

Sustainable Energy For Sufficiency Economies: Methodological Insights From Buddhism

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Introduction

To assess the actual gains in welfare that are provided by investing and developing in different energy systems, there has been an increasing shift towards analyzing choices in terms of “sustainability” (Santoyo-Castelazo and Azapagic 2014). The key to evaluating sustainability, rather than simply the direct monetary costs and benefits involved, is to stretch the scope of concern across the full range of economic, environmental and social costs and benefits. Fricker (1998, p. 367) notes how “sustainability is presently seen as a delicate balance between the economic, environmental and social health of a community, nation and of course the earth”.

If developments are judged well in terms of sustainability, then they are good at maintaining the capability of natural (and social) capital to meet the needs of future generations. Sustainability is a contested area, but those who embrace it beyond a subverted interpretation as “long-term business viability”, tend to agree on a number of less explicit but inter-related criteria such as (1) well-being and societal aspects (do outcomes really enhance individual and community well-being?) (2) equity (fairness and meeting the needs of all people, now and in the future; possibly extended to include other species) and (3) culture (protection of local cultural identity or “capital”) (Lowe 2009).

The concept of the “ecological footprint”, is now a well-known and widely utilized means of assessing the general nature and sustainability of environmental impacts of different economic activities (usually the consumption of different products or product classes). It does this by assessing natural resource demands and comparing them to the amount of ecologically productive land available to supply these resources on an ongoing basis (Wiedmann and Barrett 2010). However, the concept has been rapidly extended to cover a wide range of resources and effects (for example, carbon footprints and increasingly a diverse range of social footprints) and it is no longer necessarily tied to measures of demands upon land areas.

In this paper, we draw upon Buddhist insights to develop and tentatively apply the concept of sustainability “footprints”, to alternative energy sources. Extra-somatic energy has absolutely fundamental to the maintenance and dynamic of human systems since the first ancient agricultural settlements. In recent centuries, the development of fossil fuel resources for energy and other economic output has defined and shaped most societies and is a major driver for environmental, social and economic impacts. Hence, energy is a pivotal subject for study – a critical issue for careful and informed management. As with all central dimensions of daily life, Buddhism has many insights to offer for the sustainable management of energy resources (that is, relevant choices that will promote true long-term well-being for society).

Background And Paper Structure

This paper builds upon a previous study, by the author, outlining the potential contribution of Buddhist perspectives to assessing and guiding sustainable energy use.¹ The earlier paper reviewed existing energy assessment approaches and underlined the limitations of typical financial analysis evaluation approaches (even when augmented by market inclusion of “spillover” effects). It was proposed that practical wisdom from Buddhism has a simple and workable framework basis for enhancing true long-term welfare assessments of energy system options. This provides a decision-making logic and rationale amidst the formidable complexity related to assessing the costs and benefits of energy of different forms, technologies and applications.

The relevant practical wisdom of Buddhism stems from the primacy of the underlying profound interconnectedness and related concepts of interdependent well-being in its world view. Both Buddhism, and contemporary tools adopting full impact sustainability analysis, share the conclusion that judgements about the “goodness” of possible actions are inevitably fraught with complexity and uncertainty. The paper argues that, from Buddhism, a central maxim guiding decision-making and the basis for practical wisdom can be linked to a simple rule – *minimize intervention in (or “disruption”, “harm” or “violence” to) the social and natural worlds*. In the new sustainability analysis approaches, this is manifest as the minimization of society’s biophysical throughput or metabolism, and other negative externality effects that flow on in cause-effect chains across space and time.

Hence, it was proposed that a plausible, effective criterion for sustainability assessment of this critical domain of human action, could be found in the form of a *kamma-vipaka* index². Drawing upon the Buddhist world view and the goal of harmonizing energy use in terms of minimizing its harmful impact of the external world, this sustainability assessment criterion is intended to effectively identify minimum intervention or disturbance levels as indicators of the net well-being effects of energy options. The aim is to evaluate and identify options (and related technologies and patterns of use) with the lowest overall lifetime costs (including supply chain and extended flow-on effects) or the “least-harm” options (perhaps per unit of direct energy service provided). Of course, this would also require knowledge of how the energy application contributes directly to well-being in the provision of goods and services.

More comprehensive assessment of major economic sub-systems (such as energy) is already undergoing active development. Integrated sustainability assessment is growing rapidly in interdisciplinary fields such industrial ecology, sustainability science and ecological economics. For an energy systems example, see Santoyo-Castelazo and Azapagic (2014, p.121) who devise a “generic methodology that can be applied to different energy systems, allowing an integrated sustainability assessment of future scenarios on a life cycle basis ... [going] beyond previous research to develop a decision-support framework for an integrated sustainability assessment of energy systems where environmental, economic and social aspects are considered in parallel, enabling decision makers to incorporate different preferences for sustainability criteria and identify most sustainable options. The framework takes a life cycle approach and incorporates a range of sustainability indicators which are used to assess the sustainability of different electricity scenarios, using multi-criteria decision analysis.”

