Energy cropping and social licence: What's trust got to do with it?

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Keywords

social licence to operate; acceptance; energy crop; trust; resilience; systems thinking

Highlights

- Social licence to operate has seen limited application to cellulosic energy crops
- Key factors are distributional fairness, procedural fairness, trust & adaptability
- Trust is a notable research gap in relation to cellulosic energy crops
- Greater use of the social licence concept may help to increase the focus on trust

Abstract

Cellulosic energy crops have been promoted in various jurisdictions for their potential to mitigate climate change and enhance energy security while avoiding some of the negative impacts associated with first-generation biofuel crops. However, the successful expansion of cellulosic energy cropping depends on its acceptance by local communities. The social licence to operate (SLO) concept has been applied in mining and other sectors since the late 1990s and offers a framework for analysing the relationships between energy cropping proponents and local communities.

This review analyses recent cellulosic energy cropping studies to determine the extent to which they consider the key SLO variables of distributional fairness, procedural fairness, trust and adaptability. The results indicate that, of these four variables, trust has received the least coverage in previous studies focusing on the social dimensions of cellulosic energy cropping. This review also highlights a contrast between energy cropping studies that applied the SLO concept, all of which explicitly considered trust, and those studies that did not apply the SLO concept. This result highlights the potential role that the SLO concept could play in ensuring that the importance of trust is not overlooked by researchers, bioenergy proponents or policy-makers.

1 Introduction

Cellulosic energy crops are increasingly being established and promoted as a new land use option across the world, including through supportive policy mechanisms such as the EU's Renewable Energy Directive (RED) and US Federal Government's Renewable Fuel Standard (RFS). The arguments made by the European Parliament and Council of the European Union (2015) for promoting woody energy crops relative to first-generation fuels include their potential to deliver higher yields and greater life-cycle greenhouse gas savings while reducing risks related to competition with food production, deforestation and indirect land use change. Some types of cellulosic energy crops have also been associated with positive effects on ecosystem health, such as soil remediation and habitat provision from willow and poplar crops in Europe (Dimitriou et al. 2011), mitigation of dryland salinity from mallee eucalypts in Australia (Bennett et al. 2011) and increased soil carbon from switchgrass in the US (Lowrance and Davis 2014). However, fulfilling this potential depends on the acceptance of cellulosic energy crops by affected local communities.

The concept of a "social licence to operate" (SLO) provides a way of both conceptualising and strategically building community acceptance or approval of new activities or practices that goes beyond the requirements of formal regulatory processes. SLO definitions vary, but commonly focus on the notion of ongoing acceptance or approval of an operation, project or activity from the affected local community and other stakeholders (e.g. Joyce and Thomson 2000; McHugh 2016; Moffat et al. 2016; Thomson and Boutilier 2011). Failure to obtain a SLO can lead to significant costs to industry (Franks et al. 2014), stricter regulatory restrictions on future developments (Hall et al. 2013) or the closure of operations (Franks et al. 2011).

The SLO concept has been applied most widely in the mining sector, where it is commonly cited as having emerged in the late 1990s (e.g. Franks et al. 2014; Prno and Slocombe 2014). However, Edwards et al. (2016) provide evidence that it may have been first used slightly earlier in the forestry industry and it has since been applied to a diverse range of activities including wind farms (Hall 2014), cotton farming (Roth 2011) and the creation of protected areas (Voyer et al. 2015). While bioenergy is a relatively new area for the application of the SLO concept, recent examples include the development of bioenergy facilities in India (Eswarlal et al. 2014), the use of forest biomass for energy in Sweden (Edwards and Lacey 2014) and the cultivation of woody energy crops in Australia (Weldegiorgis and Franks 2014).

As the SLO concept becomes more prominent in the bioenergy sector, there is an opportunity to learn from experiences in other sectors such as mining and forestry. This in turn may help to reduce the risk of social conflict and ensure the long-term success of cellulosic energy crop expansion. To contribute to this learning, this article presents:

- a review of the key variables that determine SLO, as identified by previous studies in other sectors, including mining, forestry and wind energy;
- analysis of the extent to which these SLO variables have been considered in studies exploring the expansion of cellulosic energy crops; and
- discussion of the potential value of the SLO concept for future research into cellulosic energy cropping.

2. What is a social licence to operate?

The social licence to operate (SLO) concept is based on an analogy with a formal regulatory licence, evoking the idea of an approval process that must be followed, a set of conditions that must be met and a degree of certainty that is provided to an activity's proponent (Ford and Williams 2016). However, unlike a regulatory licence, a SLO is informal and intangible, is issued by a local community rather than a government agency and may be gained or lost through complex processes with high levels of uncertainty. Furthermore, while the establishment of a SLO may be necessary condition for a project to proceed smoothly, a SLO also requires active maintenance over time. Thomson and Boutilier (2011) highlight that, despite some attempts to define SLO as something more permanent, SLO is "dynamic and nonpermanent because beliefs, opinions, and perceptions are subject to change as new information is acquired" (p. 1779).

While there is a high degree of overlap between SLO and the broader concept of social acceptability (Ford & Williams 2016), SLO is characterised by the licence metaphor and the type of relationship it involves, which is typically between a business and a local community. In contrast, social acceptability may be applied to government policy as well (Ford & Williams 2016) and may be applied at larger geographic scales. For example, Wüstenhagen et al. (2007) consider local-scale “community acceptance” to be one of three key elements of social acceptance, alongside broader-scale “socio-political acceptance” and “market acceptance”.

