



Today, we're departing from our usual focus on the structure of government and the election system in Minnesota to focus on a national and, indeed, an international question of the utmost importance: Where will our future sources of energy come from? This summary covers our session with Minnesota's Joe Shuster, author of the 2008 book *Beyond Fossil Fuels: the Roadmap to Energy Independence by 2040*.

Summary of meeting with Joe Shuster

Civic Caucus, 8301 Creekside Circle, Bloomington, MN 55437

Friday, September 12, 2008

Guest speaker : Joe Shuster , author and entrepreneur

Present : Verne C. Johnson, chair; Dave Beal, Dave Broden, Marianne Curry, Bill Frenzel (by phone), Paul Gilje, Jim Hetland, Jim Olson (by phone), and Wayne Popham (by phone)

A. Context of the meeting — Soaring prices for gasoline at the pump, rising demand for oil from rapidly growing economies abroad, the growing need for alternative energy sources, increased U.S. dependence on foreign oil, long-term concerns about the supply of fossil fuels, and a host of other factors have moved the issue of energy independence to the front burner. In his book, Joe Shuster lays out a provocative plan to achieve energy independence by 2040 by moving entirely from fossil-fuels to a radically different mix of sources. He envisions nuclear power from fast neutron reactors as our dominant source of energy a generation from now.

B. Welcome and introduction - Verne and Paul welcomed and introduced Joe Shuster. His book grew from two and a half years of research, including reading 60 books, interviewing 100 energy experts and plowing through scores of studies. Shuster, a chemical engineer who lives in New Prague, co-founded Minnesota Valley Engineering, a leading manufacturer of technology-intensive cryogenic equipment. Later, he founded Teltech, an engineering and scientific consulting firm that produced hundreds of technical reports on energy-related topics. He has founded or co-founded half a dozen other technology-based companies and served as a director of more than 20 businesses and other institutions. His "energy alert" paper for the U.S. Congress predicted the 1973 oil embargo. In the preface to his book, Shuster, who is 76, says he wrote it as a call to action, so that his children and grandchildren can enjoy as future as bright and bountiful as the era that benefited him so much.

C. Comments and discussion - During Shuster's comments and in discussion with the Civic Caucus, supplemented by information from his book, the following points were raised:

1. The times call for a sense of urgency. Americans need to become better informed about the mounting crisis they face as fossil fuels get depleted. Today, the U.S. gets 86 percent of its energy

from fossil fuels: coal (23.2 percent), natural gas (23.9 percent) and oil (39.4 percent). The rest comes from nuclear (8.2 percent), hydropower (2.6 percent) and biomass and various other sources (3.3 percent). Assuming current global consumption of oil and forecasts for worldwide population and economic growth, the world will run out of conventional oil reserves in about 30 years, out of natural gas in less than 50 years and out of coal in less than 75 years, if we are forced to convert coal to satisfy the world's transportation needs. Further, these numbers do not allow for population growth or for economic expansion. And imports, often from unstable or unfriendly nations, have grown to account for 62 percent of the oil we consume. Thus, the nation needs to rapidly ramp up new sources of energy.

2. The solution to this enormous problem is to turn to a strikingly different mix of energy sources, largely nuclear power but also to other alternative energy sources. Shuster proposes that the U.S. get out of environmentally damaging fossil fuels entirely by achieving a goal of 80 percent nuclear, 10 percent solar and 10 percent wind by 2040. This calls for a radical shift in energy policy. He notes that the U.S. has not built a nuclear power plant since the late 1970s. His plan calls for at least 400 new nuclear plants to accommodate the country's electrical needs only, and ideally, 800 to accommodate the country's electrical needs plus electricity for an all electric transportation fleet—approximately 25 per year for 30 years - by 2040. Shuster and others think this is doable—plants would all be modular, and factory built.

(In Minnesota, Xcel's nuclear plants at Prairie Island and Monticello generate 24 percent of the state's electric power. Since 1994, the state has banned construction of new nuclear plants. Nationally, in this year's presidential campaign, Republican nominee John McCain's energy plan calls for the construction of 45 new nuclear plants by 2030, with an ultimate goal of building 100 of such plants. Democratic nominee Barack Obama's plan says there is no future for expanded nuclear power without first addressing four key issues: the public's right-to-know, security of nuclear fuel and waste, proliferation and waste storage.) Shuster wonders how neither candidate understands the inevitability of a large nuclear fleet—there really is no other choice.

A Civic Caucus member raised the question of how the goal of energy independence fits with the realities of globalization, where nations are often economically dependent on other nations for goods swapped in a complex international trade system.