¹ See “Buddhism, Climate Change and New Approaches to Energy for Sustainable Economies” presented at the 2014 United Nations Day of Vesak (UNDV) Celebrations and Academic Conference 7-11 May 2014 (Daniels 2014).

² This will be described in more detail in Section 3. The moral law of *kamma-vipaka* is one of central teachings of Buddhism. *Kamma* is the action and *vipaka* the result, though the word *kamma* tends to be used to cover both actions and results (Buddhist Society, 2015).

So what can Buddhist insights add to this substantial step increasing coverage and methodological sophistication in the sustainability assessment of energy systems? As will be discussed in the next section, on the one hand, Buddhism offers an extended vision in terms of understanding the causes of “harm” to human well-being. This is based on the influences and implications of the intent-thought-action process. The broader scope actually facilitates the proposition that Buddhism offers the simple rule that “more disturbance will lead to more harm” thus facilitating the possible identification of a more limited set of measures to assess sustainability implications of energy options.

This is a significant aim of this paper: to work towards a conceptual framework and methodology for identifying and applying key Buddhist “criteria” that can help deal with immense complexity that technical assessments cannot, alone, resolve. They would effectively represent the level of intervention or harm associated with alternate options. Ideally, there could be a “master” proxy or general *kamma-vipaka* indicator that correlates closely with a wide range of socioeconomic metabolism and other sustainability impact indicators.³ The guiding maxim is that of minimizing intervention given energy supply benefits.

However, the exploratory method deployed in this paper utilizes various indicators aligned with the key Buddhist principles as a first step in the eventual development of a framework for a simple and effective *kamma-vipaka* assessment approach. In particular the exploratory analysis examines assessment criteria that might be derived from key dimensions of Thailand’s King Bhumibol Adulyadej’s philosophy of the “sufficiency economy”.

Hence, the approach adopted is based on faith that the maxim of minimizing harm impact or intervention is likely to be eventually more effective (if difficult to measure) sustainability assessment approach than a diffuse set of techno-environmental criteria and the subjective assessment of top priority criteria from a restricted set of stakeholders.

The following section provides some more detail on the close and useful linkages between the notion of ecological and other “footprints” and the Buddhist notions such as universal interconnectedness and *kamma-vipaka*. This is followed by a description of the exploratory method used to create a “*kamma-vipaka* footprint” index. Section 4 briefly presents tentative results of an initial analysis of 12 nations with significant proportions of Buddhist people in their populations, and 10 other nations for comparison purposes.

Sustainability Footprints And Buddhism

The “greening of Buddhism” or perhaps more appropriately, the incorporation of Buddhist-compatible insights into modern thought about human-nature relations, has quite a long history.⁴

There are many aspects of the links between Buddhism and pro-environmental thought which seem to have little relevance to popular understanding of the discipline of economics (for example, eco-psychology, romanticism, and affective aspects of quality of life and well-being). Indeed, it is common to consider that the juxtaposition of the notions of Buddhism and economics is paradoxical. However, when economics is recognized as being primarily concerned with the way people, in any society, “make their living” and meet their needs (food, shelter, clothing and other goods and services)

³ Some of the best potential “master” indicators for the *kamma-vipaka* sustainability index are listed in Daniels (2014).

⁴ For useful descriptions of some relevant seminal works, see Kaza (2006), Tucker and Williams (1997), Batchelor and Brown (1994), and Kaza and Craft (2000).

in the face of material and temporal scarcity, then there is a clear basis for an inherent and strong connection between economics and the Buddhist world view (Daniels 2003). The Buddhist world view has a multitude of relevant dimensions for the “economic” management of resources and energy planning – activities that are more intrinsic to economics as field of study than the specific neo-classical economic approach that tends to presume that more transformation of nature and consumption of related products, means greater welfare. When economics is seen to focus upon getting the most well-being out of existing resources (and well-being is understood in the context of the longer-term and profound inter-connectedness), then the Buddhism-economic nexus is self-evident.

The potential contributions of Buddhism for the sustainable management of energy for society are derived mainly from the same four aspects of Buddhism as those for most foci in economic studies. While they may vary in the extent to which they provide insights for the energy resource management, the four aspects are (1) universal interconnectedness, (2) the law of karma or *kamma-vipaka*, (3) the Four Noble Truths, and (4) the Middle Path, minimum intervention and other behavioral guides that emerge from the Eightfold Path as the means for improved well-being (reduced suffering).