The focus on local communities has been a central element of SLO since its earliest conceptualizations, with Joyce & Thomson (2000) arguing that SLO “must begin with, and be firmly grounded in, the social acceptance of the resource development by local communities” (p. 52). The primacy of the local scale has undergone some challenges in recent years through a shift towards greater consideration of SLO at larger geographic scales (Moffat et al. 2016). For example, the term social licence has featured in national political debates in Australia around banking (Prime Minister of Australia 2016) and greyhound racing (McHugh 2016). However, most SLO definitions and frameworks in the academic literature echo Joyce & Thomson’s arguments regarding the primacy of local stakeholders (e.g. Moffat and Zhang 2014; Prno and Slocombe 2014; Thomson and Boutilier 2011). For cellulosic energy crops to expand in a socially sustainable manner, it is essential to consider the effects on local stakeholders and not simply benefits that might occur at the global or national scales, such as climate change mitigation or national energy security.

One of the defining features of the SLO concept is its non-linear conceptualization of the way in which local communities respond to new land use activities. Under the SLO concept, social acceptance is not defined in linear terms such as “low” or high”, but according to different states of acceptance separated by thresholds. This focus on states, thresholds and non-linear change connects the SLO concept to systems thinking, as demonstrated previously by Prno and Slocombe (2014). Systems thinking is based on the idea that determinist and reductionist approaches are unable to fully explain the processes operating in complex adaptive systems that are characterised by pervasive uncertainty, non-linear change, emergent properties and self-organisation (Holling et al. 1978; Meadows 2008).

Figure 1 provides a simple illustration of how a new land use activity such as energy cropping could move between different states in which a SLO is either held or lost, based on the analogy of a "ball in a basin".

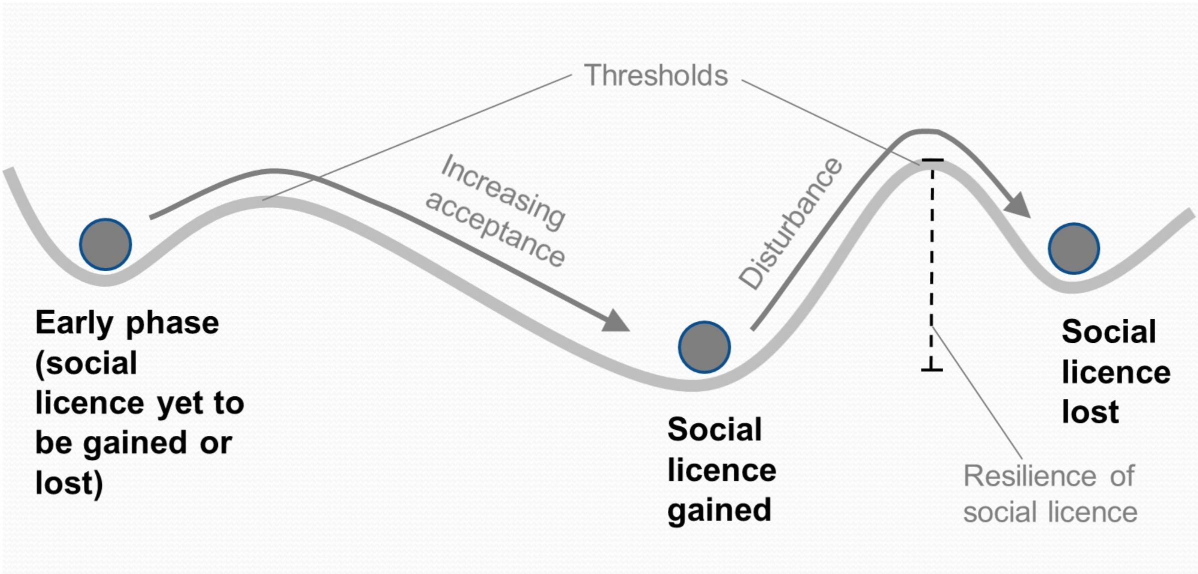

Figure 1: Hypothetical changes in SLO state for a new land use activity

Prno and Slocombe (2014) define four possible SLO states for mining activities: (1) SLO issued, mining proceeds, (2) SLO not issued, mining proceeds, (3) SLO issued, mining doesn't proceed, and (4) SLO not issued, mining doesn't proceed. Thomson and Boutilier (2011) take a different approach and define SLO states based on how strongly a SLO is held. Their first SLO state is "acceptance" (community tolerates the activity), followed by "approval" (community favourable to or pleased with activity) and finally "co-ownership" (community takes on the activity as part of its collective identity and becomes emotionally invested in its future). They also label the critical thresholds that must be crossed in order to reach each state, namely the "legitimacy boundary" (to reach acceptance), the "credibility boundary" (to reach approval) and the "full trust boundary" (to reach co-ownership).

