Redefining Energy Security in the 21st Century

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Abstract
In the 21st century, climate change and fossil fuel reserve depletion both pose challenges for energy security, as well as for general wellbeing. We propose a redefinition of energy security as the ability to meet the basic energy needs of the population in a sustainable way.
The distinction between non-renewable and sustainable sources and the distinction between basic energy needs and additional (non-basic) energy needs help clarify the path ahead for 21st century energy security: renewable energy development for meeting basic needs should be prioritized. The triple approach of combining efficiency, sufficiency and renewable energy opens opportunities for long-term energy security.

1. Introduction

Energy security poses new challenges in the 21st century. Traditionally energy security has focused on security of supply. In the 21st century the abundance of supply turns into a potential problem, because reserves are so plentiful that disrespecting the physical limits of the global climate system becomes tempting. Governments have agreed that global warming must not exceed 2°C, effectively limiting the amount of „burnable" fossil fuels to a small part of current proven reserves.[1] The key challenge now becomes to swiftly phase out the burning of fossil fuels while still ensuring energy security. This calls for a redefinition of the very concept.

The complete decarbonization of the world economy this century is inevitably linked to maintaining a fairly stable climate.[2] But its timely implementation seems to be a great challenge. Whether human society will come to meet that challenge remains to be seen and depends largely on decisions taken in the sphere of fossil energy supply. As an example, the remaining recoverable reserves of Chinese coal (roughly 150 Gt[3], equivalent to 300 Gt CO2 if burnt) are equivalent to almost 50% of the remaining global carbon budget for a 66% chance of staying below 2°[4], in itself a very risky gamble.

The current article proposes a new definition of energy security that may make it possible to find a path that links the fossil energy present with the clean energy future without sacrificing energy security, instead rather enhancing it.

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[1] McGlade, Christophe & Ekins, Paul (2015) The geographical distribution of fossil fuels unused when limiting global warming to 2 °C. Nature 517, 187–190.
http://www.nature.com/nature/journal/v517/n7533/full/nature14016.html

[2] Anderson, Kevin (2015) Duality in climate science. Nature Geoscience (2015). http://rdcu.be/eoQY

[3] Wang, Jianliang, Davidsson, S., Höök, M., Lianyong, F. (2013) Chinese coal supply and future production outlooks. Energy, 60: 204-214. http://dx.doi.org/10.1016/j.energy.2013.07.031

[4] Ibid.

The key point is a separation of basic „needs“ from non-basic „wants“. While we will never be in a position to meet everybody's *wants*, even if we pay the high price of sacrificing the climatic and ecological equilibrium of our home planet, meeting everybody's *needs* is within reach. By defining the limit between one and the other, we open the possibility for achieving 21st century energy security with clean energy.

2. Redefining energy security

Energy security has previously been defined as: "to assure adequate, reliable supplies of energy at reasonable prices and in ways that do not jeopardize major national values and objectives."[5] Traditionally, the topic of energy security has mainly revolved around oil, but recent contributions have increasingly included other energy sources[6][7] as well as taking into account environmental concerns such as climate change.

A question that has rarely been asked in energy security research is: for how many generations is energy secure? Another question that is rarely asked is: what will the energy be used for? Our definition takes these aspects into account.

We define 21st century energy security as

the ability to meet the basic energy needs of a population in a sustainable way.

Sustainable means very long-term. Seven human generations are an appropriate timescale for a true sustainability analysis. Fossil fuels do not pass this test. They can only be bridges to 21st century energy security which is necessarily through renewable energy.

Basic needs are defined as the material minimum for a healthy, dignified human life. A rough categorization puts basic food, water, housing, clothes, health care and communications in the basic needs category, whereas leisure activities, luxury articles, private cars and air travel belong into a second category which we label "*wants*".

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[5] Yergin, Daniel, 1988. Energy security in the 1990s. Foreign Affairs 67 (1), 110–132.