The dhammic underpinnings of the Buddhism-sustainability interplay have been discussed widely in existing literature and we will not outline this case in depth again here. For detailed discussion on this topic see Daniels (2007), Payette (1994) and Wagner (2007). However, a few key Buddhist sources of insight for sustainability are summarized in the following paragraphs.

Note that the overlap with sustainability concepts is not a result of “mining” for the green parts of Buddhism. The four aspects listed above are fundamentals of the Buddhist world view and their implications for sustainability are quite clear and unambiguous. This is not meant to imply that all Buddhist teaching are relevant, useful or compatible in terms of sustainability. Indeed, some aspects, such as non-attachment and possible fatalism, have been deemed as opposed to sustainability. The approach taken here is to glean insights and practical wisdom from the Buddhist tradition, and it is proposed as a useful goal for the effective management of energy resources and decisions about energy system options.

The proposed relevance and potential usefulness of Buddhism wisdom is derived largely from the essential Buddhist cosmology of the fundamentally interconnected nature of the three spheres of human existence:

- (1) the individual realm (covering existence, thought and action);
- (2) the collective interrelations or institutions that form society; and
- (3) the rest of the natural world (Yamamoto 2003).

In this universal ecology, the “ripples” from events or state changes in one realm directly spill over into the others – spatially, temporally and transcendentally – and bounce back upon the originator’s own welfare. In accordance with the a growing overall societal trend towards holism, this basic perceptual framework is highly compatible with the important new wave of environment sciences (for example, ecological economics, ecology, contemporary social ecology and natural health with their paradigmatic shift towards the primacy of nature and the “embedding” of humans, and their artefacts and built environment, within the rest of the natural world.)

Feldman (1998, p.1) describes how *paticcasamuppada* “is a vision of life or an understanding in which we see the way everything is interconnected—that there is nothing separate, nothing standing alone. Everything effects everything else. We are part of this system. We are part of this process of dependent origination.” Similarly, Wagner (2007 p.333) notes that the “Buddhist approach is based on a concept of

universal interconnectedness, mutual conditioning and a radical interdependence of all phenomena, and in this respect quite close to modern system theory. In the classical scriptures, reality is compared to a sacred net of many mutually interwoven strings at countless levels.” Macy (1991, p. xi) also notes how the Buddhist perspective is consistent with a pronounced shift in scientific thought towards a “dynamic, systemic, process view of reality”.

The interconnectedness between the three spheres of human existence (individual, society and nature) also underlies the natural order and karmic causality principles that explain the centrality of compassion in the Buddhist world view and highlight the importance of careful reflection upon the full, long-term consequences and intent of production, consumption and other human actions. As every action affects the whole universe and the self only exists in relation to others, actions that exploit the social or material world are self-injuring. The unified and interconnected nature of the universe suggests that “violent” action or intervention that consumes and damages the natural-material world, will have adverse repercussions in direct proportion to the extent of intervention.

Such pervasive inter-connectedness necessitates a profound respect and loving-kindness and compassion that extends to the natural environment and the understanding that what harms nature, will in turn, harm people (Batchelor and Brown 1994).

In Buddhism, the law of dependent origination explains how all outcomes, results or effects (*vipaka*) of speech, action or body arise from a multiple causes or actions with intent (*kamma*). In turn, these causes arise from other *vipaka* and phenomena cease when the pre-conditions change. This is basis of the law of *kamma-vipaka* which adds the qualitative aspects by identifying how ignorant action with “unskillful” or bad intent will lead to adverse results across the three realms (society, nature and back on self). “Skillfulness” is gauged by the extent to which craving, greed, delusions or aversion are embodied in the underlying motive and intent of the original action (Attwood 2003).

With dependent origination, all phenomena in reality are seen to only have a contingent existence - one that is dependent upon its connections to, and the condition of, other phenomena (XIV Bstan-'dzin-rgya 2001). Despite their seeming independence, the condition and character of all entities are determined by that of all other entities in the universe through a complex web of cause and effect (also referred to as “interbeing” (Hanh and Eppsteiner 1998)).

Given the primacy of interdependence and the law of *kamma-vipaka*, it becomes critical to carefully examine the means and implications involved in using energy for gains in economic well-being. If the underlying energy sources involve high levels of intervention and disturbance from the initiating source (for example, many fossil fuels), then the web of cause-effect relations between the three realms will have unintended negative consequences for the well-being of the instigators. This is apparent with the troubling climate change, infrastructural vulnerability, and political conflict that is now confronting the current carbon-based world economy. Such sensitive interdependence in the “karmic ecology” (Rankin 2009) (that includes human and all of the conditions that determine their well-being) portends the inherent wisdom of the Buddhist advocacy of the “Middle Way” with its careful focus upon moderation and meeting true well-being needs with minimal and non-violent intervention.