A final point to emphasise is that the SLO concept is not the only social analysis approach that considers thresholds and non-linear change. For example, Wüstenhagen et al. (2007) present the idea that a "critical mass" of socio-political acceptance may be required to deliver widespread change and Ford and Williams (2016) discuss the "domino effect" by which cascading negative outcomes for local communities can lead to a rapid decline in acceptance of plantation forestry. Both articles employ a social acceptance rather than SLO framework. Thus, SLO is only one approach that sits within a broader field of study around social acceptability and may overlap with other frameworks.

3. Determinants of SLO: Insights from other sectors

While there are relatively few studies that have applied the SLO concept to energy cropping, it has been more widely applied in other sectors, particularly mining. Many SLO studies focus on specific local case studies, but there have also been a number of attempts to develop generalised SLO frameworks that outline the key variables determining whether a SLO is gained or lost. Table 1 presents five such frameworks, including three related to mining, one for forestry and one for wind energy.

From the large number of mining studies on SLO, Thomson and Boutilier (2011) has been selected for inclusion in Table 1 due to its high citation frequency and connection to early SLO work (e.g. Joyce and Thomson 2000). Zhang et al. (2015) has been selected for its simple framework and connection to other SLO studies (e.g. Moffat and Zhang 2014; Lacey et al. 2016; Moffat et al. 2016) and Prno (2013) for its innovative use of systems thinking (also reiterated in Prno and Slocombe 2014). The frameworks presented for forestry (Dare et al. 2014) and wind energy (Hall 2014) have been included due to links between these activities and energy cropping (i.e. producing biomass and supplying renewable energy respectively). First-generation biofuels are another sector that has relevance for cellulosic energy cropping, but studies on SLO in this sector (e.g. Raman and Mohr 2014; Schut and Florin 2015) do not present generalised frameworks that are comparable to those shown in Table 1.

There is a high degree of overlap between the key variables covered by the five frameworks shown in Table 1. However, they differ in terms of the structure they impose across these variables. Zhang et al. (2015) use trust as an over-arching determinant of social licence, with distributional fairness, procedural fairness and confidence in governance all contributing to trust-building. In the other frameworks, trust is not given this central role, instead representing one key variable alongside others. Some of the frameworks also differentiate between obtaining and maintaining a SLO. This is most notable in the framework presented in Prno (2013) and Prno and Slocombe (2014), which focuses on building a resilient SLO, whereby “widespread community approval is maintained… even amid crisis events and other stresses on the company-community relationship” (Prno and Slocombe 2014 p. 679). As such, Table 1 highlights not only the variables that are linked to the initial establishment of a SLO, but also those that have been specifically linked to SLO maintenance or resilience.

For the purposes of this review, four key SLO variables have been selected for application to cellulosic energy cropping, based on the five studies in Table 1. These are (in no particular order):

1. Distributional fairness (i.e. how different stakeholders are affected by positive and negative impacts of an activity)
2. Procedural fairness (i.e. processes for communication, governance and stakeholder engagement/participation)
3. Trust (including the associated concepts of credibility and legitimacy)
4. Adaptability (including associated concepts such as flexibility and responsiveness)

The distribution of benefits and costs represents a key variable in all five frameworks, but is most prominent in those of Zhang et al. (2015) for mining and Hall (2014) for wind energy. Benefits and costs may be economic (e.g. jobs, profits, expenses), social (e.g. health, education, housing, amenity) or environmental (e.g. impacts on soil, water, biodiversity or climate). Unexpected costs or negative impacts can act as disturbances that test the resilience of an activity’s SLO, such as changes to commodity prices (Thomson and Boutilier 2011), perceived environmental damage (Prno and Slocombe 2014), pressure on the availability of health services, education or housing (Moffat and Zhang 2014) and loss of amenity following the construction of wind turbines (Hall et al. 2013).

Procedural factors include stakeholder engagement and communication, land rights (and other resource rights), decision-making processes and the varying roles of government agencies, legislators, non-government organisations and the media. Disturbances may include changes in company structure (Thomson and Boutilier 2011) or increased involvement from outside stakeholders (Hall et al. 2013; Prno and Slocombe 2014). Moffat and Zhang (2014) argue that, when it comes to stakeholder engagement and communication, quality of contact is more important than quantity. Dare et al. (2014) highlight the importance of stakeholder engagement in the forestry sector, as do Lacey et al. (2016) who provide a critique of the “top-down” approach taken in Australia’s Regional Forestry Agreement process.

Trust is emphasised in all five frameworks in Table 1, but is most prominent in the frameworks of Thomson and Boutilier (2011) and Zhang et al. (2015). Thomson and Boutilier (2011) see trust-building as essential to moving from a state of “acceptance” to higher states of “approval” or “co-ownership”. They argue that achieving “co-ownership” (the highest SLO state) requires a level of “full trust” that can only be achieved by consistently keeping promises, willingly sharing power and responding to unexpected events in the community’s interest. Zhang et al. (2015) see trust as the central element to which distributional and procedural factors contribute.

Prno (2013) and Prno and Slocombe (2014) employ resilience terminology to highlight the role that long-term trust plays in building a resilient SLO, such as the trust that the community around Alaska’s Red Dog Mine has in the mining company’s long-term commitment to the area. Conversely, they highlight that a lack of trust amongst certain stakeholders can weaken SLO resilience, citing examples from Peru and Papua New Guinea. Thomson and Boutilier (2011) also emphasise that trust is critical to SLO maintenance and cite examples where “full trust” and “co-ownership” have motivated community members to defend mines against outside criticism.

