% solution offers a benchmark for success. Sustaining efficiency gains of 2% per year throughout the twenty-first century would allow essential global economic development to continue while sparing the planet. This pace, for example, should help stabilize world population (to the extent that wealth is a primary determinant of population growth), limit atmospheric levels of greenhouse gases to below agreed-upon strategic limits, provide sufficient food for the bulk of the world's people (as well as the wherewithal to buy it), and return significant amounts of land and water to their natural states. Roadmap participants envision technology and the spread of liberal capitalism as powerful agents for the 2% solution in that they can stimulate global development and foster worldwide participation in market economies. However, the participants have also expressed some concern and caution about unbridled globalization overrunning local cultures and societies and creating instability, unrest, and conflict. At its worst, globalization could lock weaker nations into commodity-production dependencies, leading to a survival-of-the-fittest global economy in which the rich get richer and most of the poor stay poor. Establishing greater dialogue and cooperation among developed and developing nations is therefore considered critical to ensuring that globalization delivers on its promise to be a vehicle of worldwide progress that honors the diversity of nations and peoples. Targets of sustainability There is no single measure of sustainability; rather, it will require continued progress in a wide variety of areas that reflect the growing efficiency of resource utilization, broad improvements in the quality of life for today's impoverished people, and acceleration of the historical shift away from resource-intensive economic activity. The roadmap's sustainability R&D targets provide a first-order approximation of what will be required. In many cases, the targets represent a significant stretch beyond today's levels, but they are all technologically achievable. The roadmap sets an optimistic course, certain that with accelerated R&D and a much stronger technological foundation in hand by 2025, the world could be well on a path to economic and environmental sustainability by midcentury. The goals for sustainability are simply too far-reaching to be achieved solely through governmental directives or policy. Rather, they will be reached most readily via a healthy, robust global economy in which accelerated technological innovation in the private sector is strongly encouraged and supported by public policy. The challenges of bringing the world to a state of economic and environmental sustainability in the coming century are immense but not insurmountable. Technology is on the threshold of profound change, quite likely to be broader, faster, and more dramatic in its impact than that which we experienced in the twentieth century. Fortunately, the impact appears to be heading in the right direction. Much of the leading-edge technology is environmentally friendly and, from today's vantage point, is likely to lead to a global economy that is cleaner, leaner, lighter, and drier; many times more efficient, productive, and abundant; and altogether less invasive and less destructive of the natural world. History teaches us that technology can be a liberating force for humanity, allowing us to break through our own self-made limits as well as those posed by the natural world. The next steps will be to extend the benefits of innovation to the billions of people without access and, in the words of Jesse Ausubel, to begin "liberating the environment itself." This entails meeting our needs with far fewer resources by developing a "hydrogen economy, landless agriculture, and industrial ecosystems in which waste virtually disappears....and by broadening our notions of democracy, as well as our view of the ethical standing of trees, owls, and mountains." In many ways, the material abundance and extended human capabilities generated through hundreds of years of technology development have led us to a new understanding and heightened respect for the underlying "technologies of life." Offering four billion years of experience, nature will become one of our best teachers in the new century; we are likely to see new technology progressively taking on the character and attributes of living systems. Technology may even begin to disappear into the landscape as microminiaturization and biological design ensue. Still, though technology is heading in the right direction, what remains principally in question is whether the pace of innovation is adequate to stay ahead of the curve of global problems and whether new advances in technology can be quickly brought down in cost and readily distributed throughout the world. Can we achieve the 2% solution of progressive improvement in economic productivity, land and water use, recycling, emissions reduction, and agricultural yield, year after year, decade after decade, in nation after nation? It's a formidable challenge, but with better tools we just might be able to pull it off. If so, the key to success will not be found in one small corner of the world. The challenge will be met by making the basic building blocks of innovation--education, R&D, infrastructure, and law--available in full measure to future generations everywhere in the world. That future begins now.

#### The collapse of civilization would obliterate everything on the planet.

Rubin,8 [Dani Rubin, 1/9/2008. Earth Editor for PEJ News. “Beyond Post-Apocalyptic Eco-Anarchism,” http://www.pej.org/html/modules.php?...er=0&thold=0.]