The Four Noble Truths are (1) “there is suffering” — existence inevitably involves persistent dissatisfaction and related impermanence; (2) there is a cause of this suffering; it is attachment to desire (in its various forms); (3) there is a way to end suffering and achieve peace — cease attachment to desires as they seek and rely on sources which are intrinsically impermanent, and, (4) the way out of suffering is the

Eightfold Path (Sumedho 1992). Guided by the essentially interconnected nature of reality, behavior that minimizes disruptive intervention, in reality is rational and the Eightfold Path is dominated by the humanistic principles of “Right Conduct” or “non-harm” action and associated knowledge, intentions and mental conditioning underlying such action. Economic behavioral implications of Buddhist philosophy include the “Middle Way” with its moderation of desire and frugality in material consumption.

Under the Four Noble Truths, consumer society craving and attachment to ever-increasing output (and its energy resource and natural resource demands) cannot be assumed to really increase well-being without consideration for the nature, distribution and sustainability impacts of consumption. Buddhism has many other aspects that can affect overall demands for energy via the level, composition and technological means of production (see Daniels 2010). Overall energy demands are not a primary focus here. The *kamma-vipaka* assessment explored is more about the likely disturbance and full “suffering” (well-being) associated with per unit energy of various types. However, overall energy demands are, of course, highly relevant for decisions about energy planning and socioeconomic plans designed in the true long-term interest of individuals and societies deeply interconnected and embedded in nature.

Given this strong “ecological” inter-dependence imbued in the Buddhist world view, it is only a small step in drawing a close relationship between the law of karma and notions of ecological and other “footprints” of human activities. Ecological footprints have a distinct karmic aspect – damaging one’s world will come back on the instigator given the interdependence. The notion of karmic footprint has been used in a broader sense as some kind of measure of generalized accumulated karmic load linked to personal socio-psychological aspects such as speech, conduct, intention, diet and other choices. Although related, the emphasis in this discussion is at more aggregated level, focusing upon the environmental, social and economic sustainability impacts or footprints of collective economic action, through the lens of the law of karma. The concept of “green karma”, consistent with this view, is now widely discussed.⁵

From a Hindu perspective, Rankin (2009) and Chauhan et al (2009) also analyses ecological footprint as a form of “karmic footprint”. Kraft (1997) employs a similar concept “eco-karma” to represent the “multiple, cumulative and inter-connected flow of impacts of human actions (and thought) on the health and sustainability of the Earth” (Kaza 2006, p.195).

However, while the notion of “karmic footprint” can be applied to ecological footprints, the full consequences of human actions also have social and economic implications. Indeed, the effects on environmental change are also largely felt back upon humans as social and economic effects. Hence, a more accurate depiction of karmic footprint would encompass not just ecological but also social, economic and moral aspects and this broader approach is adopted in this study. A similar view is shared in Hindu and Jain literature (which had a substantial influence upon early Buddhism).⁶

⁵ For examples of discussion of “green karma” notions see <http://www.thegreatbasininstitute.org/2013/11/carbon-offsets-and-reducing-our-ecological-footprint/>
<http://humanityhealing.net/2009/09/karmic-footprints/>
<http://insight.glos.ac.uk/sustainability/Education/unescoculture/Documents/Martin%20Haigh%20-%20UK%20-%20accepted%20template.pdf>
<http://trumpeter.athabascau.ca/index.php/trumpet/article/viewFile/1072/1471>

<http://www.thedailyawe.com/2011/01/whats-your-karmic-footprint/>
<http://climatecolab.org:18081/plans/-/plans/contestId/1300207/planId/1309311>

⁶ For example see <http://www.kindredspirits.ws/Past%20Events/reducing-karma.html> and <https://www.theosophical.org/publications/1268>

Energy *Kamma-Vipaka* Footprints – An Exploratory Methodological Approach

The purpose of this paper is to develop and deploy a simple, exploratory methodology for constructing an experimental *kamma-vipaka* index or footprint to help in the sustainability assessment of alternate energy systems. It follows a simple procedure to initiate this process. Firstly, the *kamma-vipaka* footprints (KVF) of a sample, aggregated range of energy sources are constructed from indicative estimates of four types of more specialized footprints – environmental, social, sufficiency economy (inverted given a “sufficiency economy” is posited as a desirable condition), and a general proxy of the greenhouse gas emissions or carbon footprint. Secondly, these energy type KVFs are applied to a per capita energy units for each primary energy source consumed for a selected set of countries to generate an experimental national per capita KVF. While GHG emissions are included in both the environmental footprint and as a standalone footprint, this has been intentional in order to test the potential capacity of this indicator to represent overall disturbance or “harm”. It does involve some double-counting but the indicator is only one-fifth of the environmental footprint value and the GHG footprint has a relatively light weighting in the comparison and KVF value.