The final variable, adaptability, is arguably more critical to the maintenance rather than establishment of a SLO. As such, it represents one of the more important variables (along with trust) for SLO resilience (a point made explicitly by Prno 2013). Thomson and Boutilier (2011) argue that mine operators need to respond to surprises in the community interest rather than simply focusing on their own interests at times of stress. Hall (2014) stresses the importance of listening and responding to feedback from local stakeholders affected by wind farms. Dare et al. (2014) argue that forestry operators must be prepared to respond to changing stakeholder expectations around acceptable forestry practices. While these frameworks differ in their terminology, the term adaptability has been selected for use in this review to encompass associated concepts such as responsiveness, flexibility, reflexivity and agility.

Table 1: Frameworks outlining key SLO variables from the mining, forestry and wind energy sectors

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Authors and year	Context	Key variables in creating SLO	Examples of stresses or disturbances to SLO	Factors specific to SLO maintenance or resilience
Zhang et al. (2015)	Mining	Trust in mining industry determines acceptance and is influenced by: • Distributional fairness (distribution of benefits and costs) • Procedural fairness (communication, community involvement in decision-making) • Confidence in governance (to protect against negative impacts)	Examples (Moffat and Zhang 2014): • Unexpected impacts on social infrastructure (e.g. schools, healthcare, housing availability)	
Prno (2013)	Mining	• Context is key (i.e. consider local factors) • SLO is built on relationships (e.g. trustful, equal, respectful) • Sustainability is a dominant concern for communities • Local benefits and public participation are crucial • Adaptability is needed to confront complexity and build resilience	Examples: (Prno 2013; Prno and Slocombe 2014) • Outside opposition • Local environmental impacts • Actions of other mining companies	Examples (Prno 2013; Prno and Slocombe 2014) • Adaptability • Long-term commitment • Communication
Thomson and Boutilier (2011)	Mining	• Legitimacy of proponent (pragmatic, moral and cognitive) • Credibility of proponent (basic trust, openness, transparency, keeping promises, concern for community needs) • Full trust (consistency, sharing power, responding to surprises in community interest)	• Failure to deliver on promises • Opposition from outside groups • Changes in company structure • Changes in commodity prices/economic viability	• Full trust ("co-ownership state") • Building social capital (reciprocity, shared identity, trust) • Adaptability to changes
Dare et al. (2014)	Forestry	• Trust in organisations • Engagement with stakeholders • Ability to respond to changing expectations	• Changing stakeholder expectations around acceptable forestry practices	• Ability to respond to changing expectations
Hall (2014)	Wind energy	• Benefits: - Direct (for host, community and local government) - Flow on (e.g. tourism, property prices, farming) - Compensatory (compensation, risk management, maintenance) • Trust-building: - Integrity (local decisions, local agency, listening)	Examples (Hall et al. 2013): • Negative media coverage • Involvement of outside groups opposed to wind farms • Disturbances to place attachment	• Responsiveness to feedback from local stakeholders

		- Process (engagement, feedback, communication) - Understanding (support, opposition)	by visual impact of turbines	

4 Aims and methods

The aim of this review is to determine the extent to which the key SLO variables outlined in the previous section have been considered in studies exploring the social dimensions of cellulosic energy crop expansion. To address this aim, a systematic literature review was undertaken using Thomson Reuters Web of Science database, covering all literature listed in the database as of 1 December 2016. The review methodology involved a keyword search, manual review of results, systematic analysis of each relevant article to assess the extent to which key SLO variables were covered and a comparison between studies that explicitly mentioned the social licence concept and those that did not.

Studies relating to the social dimensions of cellulosic energy crop expansion where identified through a series of keyword searches, followed by a manual review of the articles identified by these searches. The search terms used were “energy crop”, “biomass crop”, “biofuel” and “cellulosic” in combination with each of the terms “acceptance”, “acceptability”, “approval”, “social licence” and “social license”. Additional articles were also identified by following citations in relevant articles identified by the keyword searches. An internet search was also undertaken by entering the same search terms into the Google search engine to identify reports from industry, government or community organisations that had not been published in the academic literature.

A final list of studies was compiled by manually reviewing search results to exclude studies that fell outside the scope of the review. The scope of the review included any study that discussed social factors related to any type of cellulosic crop (e.g. trees, shrubs, grasses), grown for any form of energy (e.g. electricity, heat, transport fuels). Studies that focused predominantly on the use of residues from forestry or agriculture were included only if the energy co-products were regarded as having the potential to influence overall land management practices, including in relation to harvesting and replanting. Studies were excluded if they focused only on first-generation biofuel crops that utilise sugars, starches or oils rather than lignocellulose. Studies were excluded if they did not discuss the social dimensions of energy cropping (e.g. technical studies of energy crop yields or applications).

The selected studies were divided into those that explicitly mention the social licence concept and those that do not. The studies were then analysed to determine the extent to which they consider the four key SLO variables identified from the mining, forestry and wind energy sectors: distributional fairness, procedural fairness, trust and adaptability. Analysis included a careful reading of each article to identify themes and match these to the key SLO variables. The results of the analysis were also checked by undertaking systematic word searches of each article related to each of the four variables (Table 2). Each study was rated based on the attention paid to each key variable using a three-tick system (i.e. ✓✓✓ = high focus, ✓✓=medium focus, ✓= low focus, no ticks = not mentioned). A single mention of a key variable or related term was sufficient to be classified as low focus (✓), while classification as high focus (✓✓✓) required multiple mentions of a key variable and/or in-depth discussion around that variable.