3. New technology will resolve the issue of how to dispose of radioactive waste. Instead of storing the waste generated by existing light-water reactors on site or at a remote repository such as Nevada's Yucca Mountain, a process called UREX-Plus will recycle nearly all of the waste into new fuel which in turn will fuel the new generation of fast neutron reactors. While scientists have proven the efficacy of this process, questions remain among some. The doubts can be resolved by building pilot plants to demonstrate and optimize both the UREX-Plus recycling process and the new proliferation resistant fast neutron reactors.

There's a dramatic difference between the current nuclear power plant technology, which produces spent fuel rods with

a life of 10,000 years before they become benign, and the new fast neutron reactor technology, Shuster said.

The central and overriding benefit of the new reactor technology is the use of already stored waste fuel rods as fuel stock, leaving

spent rods having only a life of 300 to 500 years. The technology was ready for a demonstration model until President Clinton

scratched it.

The new reactor technology represents, a Civic Caucus member said, an opportunity for America to boost its science and technology capability to produce employment and trade opportunities for the next generation and to spur economic development for the U.S. on the world market. It could be, the member said, a kind of Manhattan Project, harnessing the best and the brightest in our technology sector to a project that can take U.S. economy to the next level of benefit to humanity.

4. Experience shows that safety need not be a problem. adiation has caused only one death in the U.S. commercial nuclear industry. Concerns about the impact of the accident at Three Mile Island turned out to be wildly overstated. While the Chernobyl accident in Russia was much more serious, a Chernobyl-like accident in the U.S. won't happen because U.S. reactors are designed differently and include a containment building designed to prevent radioactivity from escaping into the environment. The U.S. Navy's nuclear-powered submarine fleet has operated since 1955 without a serious mishap. France and other countries depend heavily on nuclear power, and safety has not been a significant problem. Provisions can be made to guard against other concerns, such as transport of hazardous materials and terrorism. Shuster cites numerous studies showing that by far the greatest perils come from the burning of fossil fuels, which he estimates produce pollution that kills roughly 50,000 Americans annually.

5. Various studies show that the operating and capital costs for nuclear plants are approximately the same and often less than comparable costs for using fossil fuels to generate power. Shuster estimates capital and operating costs for a 1,000-megawatt-electric fast neutron reactor at 4.2 cents per kilowatt hour. He puts comparable costs for a conventional light-water reactor at 5.28 cents, coal-generated electricity at 4.70 cents, and electricity generated by natural gas at 4.56 cents per kilowatt hour. He cites other cost studies that arrived at similar conclusions.

6. The international cooperation needed to fully embrace nuclear energy globally can take place through the Global Energy Nuclear Partnership (GNEP). This alliance, which Shuster strongly supports, was proposed by the Bush administration. It seeks to help all countries become energy independent and rely less on imported oil, boost economic growth and encourage the use of new recycling technology and the new generation of fast neutron reactors to greatly reduce nuclear waste and proliferation concerns worldwide.

7. Alternative sources of energy, principally solar and wind, will help solve the problem, but don't believe the hype about them. Grand projections, such as one that up to half of U.S. energy would come from renewables by 2005, were totally unrealistic. Part of the reason why the alternative sources have been slow to take off is that the fossil-fuel industry lobby gets billions of dollars in tax breaks and subsidies annually from the federal government. Major challenges for both the solar and

wind industries include finding the large areas needed for generating energy and then transmitting the energy to major population centers. Still, by 2025, both solar and wind energy could be supplying up to half of the *new* electrical energy required by the U.S. from now until then.

8. Concerns about global warming distract us from the real problem: the burning of polluting fossil fuels at ever-increasing rates. Thus the debate about how much of global warming is caused by mankind doesn't really matter. The overarching issue is how to generate the energy the world needs through sources other than fossil fuels, before the fossil fuel reserves run out. Also when the transformation to all renewable clean energy is complete, mankind's emissions of greenhouse gases will stop.

9. Stepped-up conservation is a worthy effort, and will buy some needed time, but will not solve our energy problem. Shuster says that at present consumption rates, if the world conserved 10 percent of the energy it uses, oil would last only four more years, natural gas only seven more and coal eight more. Conserving 20 percent, which would be very difficult, would only double those time spans.

10. The hydrogen economy: not now and maybe never. That's the title of Shuster's chapter on why he reversed his earlier view that hydrogen would some day emerge as the ultimate alternative to fossil fuels and the internal combustion engine. While hydrogen is the most plentiful element on the planet, it is always found in combination with other elements and it is an energy carrier rather than an energy source. To be used to create a fuel, it must be separated from other elements in a process that requires significant amounts of money, facilities, and energy. In Shuster's view, the costs are out of economic reach for the foreseeable future.