The use of data and results is presented for illustrative purposes only and to establish and encourage a basis for further development of a sustainability assessment methodology that draws upon Buddhist insights about the nature of changes for positive well-being developments.

In view of their relevance to the Buddhist world view, a key set of 12 nations with significant Buddhist populations have been selected (see Table 1). It can be seen that several nations with less than 25% of their population recorded as Buddhist have been included. This is based on the recognized modern historical influence of Buddhism in these countries and relatively high levels of people who are unaffiliated or in folk religions that may suggest implicit higher levels of Buddhist influence but this is not confirmed and there is substantial variation in the extent and form of Buddhism across these nations.

Ten other countries have been included in the analysis for comparative purposes (Australia, the United States, United Kingdom, Germany, France, Finland, South Africa, Brazil, India and Indonesia).

Note that, in line with typical footprint studies, the analysis is undertaken from an energy consumption perspective rather than energy supply or production.

Table 1 Nations Included in the analysis (with significant Buddhist population %)

Percentages of Buddhists		% Folk Religion	% Unaffiliated	Total Buddhist + Folk	Total Buddhist + Folk + Unaffil
Cambodia	96.9%	0.6%	0.2%	97.5%	97.7%
Thailand	93.2%	5.0%	0.3%	98.2%	98.5%
Bhutan	74.7%	1.9%	5.0%	76.6%	81.6%
Sri Lanka	69.3%	5.0%	5.0%	74.3%	79.3%
Laos	66.0%	30.7%	0.9%	96.7%	97.6%
Mongolia	55.1%	3.5%	35.9%	58.6%	94.5%
Japan	36.2%	0.4%	57.0%	36.6%	93.6%
Singapore	33.9%	2.3%	16.4%	36.2%	52.6%
South Korea	22.9%	0.8%	46.4%	23.7%	70.1%
China	18.2%	21.9%	52.2%	40.1%	92.3%
Malaysia	17.7%	2.3%	0.7%	20.0%	20.7%
Vietnam	16.4%	45.3%	29.6%	61.7%	91.3%

Source: PEW Research Center (2015)

Ideally, the search for an effective KVF measure would lead to one or a few master proxy or meta-indicators that could represent “harm”, “violence” or “disturbance” of intervention across the three realms. However, this ambitious goal is no easy task and while possible in the longer-term, it is deemed that a better approach is to progress towards this goal by investigating a range of individual sustainability impact indicators. The development, improvement and application of sustainability analysis tools (SATs) such as material flow analysis, life cycle assessment, environmental input-output analysis, and integrated assessment (e.g. integrated water resource management, and other bioregion and catchment based ecological analysis), would be vital for evaluating individual indicators and meta-indicators. A critical feature will be analysis at “program”, and full regional to global, levels rather than simple project analysis. The purpose of such tools would be to enhance the measurement of the likely ecological, social and economic disturbance/benefits of human actions and enable the tracking or mapping of “karmic streams” across the ecosphere (Kaza 2006). They are already developing rapidly in diversity, sophistication and data capability (Daniels 2003).

The analysis is based on a simplified and limited set of energy sources comprised of petroleum, natural gas, coal, hydroelectricity, nuclear and other renewables. Again, the purpose is primarily to initiate the development of the KVR methodology rather than to provide accurate and definitive results. The energy classes utilized are restricted and highly aggregated and the limitations of this simplification are fully recognized. For example, there would be a great deal of variation in the impacts associated with “other renewable” energy sources (which span wind, geothermal, biofuel, solar thermal and PV, tidal and other very different technologies).

Similarly, impacts will vary greatly across geographic settings and a much more detailed analysis would be required to capture this differentiation. Sustainability analysis tools (SATs) would need to be applied with specific region or national contexts. Resource costs, efficiencies, and externalities would be highly contingent on the particular settings involved.

