How Much Energy Do We Need? - In support of an End-Use Based Estimation of Energy for Decent Living

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Abstract

How much energy we need for a decent standard of living for everyone is a question at the heart of energy planning, but rarely addressed. Generally, such estimation is based on a desired GDP growth. However, even achieving this GDP may not necessarily ensure satisfaction of everyone's basic needs. Energy planning should link energy and its end-use and end-user directly, promoting equity, and providing a better monitoring framework for energy use. End-use focussed, bottom-up, disaggregated energy planning is such an approach and we urge that this should be the basis of energy planning in the country.

Commentary

As India grapples with rising aspirations of a billion plus people, the abject energy poverty of several hundred million, and concerns of resources and environmental degradation, a question that assumes great importance is "How much energy do we really need?" The answer to this question critically depends on another question – "Energy for what?"

Answers to these twin questions are important at many levels like infrastructure planning, energy security, determination of social and environmental disruption that can be accepted as "justified" etc. It is also critical for equity concerns as well as in the climate change debate especially in the light of on-going international negotiations.

Unfortunately, energy planning in India has tried to answer the first question without giving adequate and meaningful thought to the latter. Underlying the energy planning process today is this equation representing the conventional wisdom of today's development paradigm:

Development = Gross Domestic Product (GDP) growth = Increasing energy use

It is not surprising then, that most energy demand projections are linked to energy requirements of specified GDP growth. However, this approach has several limitations. Some of these limitations are addressed by energy demand estimations that attempt to assess the energy requirements of specific developmental goals that represent decent living—also variously referred to as basic needs, good standard of living, dignified living etc.

In this note, we review various methods of energy demand estimations, looking particularly at some bottom up, disaggregated approaches, and discuss their implications[1].

1 Review of existing studies about estimation of energy requirement for decent living

Energy estimation methods can be divided into three broad approaches though the boundaries are not sharp and this categorisation should be seen as a continuum.

The most common approach is the use of trend analysis, extrapolations or modelling to project energy required for achieving desired GDP growth. In such approaches, the link between energy requirement and specific developmental objectives is tenuous at best. GDP growth is taken as sufficient in itself or synonymous with meeting developmental needs. Moreover these projections often do not talk about its distribution among various end-uses and end-users. The Integrated Energy Policy (IEP) report (Planning Commission, 2006) and the Electric Power Survey (EPS) prepared by Central Electricity Authority (CEA) every five years (latest, 18th EPS published in 2011 (CEA, 2011)) are examples of this approach.

Other approaches project energy requirements for meeting more concretely specified developmental objectives, often represented by some proxies like the Human Development Index (HDI), an indicator of per capita income, health and education. For example, one approach uses the strong co-relation between HDI for different countries and their per capita electricity consumption to derive the electricity needed to achieve a desired level of HDI.

Finally, there are end-use focussed, bottom-up, disaggregated assessments of energy needed to meet specific developmental goals, where such a set of developmental goals form a detailed normative framework. For example, such a framework could specify the appliances each household should have, the extent of travel each person would be able to undertake, and so on. Two examples of this method are given below.

In the 1980s, Prof. Amulya Reddy and his colleagues estimated that 1 kilowatt per capita energy would be sufficient to provide a specific set of basic needs which represented a standard of living in some developed countries in the mid-1970s. (Goldemberg, Johansson, Reddy, & Williams, 1985). They listed various services and products that constitute a good standard of living, along with the desired per capita level of activity for each and estimated energy needed for this. Another example is primary energy requirement for specified basic needs for China, carried out around by Zhu and Pan (2007).

An important concern with the GDP-linked projections is that even if the energy demand is met, and GDP target also achieved, there is no guarantee that developmental objectives would be met. The other methods, by linking energy demand projections to specific developmental goals, emphasise that the allocation of energy to various end-uses and end-users is equally important to ensure that the specified goals are achieved. This can be a powerful tool to help energy sector become more equitable and effective in meeting developmental objectives.