[6] GEA (2012). Global Energy Assessment – Toward a Sustainable Future, Cambridge University Press, Cambridge, UK and New York, NY, USA and the International Institute for Applied Systems Analysis, Laxenburg, Austria.

[7] Jewell, J., A. Cherp and K. Riahi (2012). "Energy security indicators for use in Integrated Assessment Models. LIMITS deliverable 4.1. Accessed at: http://www.feem-project.net/limits/docs/limits_d4-1_iiasa.pdf.

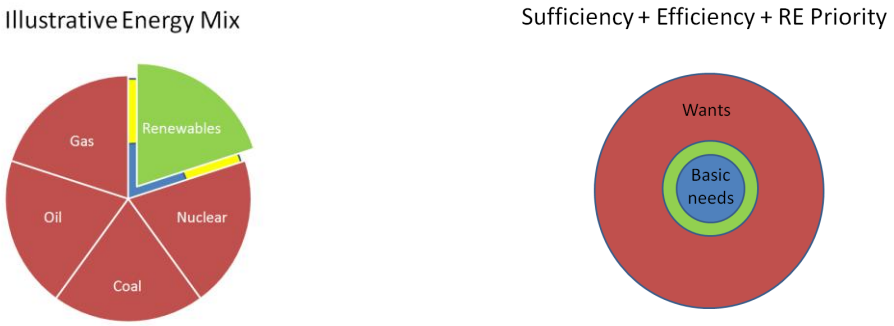

Figure 1. Reconfiguring energy supply for 21st century energy security, with a focus on securing basic needs (blue) with sustainable energy (green) vs. non-renewable energy (brown)

By separating basic needs from optional wants we manage to lower the bar for the target of energy security to be achieved and prepare the ground for a phase out of fossil fuel extraction and burning. As fossils move away from center stage in the national energy strategy, fossil fuel price volatility becomes less relevant and conflict over fossil fuel access less likely. From the long-term perspective, basic needs must eventually be met sustainably. Whether basic needs are met is a key success criterion of a society. How many wants are met is not as relevant, and can be considered as optional. In the fossil age, coal, oil and gas enable us to live sumptuous lifestyles – sumptuous as compared to our own grandparents for example, or as compared to the poorer members of our human family. Because fossil fuel emissions have turned into an essential problem, the ability of a society to restrict the burning of fossil fuels for excessive consumption is also a success criterion.

A situation where basic needs are met by fossil fuels is not desirable under the concept of 21st century energy security. It is characterized as a dangerous "fossil fuel addiction". Breaking with such addictions opens up the possibility for a more rapid transformation to an energy-secure post-fossil society.

3. Combining sufficiency, efficiency and renewable energy

Saving energy has long been an important component of energy security strategies in China. The same ends can often be achieved with less ressources through good design and modern technologies. Examples include residential retrofits for heating savings, efficient public transport, energy-efficient household appliances, avoiding excess packaging and even a reduced meat diet. Saving energy is one way to increase efficiency that has already been squarely identified and acted upon in China, even though further progress can surely be made.

By combining efficiency with sufficiency, the overall amount of energy needed for meeting basic needs can be reduced even more. This is an important step on the way to 21st century energy security where the portion of basic needs fits within the supply of renewable energy (see Fig.1).

Ultimately the goal is to meet at least all basic needs with sustainable energy and phase out the burning of fossil fuels, a stage not yet reached in Fig. 1.

Figure 2. Sufficiency perspective on energy supply; Efficiency-improved sufficiency perspective

Fig. 2 distinguishes between basic needs (blue) and optional "wants" (yellow). Efficiency can reduce the amount of energy necessary for meeting basic needs. Wants are unaffected, since they tend to adapt flexibly to whatever amount of energy is available.