The composition of energy sources by the study group of nations is presented in Figure 1. Unfortunately, the energy data used are for 2003 due to resource constraints

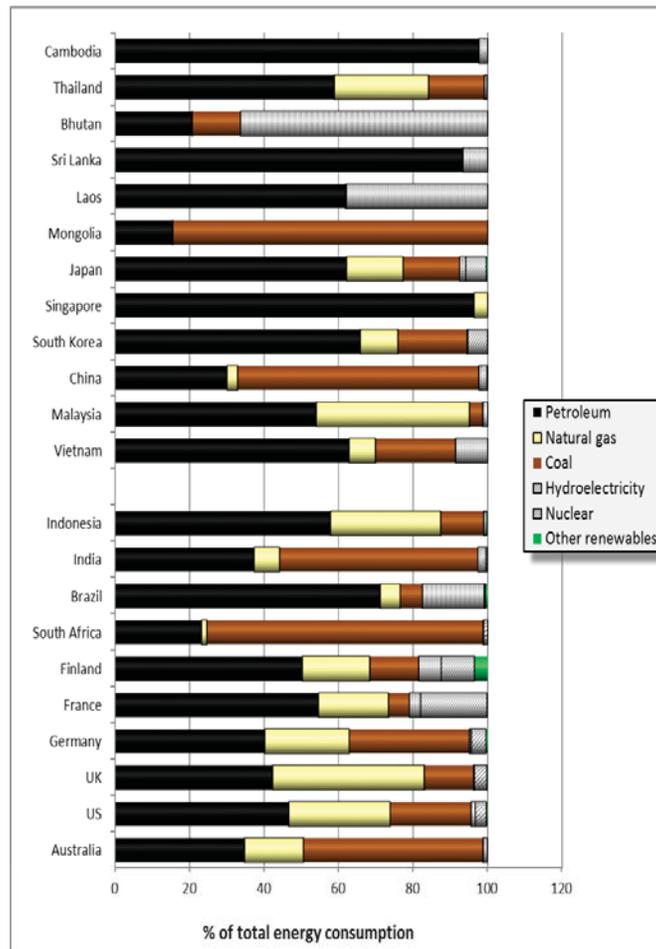
in completing the analysis. The mix of energy sources has undoubtedly changed considerably since this period but the methodological approach is highlighted over the actual results.

In 2003, the high dependence on petroleum and coal is noted for most of the nations with significant Buddhist populations, and the limited role for renewable sources is evident throughout all nations – including the higher income countries – with the exception of hydroelectricity in Bhutan, Mongolia, and perhaps Vietnam and Brazil.

The KVF has been constructed from these initial data by first rating the energy sources according to the four component “footprints” - environmental, social, sufficiency economy and greenhouse gas (GHG) emissions footprint. To do this a number of indicators of each footprint type have been selected on the basis of their typical use in existing studies. A list of these indicators and their weightings is provided in Table 2. These indicators are just intended as representative sets and are bound to be incomplete. Furthermore, the relative component indicator weightings and overall footprint weightings are somewhat arbitrary and based on personal evaluation from the author’s knowledge and research. Again, the illustration of the potential methodology is the key aspect rather than the accuracy of the attributed values. There are certainly more formal techniques available (for example, see Santoyo-Castelazo and Azapagic (2014)) using variations of methods such as multi-criteria decision analysis (MCDA) but the analysis has been restricted in view of resource constraints and the emphasis on demonstrating the methodology.

Ratings of 1 to 5 were ascribed to each of the 13 individual indicators, for the three composite footprints, on the basis of their estimated footprint (1 =low, 5=high) and an individual rating of 1 to 5 was allocated for the GHG footprint. All impacts were assessed in terms of the typical effect of the production and use of the energy in the study country and the countries or regions from which the energy was derived. The ratings for the individual indicator components in the sufficiency economy index were reversed so that the total measure for this index reflected negative effect rather the positive status attributed to compatibility with a sufficiency economy. It is not possible to provide a detailed description of the sufficiency economy philosophy but the representative set of indicators have been derived from the extensive descriptions of the relationship between the philosophy and sustainability as described in Na Ayutthaya (2010), Royal Thai Embassy Tokyo (2015), UNDP (2007), and Wibulswasdi (2010).