Table 2: Search terms used to identify key variables in selected studies

Variable	**Search terms used**
Distributional fairness	“distribut” (for distribution, distribute, distributional), “impact”, “cost”, “benefit”, “value”, “income”, “fair” (including fairness), “just” (including justice), equit (for equity, equitable)
Procedural fairness	“proce” (for procedural, procedures, process), “gov” (for governance, government), “communicat” (for communicate, communication), “engage” (including engagement), “participat” (including participate, participation, participatory), “fair” (including fairness), “just” (including justice), equit (for equity, equitable)
Trust	“trust”, “cred” (for credible, credibility), “reliab” (for reliable, reliability), “legit” (for legitimate, legitimacy)
Adaptability	“adapt” (for adaptability, adaptable, adaptation), “respon” (for respond, responsive, response), “flex” (for flexibility, flexible, reflexivity), “agil” (for agile, agility)

For many of the selected studies, cellulosic energy cropping was only one factor covered alongside others such as forest harvesting or site selection for processing facilities. As such, each study was rated based on the degree to which it covered cellulosic energy crops (high, medium or low) and the extent to which other aspects of bioenergy were discussed (first-generation crops, forestry residues, agricultural residues and infrastructure such as processing facilities). Each study was also reviewed to identify variables that may have an influence on social acceptability in the bioenergy sector but do not feature prominently in SLO frameworks from the mining, forestry and wind energy sectors.

5 Results

Overall, thirty-three cellulosic energy cropping studies were identified as falling within the scope of the review. Six of the studies explicitly mentioned the social licence concept (referred to hereafter as "SLO studies"), while the other twenty-seven considered the social dimensions of energy cropping to some degree but did not apply the social licence terminology ("non-SLO studies"). These two sets of studies are presented separately in sections 5.1 and 5.2, with comparisons and further discussion in section 6.

5.1 Studies applying the SLO concept to cellulosic energy cropping

Of the six studies identified that mention social licence (or license) in relation to cellulosic energy cropping (Table 3), five were academic journal articles and one was a report commissioned by a local community group (Parsons 2016). While none of the studies focus exclusively on cellulosic energy cropping, three cover energy cropping case studies, including in India (Eswarlal et al. 2014) and Australia (Parsons 2016; Weldegiorgis and Franks 2014). Two of the others focus primarily on forestry residues, but highlight the potential for bioenergy usage to influence management practices around harvesting and replanting (Edwards and Lacey 2014; Rothe et al. 2015). The final study (Gold 2011) presents a global literature review covering all types of bioenergy, including energy crops, residues and bioenergy facilities (using the phrase “local licence to operate” rather than “social licence to operate”).

Table 3: Studies explicitly applying the SLO concept to cellulosic energy cropping. Order is based on degree of focus on cellulosic energy crops, then year of publication.

Authors and year	Focus country	Focus on cellulosic energy crops	Other bioenergy				Key variables discussed				Potential contributions to SLO body of knowledge
			1st-gen. crops	Forestry residues	Agric. residues	Infrastructure	Distributional	Procedural	Trust	Adaptability	
Parsons (2016)	Australia	Medium		✓	✓	✓	✓✓	✓✓✓	✓✓	✓✓	Wastes vs crops, Community ownership
Weldegiorgis and Franks (2014)	Australia	Medium		✓		✓	✓✓✓	✓	✓		Rehabilitation of land, Scale of cropping
Eswarlal et al. (2014)	India	Medium		✓	✓	✓	✓✓✓	✓✓✓	✓✓✓	✓	Impacts of facilities vs cropping
Rothe et al. (2015)	Australia & Germany	Low		✓			✓✓	✓	✓		Cultural practices, Opposition to native forest harvest
Edwards and Lacey (2014)	Sweden	Low		✓		✓	✓✓	✓	✓✓	✓✓✓	Local (amenity) v global (climate change mitigation)
Gold (2011)	Global	Low	✓	✓	✓	✓	✓✓✓	✓✓✓	✓✓✓	✓✓	Adapting supply system to context, Role of certification

Of the four key variables identified from SLO studies in other sectors, three (distributional fairness, procedural fairness and trust) are well-covered across the six SLO studies in Table 3. Adaptability has a lower level of coverage and is discussed in only four of the six studies.

With regard to the distribution of costs and benefits, some factors discussed in the six SLO studies overlap with other sectors in which SLO has been considered (e.g. employment), while others are specific to the bioenergy sector. Landscape amenity is an issue for both wind energy (Hall et al. 2013) and bioenergy (Edwards and Lacey 2014; Eswarlal et al. 2014), as is climate change mitigation through renewable energy provision. Similarly, impacts on soils, biodiversity and other ecosystem elements (Weldegiorgis and Franks 2014) are not unique to bioenergy and are also prominent in SLO studies around mining (Prno and Slocombe 2014) and forestry (Dare et al. 2014).

