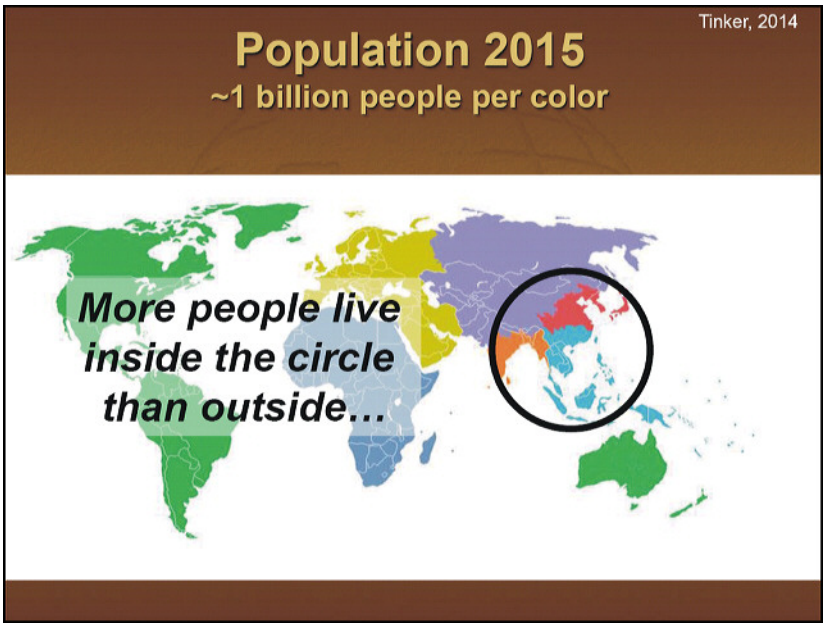
Energy Generations - Van Tuyl Lecture Series

Scott Tinker traveled from Texas to present the Weimer Distinguished Lecture on November 13, 2014 at the Colorado School of Mines. Dr. Tinker is the Director, Bureau of Economic Geology and State Geologist of Texas. He is also the Professor, Allday Endowed Chair of Subsurface Geology, John A. and Katherine G. Jackson School of Geosciences, University of Texas at Austin.

The advance notice for the talk mentioned that when Dr. Tinker's father (Tom Tinker) and the fathers of his colleagues, Paul Weimer and Steve Sonnenberg (Bob Weimer, Frank Sonnenberg) began their geologic careers in the 1950s, coal was completing its reign as the dominant global fuel and oil was on the rise. Thirty years later, oil was at its global peak, satisfying nearly 50% of the total global energy demand. Currently, oil has fallen to below 35% of demand, coal remains important, and natural gas is rising to become the dominant fuel of the 21st century.



Dr. Tinker started by introducing a perspective on energy over the past 30 years. From 1980 to 2010 the world's population increased from 4 billion people to 7 billion, with half residing in the Far East. In 1980 fossil fuels represented 92% of the world's energy mix; by 2010 their use had declined slightly to 85% of the total. In Southeast Asia and Australia, coal composes over half of the energy mix. In other comparisons over the years, women were 25% of the world's geoscientists in 1980, while today that figure is 40%. In the last decade there has been a growth in US student visas, so that now non-residents total 25% of PhD candidates, with China accounting for a large part of this growth. In 1980 starting salaries for geoscientists were around $20,000. Today a master's graduate can expect a $100,000 beginning salary. The inflation adjusted price of oil in 1980 was $100 and until recently it was $100, although there have been many

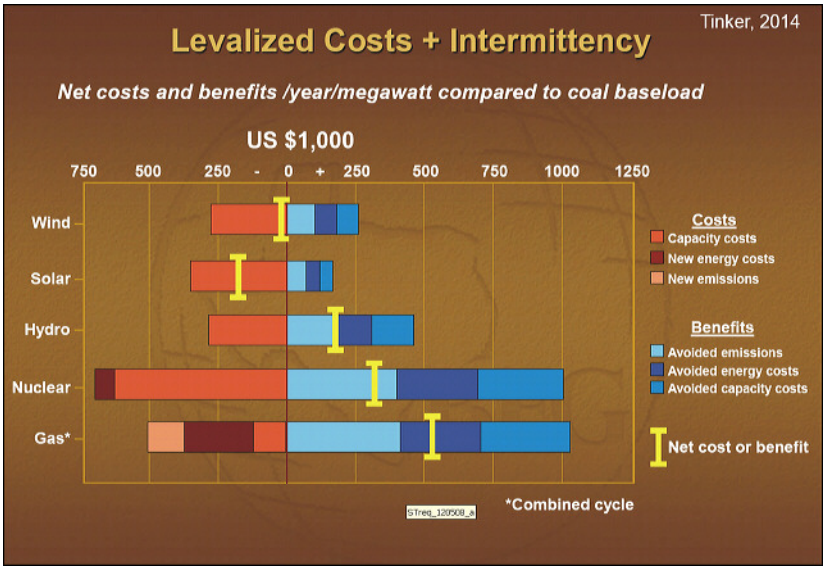
price fluctuations over this period. Oil price spikes have tended to precede recessions. Also, in 1980, if you cored shale you were fired. Now, if you don't core shale you get fired.