Figure 1 Primary energy consumption composition for the study group of nations - 2003



Source: Chow (2003)

Table 2 The indicator components and weightings for the energy *kamma-vipaka* footprint (KVF)

Indicator weighting in the individual footprint		Total weighting for each footprint in calculating the KVF
Environmental Footprint		1
GWP/GHG	1	
Eco Land Disturbance	1	
Risk 1 (Short-Term)	1	
Risk 2 (Long-term; Inter-generational; excl climate change)	1	
Other environmental externalities	1	
Social Footprint		0.7
Conflict	1	
Human rights	1	
Risk 1 (Short-Term)	1	
Risk 2 (Long-term; Inter-generational)	1	
Sufficiency Economy Index: (ratings are reversed for this index)		1
External dependence - % imported	1	
Scale - human scale, ability for local control	0.7	
Knowledge increase - from associated research and development need to enhance	0.5	
Sustainable use of key resources - renewability; fit natural cycles	1	
GHG Emissions Index		0.5

The ratings applied to each individual composite indicator and the GHG footprint are presented in Appendix 1. As noted, all of the ratings are somewhat arbitrary and would require (1) more extensive country-specific research for each energy source, and, in the longer-term, (2) the further development and application of SATs and the adoption of life cycle and full supply chain approaches and (3) consideration of likely future developments in relevant technologies.⁷

The indicator ratings were then weighted and summed to obtain the individual four footprint measures. These footprints were multiplied by the per capita BTU (British Thermal Unit) energy use of each type, and for each country, to estimate the four total energy use footprints. The summation of weighted values for the four footprints (according to Table 2) then generates the experimental overall energy KVF. The results of this analysis are provided in the next section.

Experimental Results – Energy *Kamma-Vipaka* Footprints

While the actual empirical results of this exploratory analysis are of minimal direct value, they are presented below in graphical format in order to help visualize and understand the initial energy KVF (*kamma-vipaka* footprint) methodology and facilitate its ongoing refinement.

The first graph (Figure 2) shows the individual footprints (and in total, the KVF) for each energy type. As discussed, the four individual footprints have been calculated as the sum of the relevant weighted component indicators (with their 1 (low) to 5 (high)

⁷ For discussion of the rapid growth in sophistication of multiregional extended input-output models that can track sustainability effects with specific trade flow across the world, see Wiedmann et al. (2007).

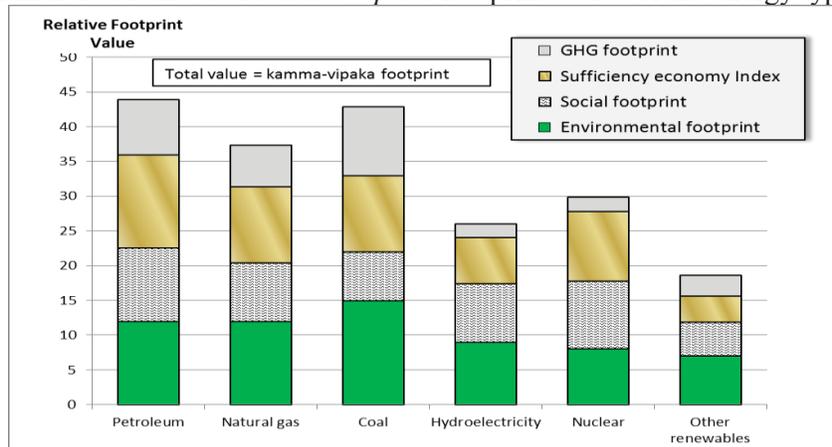
footprint ratings). The KVF is simply the sum of the weighted values for the environmental, social, sufficiency economy and GHG emissions footprint.

Though the results should be interpreted with much caution, the experimental methodology does yield results that tend to fit with expectations. The disturbance or harm levels of the fossil fuel energy sources are relatively high and the renewable sources fare well according to the criteria used in their calculation. The fossil carbon sources are high on all individual footprints and while hydroelectricity has a smaller KVF overall, this is largely due to the lower GHG and environmental footprints. The social footprint for hydroelectricity remains quite high. The “other renewables” renewables score quite well on every footprint type – especially the sufficiency economy and social measures and, to a lesser extent, GHG and environment.

The national results for the individual footprints and overall KVF based on the per capita energy use should be considered as even more experimental given the lack of a detailed analysis of country-specific impacts. However, tentative findings are presented in Figure 3 to demonstrate the potential use of the methodology if more fully developed in the future.