Some of the issues appearing in the six energy cropping studies that are not prominent in the SLO frameworks from other sectors include energy security for local communities (Eswarlal et al. 2014; Rothe et al. 2015), the potential loss of food-producing land (Parsons 2016) and impacts related to bioenergy facilities (Eswarlal et al. 2014; Weldegiorgis and Franks 2014). Regarding the link between energy cropping and bioenergy facilities, Eswarlal et al. (2014) found that local community concerns related to bioenergy facilities (e.g. noise, air pollution, traffic and visual impact) were more common across the Indian case studies they reviewed than concerns directly related to energy cropping such as landscape change and soil depletion.

In terms of procedural fairness, Eswarlal et al. (2014) cite the importance of communication and local control, which are also common to mining and other sectors. Parsons (2016) provides an example of a community engagement process from the Northern Rivers region of New South Wales (NSW), Australia, for a proposed bioenergy facility that could utilise either residues (municipal, forestry, agricultural) or energy crops. This draws on the author's previously work on SLO in the minerals industry (e.g. Parsons et al. 2014). Gold's (2011) review article highlights the importance of sustainability certification processes for the creation of localised SLOs for bioenergy, which is also an issue for the forestry sector and thus not unique to bioenergy.

The importance of trust is highlighted in all six SLO studies, but features most prominently in the studies by Eswarlal et al. (2014), Gold (2011) and Parsons (2016). Eswarlal et al. found community trust in bioenergy companies to be a key factor in all four of their Indian case studies, while Gold highlights the role of global certification schemes in building credibility and trust amongst consumers. In northern NSW, Parsons found that a key influence on trust was whether or not the bioenergy facility was locally-owned and managed. In relation to forestry-based bioenergy, a lack of trust in forestry companies and regulators was cited by both Edwards and Lacey (2014) in Sweden and Rothe et al. (2015) in Australia. Rothe et al. (2015) contrasts the situation in Tasmania, where community acceptance of forest-based bioenergy is low, with Bavaria, where it is high and the practice is well-established. Bavarian traditions around the use of firewood for heating and the community scale of many bioenergy facilities are argued to be critical to building and maintaining a social licence there.

The last of the four key variables, adaptability, is discussed in four of the six SLO studies. Much of this discussion focuses on factors common across different sectors. For example, Parsons (2016) argues that bioenergy proponents in northern NSW need to be responsive to community values and Edwards and Lacey (2014) argue that SLO creation and maintenance is a dynamic and iterative process that must be reflexive to changing norms, values and information. Gold (2011) goes a step further by arguing that not only must bioenergy supply systems adapt to their social, economic and environmental context, but that legal and political frameworks must also be adapted to incorporate bioenergy. In discussing adaptability, Eswarlal et al. (2014) again highlights the link between energy cropping and bioenergy facilities, citing the example of a company in Tamilnadu, India, that adapted its chimney design in response to community concerns and then adapted its community engagement practices in order to avoid further unplanned shutdowns.

5.2 Studies covering social dimensions of cellulosic energy cropping that do not apply the SLO concept

Twenty-seven studies were identified that discuss the social dimensions of cellulosic energy cropping but do not apply the SLO concept (Table 4). Of these, twelve were classed as having a high focus on cellulosic energy cropping relative to other types of bioenergy, nine were classed as medium and six were classed as low. The studies focus on a wide range of developed and developing countries with the most commonly studied countries being the UK, USA and Germany. The communities of focus also vary, with some studies focusing on energy crop adoption by farmers (e.g. Baumber et al. 2011; Daraban et al. 2015; Glithero et al. 2013), some on other local stakeholders (e.g. Boll et al. 2014; Dockerty et al. 2012; Spartz et al. 2015), some on policy-makers and industry groups (e.g. Chin et al. 2014; Raman et al. 2015; Stupak et al. 2016) and some on the general public at a state or provincial level (e.g. Longstaff et al. 2015; Marciano et al. 2014; Rollins et al. 2015).

Table 4: Cellulosic energy cropping studies that consider social impacts but not the SLO concept. Order is based on degree of focus on cellulosic energy crops, then year of publication.

Authors and year	**Focus country**	**Focus on cellulosic energy crops**	**Key variables discussed**								
			1st-gen. crops	Forestry residues	Agric. residues	Infrastructure	Distributional	Procedural	Trust	Adaptability	Potential contributions to SLO body of knowledge
Enell et al. (2016)	Sweden	High					✓	✓			Rehabilitation of land, Aesthetic value
Raman et al. (2015)	UK	High		✓	✓	✓	✓✓✓	✓✓	✓	✓	Food vs fuel, Trust in certification, Social enterprises
Longstaff et al. (2015)	Canada	High				✓	✓✓	✓✓		✓	Deliberative engagement, Food vs fuel
Lord (2015)	UK	High					✓				Use of marginal land to avoid food-fuel conflicts
Daraban et al. (2015)	Romania	High			✓	✓	✓✓				Use of marginal land
Nuberg et al. (2015)	PNG	High					✓✓	✓		✓✓	Acceptability for end-users of fuelwood
Rollins et al. (2015)	Canada	High					✓✓✓	✓	✓	✓	Genetic modification, Local vs general public
Boll et al. (2014)	Germany	High					✓✓	✓		✓	Recreation and amenity for urban people