Unlike twenty-five years ago, increasingly, people are adopting the anarcho-apocalyptic, civilization-must-fall-to-save-the-world attitude. It is a fairly clean and tight worldview, zealously bulletproof, and it scares me. I want the natural world, the greater community of life beyond our species, with all its beautiful and terrifying manifestations, and its vibrant landscapes to survive intact – I think about this a lot. A quick collapse of global civilization, will almost certainly lead to greater explosive damage to the biosphere, than a mediated slower meltdown. When one envisions the collapse of global society, one is not discussing the demise of an ancient Greek city-state, or even the abandonment of an empire like the Mayans. The end of our global civilization would not only result in the death of six billion humans, just wiping nature’s slate clean. We also have something like 5,000 nuclear facilities spread across the planet’s surface. And this is just one obvious and straightforward fact cutting across new radical arguments in favor of a quick fall. We have inserted ourselves into the web of life on planet Earth, into its interstitial fibers, over the last 500 years. We are now a big part of the world’s dynamic biological equation set – its checks and balances. If we get a “fever” and fall into social chaos, even just considering our non-nuclear toys laying about, the damage will be profound. It will be much more devastating than our new visionaries of post-apocalyptic paradise have prophesized. If one expands upon current examples of social chaos that we already see, like Afghanistan or Darfur, extrapolating them across the globe, encompassing Europe, Asia, North and South America, and elsewhere, then one can easily imagine desperate outcomes where nature is sacrificed wholesale in vain attempts to rescue human life. The outcomes would be beyond “ugly”; they would be horrific and enduring. That is why I cannot accept this new wave of puritanical anarcho-apocalyptic theology. The end-point of a quick collapse is quite likely to resemble the landscape of Mars, or even perhaps the Moon. I love life. I do not want the Earth turned barren. I think that those who are dreaming of a world returned to its wilderness state are lovely, naive romantics – dangerous ones. Imagine 100 Chernobyl’s spewing indelible death. Imagine a landscape over-run with desperate and starving humans, wiping out one ecosystem after another. Imagine endless tribal wars where there are no restraints on the use of chemical and biological weapons. Imagine a failing industrial infrastructure seeping massive quantities of deadly toxins into the air, water and soil. This is not a picture of primitive liberation, of happy post-civilized life working the organic farm on Salt Spring Island.

#### The transition away from growth would fail – extremists would hijack the movement

Martin Lewis professor in the School of the Environment and the Center for International Studies at Duke University. Green Delusions, 1992 p170-171

While an explosive socioeconomic crisis in the near term is hardly likely the possibility certainly cannot be dismissed. Capitalism is an inherently unstable economic system, and periodic crises of some magnitude are inevitable. An outbreak of jingoistic economic nationalism throughout the world, moreover, could quickly result in virtual economic collapse. Under such circumstances we could indeed enter an epoch of revolutionary social turmoil. Yet I believe that there are good reasons to believe that the victors in such a struggle would be radicals not of the left but rather of the right. The extreme left, for all its intellectual strength, notably lacks the kind of power necessary to emerge victorious from a real revolution. A few old street radicals may still retain their militant ethos, but today’s college professors and their graduate students, the core marxist contingent, would be ineffective. The radical right, on the other hand, would present a very real threat. Populist right-wing paramilitary groups are well armed and well trained, while establishment-minded fascists probably have links with the American military, wherein lies the greatest concentration of destructive power this planet knows. Should a crisis strike so savagely as to splinter the American center and its political institutions, we could well experience a revolutionary movement similar to that of Germany in the 1930.

### 1AR AT Dedev – Plan -> Sustainability

#### H-cars are environmentally sustainable

Ariel Schwartz, 2012, Facts Coexist, "this fueling station fills vehicles with clean hydrogen from dirty water," <http://www.fastcoexist.com/1678467/this-fueling-station-fills-vehicles-with-clean-hydrogen-from-dirty-water>,

Wastewater--the stuff that goes down the toilet when you flush--is often treated and used for everything from creating artificial snow to watering golf courses. But this is perhaps the most palatable option for reusing the stuff that we've heard in a while: Hydrogen fueling company Air Products just opened a fueling station that turns methane gas from a local wastewater treatment plant into hydrogen gas that can be used to fill fuel cell vehicles--a first in the hydrogen fuel cell industry. The Orange County, CA station uses methane gas from the Orange County Sanitation District's municipal wastewater plant. The methane is funneled into a purification system, where it is fed to a fuel cell and turned into hydrogen. Electricity and heat from the fuel cell is used at the wastewater facility, while excess hydrogen is used at Air Products' filling station. The station can produce enough hydrogen to fuel up to 50 vehicles each day. "This is the epitome of sustainability, by taking human waste and transforming it into electricity which we need, and transportation fuel that we need, as well as thermal product heat that could serve the process of transforming the feed waste into productive products," said Professor Scott Samuelsen, director of National Fuel Cell Research Center at the University of California, Irvine, in a statement.