The Far East obtains half of its energy from coal, but this represents twice as much coal consumed as the rest of the world combined. Africa's population is forecast to surpass the rest of the world combined by 2060. Ten years ago China purchased 1/3 the number of cars as the US, whereas today that figure is 1.3 times the US. China appears to be returning to its historical levels of GDP relative to population after a decline in the last part of the 20th century.

Over the past 30 years, world oil production has grown to more than 30 billion barrels of oil per year. Where will new production come from? The world shale oil resource is estimated at 1,300 Bbo. The US is producing 3.1 million barrels of shale oil per day. The alternatives to oil include more oil (tar sands, etc.), biofuels, natural gas, electricity and hydrogen fuel cells. The world produces 115 Tcf of natural gas per year. The world shale gas resource is estimated at 5,600 Tcf, but this could be overly conservative. Shale gas production in the US has progressed from a negligible level 10 years ago to 10 Tcf per year.

The US shale oil production has been accurately forecast by Ed Morse, Global Head of Commodities Research at Citigroup, who said in 2010 that production would go from 0.5 to 4 million barrels per day in a decade. The Texas Bureau of Economic Geology (BEG) has produced a US Shale Gas Integrated Study, although this study and one generated by the Energy Information Agency show different conclusions and require examination of methodologies in estimating resources. Professor Medlock of Rice University has forecast a shale gas production increase from 4 to 15 Tcf/year by 2040. George Mitchell's efforts in the Barnett Shale of the Ft. Worth Basin required nearly two decades and horizontal drilling to prove the resource. Resource evaluations in the Barnett, Haynesville and Fayetteville shales will continue to be price dependent. The shale source in these three basins combined is smaller than that of the Marcellus Shale, which underlies 45,000 square miles.

Missing from future shale gas resources estimates is production from Russia and the Middle East, both of which have large conventional resources. The Middle East currently exports 3 Tcf/year of conventional gas per year. Water will be a limiting factor in fracing, but methods utilizing dry fracking techniques are on the horizon. Some problems with drilling booms include social issues, flaring, and induced seismicity. Ironically, the city of Denton, Texas has recently placed a moratorium on fracing. A plot of the depth of wells in the Marcellus compared with the depth of fresh water aquifers indicated an improbability of direct contamination. Dr. Tinker was complimentary of Governor Hickenlooper's efforts to mediate with disparate interests over shale drilling in Colorado.



Each energy source has its pros and cons. Alternatives to natural gas include coal, which is energy dense but also rich in emission of greenhouse gases. Nuclear energy has the advantages of being energy dense with no emissions, but there are problems with waste disposal (and the infrequent reactor release). Wind and solar power are intermittent, an issue that could be mitigated in the future by development of energy storage methods. The levalized costs for these alternatives are higher than coal. Geothermal and hydropower for now can be regarded as supplements. In the US fracing gas has largely replaced coal, and carbon emissions have decreased. Europe has been influenced by the Fukishima nuclear disaster and the movie “Gas Land”, and greenhouse gas emissions there are stable. In China burning coal has increased carbon emissions by 3 gigatons from 2005 to 2011, but their electricity is cheap. The energy scenarios could change by solving the energy storage problem. Compressed gas in caverns, pumped hydro, flywheels, and chemical batteries are some of the energy storage options to be researched in the future. Energy is also a main component in national security, and this concern must be balanced with environmental issues.

The five critical "E"s that must be considered together are energy, economy, environment, efficiency, and education. Also, there is much disparity in standard of living throughout the world - half of the population is still concerned about eating, clothing and shelter over their head. Collaboration between academics and industry will increase the databank and push development forward. Steve Koonin, the undersecretary for science in the Energy Department during President Barack Obama's first term, wrote an article on climate change in the Wall Street Journal to illustrate the uncertainties inherent in this subject.

In answer to questions: thorium for nuclear reactors has possibilities as it is abundant. Fusion energy is 30 years away and always will be. Compressed air in caverns is a good prospect for energy storage. For CO_2, geological sequestration is probably the best bet,

although capture is a problem. The world emits 54 trillion tons of CO_2 every year. Sequestration is technically feasible, but expensive. Oilfield CO_2 sequestration won't contain all of the resource, but it is great driver for developing infrastructure. In regard to methane hydrates (methane locked in ice in deep marine or arctic environments), we don't really know the size of the resource, but it is considerable. The BEG uses an estimate of 1% increase per year due to technology when making their resource estimates.

The slides from this lecture can be downloaded here.