4. Example applications of 21st century energy security

Example 1: Coal in China's 21st century energy security

Coal provides for many of the basic needs of the Chinese people today. This is problematic, because coal burning is a key driver of the climate crisis and reserves are exhaustible. Ultimately recoverable coal reserves in China have been estimated at around 220 Gigatons,[8] with about 70 Gt already extracted and burnt. Chinese coal production is expected to peak between 2015 and 2030 and what follows will be a steady decline. Within a lifetime, the coal age will definitely be over. The end game of coal in China is defined by two conditions:

1. Chinese reserves of coal do not allow for a continued growth of the current "coal-based civilization". The peak in coal extraction is imminent in the next few years and a decline thereafter inevitable.[9] From a historical perspective, the fossil age represents a very brief section of Chinese history. The end of coal burning over the next decades is already foreseeable.

2. The overall amount of Chinese coal extracted is one of the key factors determining the future fate of the climate on our home planet. Beyond 2°C of warming looms the danger

[8] See footnote 3.

[9] Ibid.

of triggering global run-away climate change – warming that cannot be stopped before making wide parts of the world, particularly coasts and dry areas, uninhabitable for humans. The speed of the Chinese coal phase-out is of crucial importance for the planet's climate.

As the transition from coal to renewable energy happens, focussing on basic needs first can ensure that these will continue to be met in the post-coal era. As the impacts of the climate crisis begin to show, governments may wish to increase mitigation ambition. Enhancing 21st century energy security by reducing the coal dependency of basic needs can open the way for increased mitigation.

Example 2: Multistep electricity prices (阶梯电价)

Provision of basic electricity services – powered by renewable energy is one key goal of 21st century energy security. The application of staggered tariffs which make basic consumption cheap and increase as the level of consumption exceeds the basic needs are a very good example of a mechanism where this principle has been successfully implemented.

Example 3: The family car

A family car is a very prominent example from the "wants" category. It is not a basic need and many generations before the invention of the automobile have fared well without it. From a 21st century energy security perspective, efficient and affordable public transport is the priority. Advanced information technology together with new business models that focus on mobility instead of selling the "product" car will make the privately owned family car which stands still for 95% of the time a thing of the past.

Example 4: Airplane flights

Flying is the most energy intensive mode of travel and thus is firmly placed in the "wants" category and a candidate for high taxing, because airplanes will most likely not be run on clean energy any time soon. Many flights will effortlessly be replaced by advanced communication technologies, once prices are high enough to eliminate the economic incentive of flying. Comparing China and the United States of America – two countries of similar geographical size – from a 21st century energy security perspective, China is in a much better position through its well-developed network of high-speed rail than the United States which rely heavily on air travel.

5. Conclusion

We believe to have shown how the basic needs of a population can become the primary focus of 21st century energy security efforts. The literature on basic human needs is not well consolidated at this point. Several scientific, political and spiritual approaches exist, yet there is no widely accepted model. This leaves policymakers with the task of piloting feasible candidates for drawing

a limit between basic needs vs. wants. In order to move the new energy security agenda forward both science and politics have a role to play. There are Chinese concepts that can help establish an approach. For basic needs, the concept of "Shiyizhuxing" (食衣住行) can be a starting point for focussing efforts of the clean energy transition. A "Well-off society" (小康社会) is a goal area that can become more relevant as needs and wants start to be distinguished in energy policies. The idea of an ecological civilization (生态文明) is not imaginable as one powered by burning fossil fuels. Inernationally, there are also helpful concepts for orientation: the "Self-sufficiency economy" in Thailand[10], "Buen vivir" ("Good living") in Latinamerica[11], "Gross National Happiness" in Bhutan[12], the "Common-good economy" in Austria[13]. All of these point into the direction of a post-fossil society. Reorienting the priorities in energy supply towards 21st century energy security can help bring these visions to life.

In today's China, there is no energy security without coal. The key challenge can thus be characterized as replacing the heart of the Chinese energy landscape, securing basic needs with renewable energy as soon as possible. The proposed concept of 21st century energy security may provide strategic guidance to manage the 21st century energy transition in a successful and socially just way.

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