### AT Highway Revenue DA

#### Infrastructure spending is decreasing now and the government would obviously find other ways to get revenue

Larry Ehi, 5/2/12, Transportation Issues Daily, "higher fuel standards could reduce federal transportation funds by $57 billion by 2022," http://www.transportationissuesdaily.com/higher-fuel-standards-could-reduce-federal-transportation-funds-by-57-billion-by-2022/,

The higher fuel economy standards certainly will be good for our environment and energy security, but it could reduce federal transportation revenue by $57 billion by 2022, a 13 percent reduction. That’s according to a new study from the nonpartisan Congressional Budget Office (CBO). The standards would result in a 21 percent drop in funding by 2040, but the drop will be very gradual leading up to that year. That’s because “the proposed standards gradually increase in stringency—boosting the fuel economy of the new-vehicle fleet from 34.1 miles per gallon (mpg) in 2016 to 49.6 mpg by 2025—and because the vehicle fleet changes slowly as older vehicles are replaced with new ones.” What’s the solution? One or more of the following: Reducing spending on highways and mass transit, Transferring additional money from the Treasury’s general fund to the Highway Trust Fund, and Increasing the gasoline tax or raising revenues from other sources to provide receipts to the trust fund. The word “tolling” doesn’t appear in the document, but “other sources” would almost have to include tolling, something Congress and the country is going to have to become more willing to support. And an infrastructure bank will go only so far: The Fantasy Solution of an Infrastructure Bank. Grab some Kleenex and read the 10-page briefing paper. Meanwhile, roads and bridges are aging and need repairs or replacement. A growing population and the need to help businesses and industries remain internationally competitive requires investment. As a share of GDP, public spending on infrastructure has ranged from 2.3 percent to 2.5 percent since the mid-1980s. Before then, it had trended downward, from a peak of 3 percent in the late 1950s and early 1960s.

### Plan Popular – General

#### Government support exists for hydrogen fuel stations

Clifford Atiyeh, 6/25/12, Exhaust Notes, "federal officials see 'opportunity' in hydrogen, but little exists," <http://editorial.autos.msn.com/blogs/autosblogpost.aspx?post=690fb88d-4604-4625-b53f-f961beb01548>

Of course, if it all works, hydrogen may be the ultimate answer to a clean, self-sustaining fuel. Hydrogen is the most abundant element on Earth, and the chemical reaction of hydrogen in a fuel cell emits only water vapor and electricity. It could be wonderful. There is also some government interest. A $4,000 tax credit exists for owners of hydrogen-powered vehicles, as well as a (much larger) credit for owners of hydrogen fuel stations. Both are set to expire in 2014. Former President George W. Bush set aside $1.2 billion for hydrogen research in 2003, with the goal of having an actual infrastructure by 2020. If you look around, not much has happened, including the so-called East Coast Hydrogen Highway promised from Maine to Miami.

### AT Politics – Plan Popular (Public)

#### Hydrogen cars are popular – people think it’s limitless energy.

Farrell et al 2003 Alexander E Farrell, Energy and Resources Group @ University of Cal Berkeley, David W Keith, Dept of Engineering and Public Policy @ Carnegie Mellon, James J Corbett, Marine Policy Program @ University of Delaware, A strategy for introducing hydrogen into transportation, Energy Policy 31:13, October 2003, pg 1357–1367

Hydrogen has long been advocated as a transportation fuel for a variety of reasons: as a means of responding to resource (e.g. petroleum) scarcity and growing US dependence upon petroleum imports (Hoffman, 2001; Mathis, 1976), as a means of improving environmental quality (Berry et al., 1996; DeLucchi and Ogden, 1993), as a high-performance aircraft and rocket fuel (Sloop, 1978), as a means of expanding the use of nuclear energy (Marchetti, 1976), and as a means of responding to climate change (Lenssen and Flavin, 1996; Ogden, 1999). Interest in hydrogen has recently been renewed, as evidenced by Iceland's plans to develop a “hydrogen economy” (Arnason and Sigfusson, 2000; Jones, 2002), the passage of the US Hydrogen Future Act of 1996, and the development of numerous hydrogen research activities around the world (Barbier, 2001). These activities include the recent “FreedomCAR” proposal from the Bush Administration (Abraham, 2002), and, most notably, investments by major automobile manufacturers in fuel cell vehicles for possible production in just a few years (Hanisch, 2000; Pearce, 2000). Recent advances in fuel cell technologies have also played a role. Finally, there is enormous power in the (exaggerated) popular view that fuel cells offer the potential for affordable, compact, silent, efficient, emission-free energy from ‘unlimited’ resources.