We reviewed in detail several energy and electricity needs projections, together representative of all of the above methodologies. Following is a summary of the estimates for electricity and energy needed for India in the year 2032, calculated by us where needed, based on these studies.

Table 1: Total energy and electricity needed for India in year 2032 based on various approaches

Sr. No.	Approach / Study	Per capita in 2032		Total in 2032	
		Electricity (kWh)	Energy** (W)	Electricity (billion kWh)	Energy (Mtoe)
A	**GDP based approach**				
1	IEP, India	2643	1369	3880	1514
2	18th EPS, India	2703		3968	
B	**Achievement of certain desired outcomes**				
1	HDI-Electricity co-relation, HDI=0.7 (UNDP; World Bank, 2016)	2895		4250	
2	Expert Group on Low Carbon Strategies for Inclusive Growth, India				
2.1	Baseline, Inclusive Growth (BIG) scenario	2296		3371	1146
2.2	Low Carbon, Inclusive Growth (LCIG) scenario	2361		3466	1108
C	**Bottom-up approach based on normative framework**				
1	Amulya Reddy and colleagues	2315	1594	3398	1763
2	Zhu and Pan 2007, China	1195*	2452		2711
3	2000 W Society, Switzerland (Novatlantis, 2010)		2000		2211
	Actual for India in 2011-12	**884**		**1056**	**526**

*- Per capita electricity considers use only for household sector. Electricity use in other sectors is considered in respective sectors.

**- Energy includes primary energy needed for electricity generation.

2 Implications for energy planning

Our review suggests that there are serious limitations of using the GDP based approach for energy needs estimations. The bottom-up, disaggregated method offers a much more powerful approach, on which we will focus.

First, a word about the figures in Table 1.– In trying to derive a macro picture, these studies essentially take up sectors and end-uses with immense diversity (for example, variety of dwellings) and aggregate them to one single figure, in the process hiding wide variation found in real world. Thus, such estimates need to be taken as indicative rather than absolute. However, these numbers can provide important insights.

For example, the total electricity generation and primary energy supply in the year 2032 projected by the IEP and estimations based on the approach by Amulya Reddy and his colleagues are almost in line. This means that if the assumptions made by Reddy and others are met, then the energy supply projected by IEP can potentially provide the entire Indian population in 2032 with the standard of living that many developed countries enjoyed in the 1970s. Whether this actually happens will depend on whether the energy supply in 2032 is distributed among various end-uses and users in a

manner recommended by Reddy and others. The IEP itself does not present either any pattern for distribution of the energy or expected levels of standard of living in 2032. This highlights what IEP-like exercises lack, and also the importance of bringing distribution into energy projection and planning.

Thus, the most significant insight is that 'energy for what' is as vital as the issue of 'how much energy'. The end-use and end-user should be identified at planning and estimation stage and the energy should indeed go to meet these needs.

More broadly, these approaches reveal the following three fundamental elements.

1. Framework: The estimates start with a well-defined normative framework of specific goals (in terms of goods, services etc.) required for a decent living and estimate corresponding energy requirement. This makes the developmental goals of energy planning explicit.

2. Pathways: These estimates lay out the *distribution of the energy to specific end-uses (and end-users)* highlighting that not only does the energy need to be generated but that it also needs to flow through certain pathways.

3. Methodology: In laying out the pathways, the estimates also provide a *methodology for the estimation of energy required for various elements of specific developmental goals*. This allows identifying potential ways for meeting the same needs by lesser levels of energy along with other important co-benefits.

Approaches with these three elements also have other advantages. First, the pathways provide a template for subsequent monitoring of energy use—to ensure that energy is going to the correct end-use to achieve the claimed developmental goals. This can result in more structured and effective monitoring, and in the process, increase accountability of energy planning and its implementation.