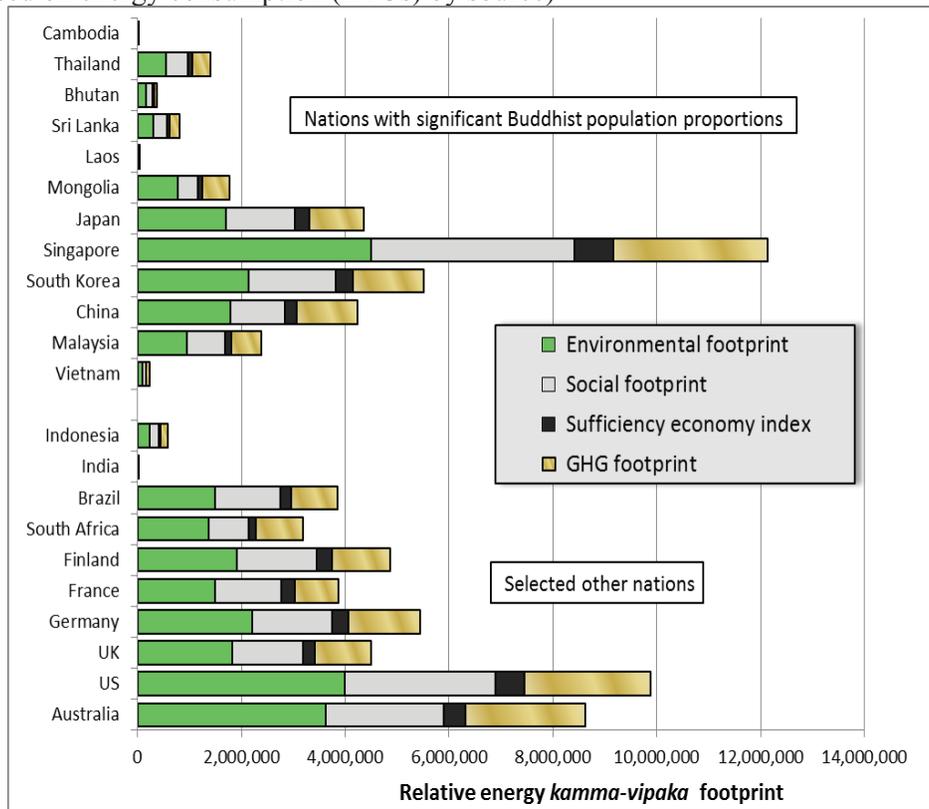
The per capita energy footprints can be seen to vary largely in accordance with per capita income levels and dependence on fossil fuel energy sources. The exceptionally high levels for Singapore probably stem from its extreme dependence on imported petroleum energy sources (and hence high use per GDP ratios) and high per capita income. In combination with data on national energy consumption mix, and analysis of economic structural conditions, and other social, economic and environmental indicators, and an improved KVF analysis can provide useful insights into the nature and sources of energy sustainability impacts as assessed from Buddhist insights.

Figure 2 Individual and total *kamma-vipaka* footprint scores of the energy types



For more complete analysis, it would be necessary to compare the KVF findings with the economic sustainability benefits associated with energy use. Relevant indicators might include annualized/levelized costs, security of supply, reliability of supply, and energy return on investment together with the benefits of increased energy use associated with higher GDP per capita levels. The KVF method and measures outlined do not purport to provide a complete social cost-benefit analysis framework facilitating optimal energy scenario identification but, rather, simply exemplify the basic framework for a decision-making support tool based on wisdom from the Buddhist world view.

Figure 3 Experimental national *kamma-vipaka* footprints for per capita energy use (based on energy consumption (BTUs) by source)



Concluding Thoughts

This paper has attempted to demonstrate the potential usefulness and viability of a *kamma-vipaka* footprint measure that integrates Buddhist insights into the sustainability assessment for energy. The initial formulation of a methodology has been the primary aim of the research completed. While the results presented are highly tentative and of little immediate value, the illustrative example offers clues about energy system options that are consistent with the Buddhist world view, sustainability, and real growth in well-being.

The methodology requires substantial further development before it might provide an effective and accurate guide for strategic energy policy. Progress would entail at least two facets. First, there is a need for better identification of the appropriate criteria for assessing a Buddhism-inspired view of energy sustainability and hence the derivation of suitable indicators of challenging parameters such as “non-harm”, and minimum disturbance or intervention. This would also require informed input about the prioritization and weighting of indicators (from expert Buddhists and scientists from all relevant fields of environmental analysis and transdisciplinary sustainability assessment). It also involves the careful balancing of the need for material quality of life improvements (in many of the world’s poorer nations) and minimizing environmental disruption. Identification of one or small number of footprint “meta-indicators” of the key Buddhist criteria would provide a very effective basis for evaluation.

Secondly, improved understanding of the interconnectedness and karmic flows associated with energy systems requires substantial investment and commitment to improving and extending the application of the growing suite of sustainability analysis

tools. This would also be instrumental in the identification of an optimal (set of) KVF indicators.

Furthermore, intensive country and bioregional analysis of impacts would underpin the collection and evaluation of more accurate data to generate the KVF indicators.

Hence, a *kamma-vipaka* approach to sustainable energy should help emphasize and encourage research and development for national strategic policy regarding energy and other key environmental resources. It would also provide useful insights, in combination with related sustainability analysis techniques, to implement energy systems for creating less harmful, gentler, but ultimately more effective economies.

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