Authors and year	**Focus country**	**Focus on cellulosic energy crops**	**Key variables discussed**								
			1st-gen. crops	Forestry residues	Agric. residues	Infrastructure	Distributional	Procedural	Trust	Adaptability	Potential contributions to SLO body of knowledge
Glithero et al. (2013)	UK	High					✓✓	✓✓		✓	Impact on land quality for future agricultural use
Dockerty et al. (2012)	UK	High				✓	✓✓✓	✓✓			Food vs fuel, Aesthetics, Infrastructure impacts
Baumber et al. (2011)	Australia	High				✓	✓✓✓	✓✓		✓✓	Rehabilitation of land, community ownership
Kaul et al. (2010)	India	High		✓			✓				Short rotations (enhance climate change mitigation)
Spartz et al. (2015)	USA	Medium	✓	✓	✓		✓✓✓	✓	✓		Framing land use as ‘cropland’ or ‘woodland’
Steinhäußer et al. (2015)	Germany	Medium	✓				✓✓✓	✓		✓	Food vs fuel, Monoculture vs mixed-use
Lupp et al. (2015)	Germany	Medium		✓			✓✓✓	✓✓			Food vs fuel, Aesthetics, Ecosystem benefits
Dragojlovic & Einsiedel (2015)	Canada	Medium	✓	✓	✓		✓✓	✓		✓	Food security, increase in forest harvesting
Mbzibain et al. (2013)	UK	Medium	✓				✓✓	✓	✓	✓	Lack of trust in government policy, Biomass inflexible
Ostwald et al. (2013)	Sweden	Medium	✓		✓		✓✓✓	✓		✓	Food vs fuel, Aesthetics, Land tenure
Bailey et al. (2011)	USA	Medium		✓		✓	✓✓✓	✓		✓	Farmer vs corporate ownership

Authors and year	**Focus country**	**Focus on cellulosic energy crops**	**Key variables discussed**								
			1st-gen. crops	Forestry residues	Agric. residues	Infrastructure	Distributional	Procedural	Trust	Adaptability	Potential contributions to SLO body of knowledge
Chapotin & Wolt (2007)	USA	Medium	✓				✓✓	✓	✓	✓✓	Genetic modification, Consumer acceptance
Plieninger et al. (2006)	Germany	Medium		✓	✓	✓	✓✓	✓✓		✓	Scale of facilities, Competition for land
Roder (2016)	UK	Low	✓		✓	✓	✓✓✓	✓✓	✓	✓	Food/fuel/other, Supplier trust in processors
Stupak et al. (2016)	Global	Low	✓	✓	✓		✓	✓✓✓	✓✓	✓✓	Role of certification & sustainability governance
Chin et al. (2014)	Malaysia	Low	✓			✓	✓✓✓	✓✓✓	✓✓	✓✓	Socio-political, community & market acceptance
Marciano et al. (2014)	USA	Low		✓		✓	✓✓✓	✓		✓✓	Facilities, Local support vs general public
Johnson et al. (2013)	Global	Low	✓	✓	✓	✓	✓✓	✓✓✓	✓	✓✓	Trust in research, Regulatory & researcher flexibility
Youngs (2012)	Global	Low	✓	✓	✓	✓	✓✓✓	✓	✓	✓✓	Use of marginal land, Annual vs perennial crops

Of the four key variables used to analyse the studies, distributional factors were most commonly cited (all 27 studies), followed by procedural factors (24 of 27) and adaptability (20 of 27). Trust (including credibility and legitimacy) was the least covered of the four key variables, mentioned in 10 of the 27 non-SLO studies.

While many of the distributional factors were similar to those found in the mining sectors (e.g. economic benefits, environmental risks), others were more specific to the bioenergy sector, including food security impacts (featured in 14 of 27 studies) and impacts from bioenergy facilities or other infrastructure (12 of 27). Other factors that overlap with the forestry and wind sectors include aesthetic or recreational impacts (6 of 27) and the potential for energy crops to contribute to the rehabilitation of land or provide ecosystem services (3 of 27). All of these distributional factors also appeared in the six SLO studies reviewed.

With regards to procedural fairness, all but three of the non-SLO studies included some discussion of stakeholder participation, engagement and/or governance. The issue of whether small-scale and/or community-owned facilities involve fairer processes was raised in multiple studies (7 of 27), as was the issue of bioenergy certification (3 of 27). Both of these issues were also raised in the SLO energy cropping studies and both have parallels in the mining, forestry or wind energy sectors.

Adaptability was covered in less breadth and depth across the non-SLO studies than distributional or procedural factors. However, notable examples of adaptability issues include the need for local industries to adapt to changing market conditions (e.g. Chin et al. 2014; Marciano et al. 2014), the need for adaptive policy-making and governance (e.g. Johnson et al. 2013; Stupak et al. 2016) and the perceived inflexibility of energy cropping relative to other land uses due to the longer harvest cycles (e.g. Glithero et al. 2013; Mbzibain et al. 2013). Of these factors, the inflexibility of energy cropping is the one that has least overlap with the mining sector, but has parallels with forestry (e.g. plantations with long harvest cycles established on agricultural land).