### AT Politics – Plan Popular (Security Spin)

#### The plan will get spun as a national security issue – makes it popular

Peter Schwartz and Doug Randall, 2003, Wired, "how hydrogen can save America," <http://www.wired.com/wired/archive/11.04/hydrogen_pr.html>,

Hydrogen's fuel-efficiency offers immediate benefits to transportation companies that maintain their own vehicles and use them for limited, predictable distances. In fact, FedEx and UPS plan to phase in fuel-cell trucks over the next five years. The Bush administration should take advantage of this synergy between early adopters and the national interest by offering $10 billion in tax breaks to companies that invest in hydrogen-powered fleets. Also, in regions served by a refinery hub, $5 billion should be allocated for fuel cell police cars, ambulances, maintenance trucks, and other municipal vehicles. The military is another sensible target, since 60 percent of its logistics budget is devoted to transporting gasoline. The critical need to build infrastructure along with vehicles brings to mind an earlier Apollo-like initiative: Eisenhower's National Defense Highway Act. As an officer during World War II, Ike struggled to move troops across the US and saw how Germany's highways conferred a military advantage. Once in the Oval Office, he called for $300 billion in today's dollars to build an interstate highway system. Funded by a gas tax, that program's dramatic success proved that national security can motivate federal infrastructure projects on a grand scale.

### A2 – KRITIKS – ETHICS / A2 UTIL BAD

#### Transition to h2 is good in both utilitarian and environmental ethics frameworks.

Guido 2009, Gianluigi Guido, prof of Economy @ U of Salento, Behind Ethical Consumption: Purchasing Motives and Marketing Strategies for Organic Food Products, Non-GMOs, Bio-Fuels, 2009, 126

In light of the relevance of issues like energy security and global warming, it is possible to hypothesize that the diffusion of renewable energy sources may be crucial to the well-being of future generations (cf. Elliott 2000). Yet, the adoption of renewable transportation fuels like bio-fuels and hydrogen, in alternative to fossil fuels, is likely to be guided not only by their perceived consequences - in terms of advantages and disadvantages - but also by the ethical principles of potential users.

### H2 CONSUMPTION = ETHICAL

#### Transition to hydrogen is based on ethical rather than economic consumption practices.

Guido 2009, Gianluigi Guido, prof of Economy @ U of Salento, Behind Ethical Consumption: Purchasing Motives and Marketing Strategies for Organic Food Products, Non-GMOs, Bio-Fuels, 2009, 146-147

The two studies reported in this chapter show that the success of certain new technologies launched onto the mass market does not only depend on their technical characteristics and performances. Consumers are likely to use moral principles as criteria when evaluating ethically charged innovations. These studies show that the public acceptance of new technologies in civil transportation, such as bio-fuels and hydrogen cars, depends on the degree to which such products are perceived as congruent with individuals’ moral norms pertaining to ethical issues, such as environmental protection, biodiversity preservation, and societal well-being. These Endings are in line with those reported in Chapters 2 and 4 (above), showing that moral norms, described as the set of personal beliefs regarding what is right or wrong, and ethical self- identity, defined as the extent to which individuals perceive themselves as being ethical consumers, play a determining role in the consumption of organic rather than non-organic food products. Moreover, our results show that when an emerging technology, like hydrogen, is perceived to have a great potential to alleviate specific ethical issues at a global level, consumers tend to use different evaluative criteria depending on their level of expertise and knowledge as regards the product. Novice consumers tend to underestimate the importance of technical problems regarding with the development of product prototypes, while overestimating the relevance of potential benefits for the environment and for society at large. An opposite bias seems to emerge for expert consumers, who tend to be more focused on technical aspects and performance. These findings have implications for companies involved in the development of ethically relevant technologies in the energy and automotive industries. At a strategic level, the adoption of ethical marketing approaches that are consistent with environmental protection, biodiversity preservation, societal well-being and other moral principles could positively affect key variables, such as new product success, change in market share (Baker and Sinkula 2005), as well as business performance in general and corporate reputation (Menon and Menon 1997). Specific strategies in such a context pertain not only to the development of “green” products or to the use of recycled raw materials in production processes, but also to the adoption of effective communication initiatives. Companies’ marketing strategies should focus on specific ethical issues, which should be integrated in their strategic planning processes (eff Banerjee 2002).

#### The consumption of hydrogen cars is fundamentally ethical – not economic.

 Guido 2009, Gianluigi Guido, prof of Economy @ U of Salento, Behind Ethical Consumption: Purchasing Motives and Marketing Strategies for Organic Food Products, Non-GMOs, Bio-Fuels, 2009,

This finding stresses how an ethical concern for healthy life could lead individuals to accept hydrogen as a new transportation technology. The relevance of personal and societal well-being as a moral principle guiding consumer perception of hydrogen cars is also confirmed by the importance level ascribed to an improved quality of life in urban areas (19.6I%). However, well-being is not the only principle driving consumer perception. Environmental protection is the second highes t rated benefit associated with hydrogen car accep- tance (2l.76%). The independence from foreign oil supplies (l8.46%) and the possibility of 5.161 saving (l8.22%) are the only economic advantages perceived liom hydrogen cars.