This process also reveals where energy is a driver to meeting a goal, and where it plays a more secondary role. For example, for health care, what are the relative roles of a cold chain (needing energy) and other factors like proper training of health workers, public awareness, availability of medicines etc.? By revealing the precise nature of the role played by energy, a disaggregated energy needs assessment can assist in development of policies, supporting interventions and cross-sectoral linkages that are necessary to make energy interventions effective in realising developmental goals.

Such estimates indicate what levels of energy supply are necessary for a life with dignity. Therefore, they also offer pointers to which energy needs can be considered as being beyond basic needs. This offers important boundaries in terms of what social and environmental disruptions can be considered as acceptable and justifiable, as they may be necessary to meet the basic needs.

A word of caution is in order here.

The mere fact that a certain amount of energy supply is required for basic needs should not be seen as a blanket sanction for each and every energy project. Individual projects must get their sanction depending on their costs, impacts, broad public acceptance, and after establishing that they are indeed the least cost and most appropriate option.

Thus, an important learning from such bottom-up, disaggregated approach is that just planning for capacity expansion or energy generation is not enough unless the *policies, processes, pathways and structures too are simultaneously created to ensure that the energy ends up meeting specified developmental goals*. In other words, energy requirement estimated for meeting basic needs will meet basic needs if it goes to meet basic needs. One cannot calculate it for basic needs and then divert it for other needs.

This also presupposes *the specification of such developmental goals* and *underscores their centrality to energy (supply) planning.*

3 Sustainability of energy supply

One important question is whether the energy required for a decent living can be obtained in a sustainable manner. HDI –energy related studies show that almost every country that has an HDI greater than 0.8, and even 0.7 (the desired goal) has an unsustainable ecological footprint.

This highlights that sustainability of energy supplies will be an important consideration or constraint in energy planning. Hence, prioritisation of energy use for basic needs is crucial given the high likelihood of unsustainability of current energy supply systems. The principle here is that if anything at all can justify unsustainable means of energy supply, it is that this energy is needed for basic needs of the people. Third, it appears that current global energy supply is probably enough to meet the basic energy needs of everyone on this planet if it is distributed equitably. For example, literature reviewed indicates that an energy supply of 1200 to 1800 kgoe/capita/year would be needed for a dignified living, whereas the per capita total primary energy supply in 2011 was almost 1880 kgoe (IEA, 2013, p. 48). Thus, there is enough energy to meet basic needs as per these studies; but it is highly unevenly distributed among and within countries.

Of course, even the current energy production is likely to be unsustainable. However, more equitable distribution of existing and future energy supply can be a powerful way to meet energy needs in a more sustainable (or less unsustainable) manner. Indeed, possibly it may be the only way to do so.

Lastly, we need to make all efforts to shift towards sustainable energy sources and production methods. At the same time, it would be imperative to re-examine the entire gamut of our energy needs (globally) and to see possibilities of its reduction. For it is unlikely that the planet will be able to sustain the kind of energy needs exhibited by the high energy consuming societies.

4 Conclusion

To conclude, a bottom-up, disaggregated approach to energy planning can help us answer the question of how much energy we need for ensuring dignified living. The process by its very nature also indicates end-uses and end-users for the energy, which is equally important. It can also offer insights into the best way to meet a particular developmental goal from the energy perspective, the relative criticality of energy as an input to meet the specific goal, and the policies and cross-sectorial linkages that are important to ensure that energy used does indeed help meet the objectives. Last but not the least, such an approach can facilitate the monitoring of the implementation and increase its accountability.

Given all this, it is strongly recommended that such an approach be enshrined as the basis of energy planning in the country.

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[1] This note is based on a detailed report published by Prayas (Energy Group), titled: How Much Energy Do We Need: Towards End-Use Based Estimation for Decent Living, available at http://www.prayaspune.org/peg/publications/item/298-how-much-energy-do-we-need-towards-end-use-based-estimation-for-decent-living.html