11. Moving to an electrified transportation industry offers sweeping benefits. Foremost among them, Shuster argues, are lower transportation costs, less imported oil, an improved balance of payments, a stronger dollar, fewer wars for energy resources, and less pollution. But gaining these benefits means moving rapidly to hybrid plug-ins and all-electric cars, speeding up research on batteries and battery-charging systems, phasing out gasoline-powered vehicles, adding surcharges on gasoline and purchases of cars getting less than 30 miles to the gallon, possibly even rationing gasoline, adding plug-in stations at convenient locations, boosting the penalties manufacturers pay for noncompliance with efficiency standards, and helping Detroit's automakers get back on their feet.

12. Drilling in Alaska and offshore won't provide enough oil to make a significant difference. Shuster says drilling in the Arctic National Wildlife Refuge and the National Petroleum Reserve of Alaska territory would help some, but wouldn't provide much of a bridge to a non-fossil fuel era. It would be very risky for the environment. Offshore drilling would be very expensive. Of the options for boosting domestic oil supplies over the next 30 years, only oil shale offers a reasonable, reliable and available solution. He cited a study that shows the cost to produce oil from oil shale is about the same as the cost to recover oil off shore, particularly beyond the continental shelf.

13. Shuster is critical of carbon credits, carbon offsets and cap-and-trade systems, which are designed to reduce emissions. He views these plans, which have been gaining political popularity, as abuse-prone schemes that buy time and distract attention from more direct efforts to get off of our addiction to fossil fuels. Under cap-and-trade programs, an authority sets a limit on the pollutants that can be emitted. Companies get permits and are limited to emitting a specified amount. If they exceed

the limit, they must pay a fine or buy credits from companies that are under the limits. Shuster says capping and trading has not reduced emissions in Europe where they have had considerable support for this scheme and have been at it for three years.

14. Shuster questions T. Boone Pickens' heavily publicized plan for energy independence. The Pickens plan calls for the U.S. to generate a fifth of its electricity from wind by 2030, thus freeing up natural gas so it could be used to power trucks and automobiles. Shuster says the plan falls apart upon close scrutiny. Replacing 20 percent of the energy needed to produce electricity with wind energy would steer only 20 billion gallons of gasoline equivalents into the transportation system—10 percent of the 200 billion gallons of gasoline and diesel fuel the U.S. transportation fleet uses annually. Shuster adds that since the wind part of the Pickens plan would save only a tenth of the oil the U.S. consumes annually, it would be cheaper and more effective to start switching to plug-in hybrids and all-electric cars instead. Going to more nuclear energy would be a cleaner option, and one much more easily managed and considerably cheaper.

15. He has only a fraction of the marketing clout of Pickens, who is spending \$58 million to tout his plan. The book, published by Beaver's Pond Press in Edina, has gone through its first printing of 5,000 copies and is into its second printing now, but Shuster says it hasn't been easy to market the book. He says it will have more impact if he can persuade politicians in Washington of its merits. He has distributed his book to U.S. senators and representatives, much as he circulated his 1973 paper forecasting an oil embargo to them. But he got more attention from them than he has so far this time. All book reports and feed back from Amazon and elsewhere claim the book is an easy read and suitable for a mass audience. Shuster stated that every teacher, every parent, and every college student should read this book. They must become better informed so they can help effect change. Paul Gilje said he could not put the book down—the same as if he was reading Vince Flynn or Cussler.

16. Closing summary by Shuster —

a. If the transformation to all renewables takes fifty years, the world will need 1.5 trillion barrels of oil to bridge us when we only have 1 trillion barrels of conventional oil left in the world.

b. A total solution will require many things to be done; further development of biofuels, rapid development of plug-in hybrids and all electric automobiles, aggressive development of the country's oil shale resources and immediate construction of the required nuclear energy pilot plants

c. Reject feel good band-aid solutions often proposed by the government. Insist on the complete story—all quantified stating exactly the expected outcome and at what price.

d. Aggressively promote GNEP because if the U.S. fixes its problem and the rest of the world does not, we still all lose. The world needs U.S. leadership now more than ever.

17. Thanks to Joe Shuster— On behalf of the Civic Caucus, Verne thanked Shuster for meeting with the caucus.

18. Thanks to Dave Beal —On behalf of the Civic Caucus, Verne expressed special thanks to Dave Beal, a columnist for *Twin Cities Business* magazine and a longtime business journalist for the *Pioneer Press*, for taking notes and writing up the summary of today's meeting.