Trust (including credibility and legitimacy) was the least covered of the four key variables, mentioned in 10 of the 27 non-SLO studies. This represents the clearest divergence from the SLO studies, all of which mentioned the role played by trust. Where trust was mentioned in the non-SLO studies, many of the issues discussed were similar to those identified for the SLO studies and in the frameworks explored for mining, forestry and wind energy. These factors include trust in bioenergy companies (Roder 2016), trust in policy-makers (Mbzibain et al. 2013) and trust in sustainability certification schemes (Raman et al. 2015). Two trust factors mentioned in the non-SLO studies that were not as prominent in the SLO studies or frameworks from other sectors are distrust of genetically modified energy crops (Chapotin and Wolt 2007) and the importance of trust in the research community (Johnson et al. 2013).

6 Discussion

As shown by the results of the literature review, the SLO concept is yet to be widely applied to the social analysis of cellulosic energy cropping. Less than one-fifth of the studies identified through the review applied the SLO concept. However, those studies that did apply the SLO concept showed a stronger tendency to consider the role of trust in obtaining and maintaining community acceptance of energy cropping activities.

Of the four key variables drawn from SLO frameworks used in the mining, forestry and wind energy sectors, distributional fairness was covered most consistently across the energy cropping studies reviewed. This was true of both the studies that applied the SLO concept and those that did not. Procedural fairness was also discussed in the vast majority of reviewed studies, with only a few exceptions. Adaptability received lesser coverage than distributional and procedural factors (discussed in around 70% of studies), but this proportion was similar across both the SLO and non-SLO studies. Trust represents the clearest discrepancy between the two sets of studies, with all of the SLO studies discussing this factor to some degree, compared with less than half of the non-SLO studies (10 out of 27).

One possible explanation for the lesser focus on adaptability and trust is the role that these factors play in the maintenance as opposed to establishment of a SLO. Indeed, Prno (2013) cites adaptability as critical to SLO resilience over the longer-term and Thomson and Boutilier (2011) regard trust as essential for maintaining a SLO in the face of disturbances such as opposition from outside groups. As cellulosic energy cropping is an emerging land use, the need for a bioenergy company to adapt to changing circumstances may be yet to arise in many cases. However, this explanation is less satisfying for trust than it is for adaptability, as trust is a critical variable for both SLO establishment and SLO maintenance (Zhang et al. 2015; Thomson and Boutilier 2011). Moreover, it does not explain the discrepancy between the SLO and non-SLO studies with regards to trust.

Zhang et al. (2015) consider trust to be the overarching variable for the establishment of a SLO, with distributional fairness, procedural fairness and confidence in governance all contributing to the building of trust. Similarly, Thomson and Boutilier (2011) regard “full trust” to be a pre-requisite for reaching the highest state in their SLO framework (“co-ownership”). This emphasis on trust in the SLO literature may help to explain the discrepancy in the level of prominence given to trust between the reviewed studies that applied the SLO concept and those that did not. Three of the six energy cropping studies that applied the SLO concept feature authors who have also published on SLO in the mining sector (Edwards and Lacey 2014; Parsons 2016; Weldegiorgis and Franks 2014), providing a pathway for the sharing of ideas and experiences between these two sectors.

The results of this review suggest that energy cropping studies that apply the SLO concept may be more likely to explicitly consider the role of trust than those that do not. This finding should not be taken as a criticism of any individual study, as there are a variety of reasons why researchers may focus their attention on particular variables over others. Nonetheless, the overall paucity of studies that focus on the role of trust does present a risk that this critical factor could be overlooked by future researchers, by proponents of energy cropping or by policy-makers.

One key limitation that should be taken into account when interpreting the results of the review is that the authors’ motivations for undertaking each study are unknown. For example, the authors who applied the SLO concept may have been motivated to consider the issue of trust and, as a result, sought out a framework in which trust was a central feature (i.e. SLO). While the review showed a correlation between the application of SLO and the consideration of trust, this does not necessarily indicate causation.

For researchers, proponents and policy-makers interested in building community trust around cellulosic energy cropping, the SLO literature from mining and other sectors offers a number of strategies. Zhang et al. (2015) highlight how companies can build trust through careful consideration of distributional and procedural fairness and Moffat and Zhang (2014) argue that quality of contact with local stakeholders is more important than quantity when seeking to build trust. Thomson and Boutilier (2011) emphasise that trust can be built from an early stage by endeavouring to keep small, short-term promises. Another trust factor that can be considered at an early stage is the pre-existing level of trust in key institutions. For example, the lack of trust found in some Australian communities towards forestry companies and regulators involved in native forest harvesting (Parsons 2016; Rothe et al. 2015) may need to be addressed before related bioenergy activities can progress in a trustful manner.

Drawing on the SLO literature is one means by which a greater focus on trust may be achieved around cellulosic energy cropping, but it is not the only option. The social acceptance framework of Wüstenhagen et al. (2007) does not mention SLO but emphasises trust as a critical variable alongside distributional and procedural justice. It is notable that, of the non-SLO studies reviewed, three of the ten that discuss trust cite Wüstenhagen et al. (2007) or a related article (Wüstenhagen and Menichetti 2012). Thus, it may be possible to generate a greater focus on trust by either: (1) adopting a SLO framework that draws on experiences gained in mining and other sectors; or (2) using an alternative social acceptance framework such as that of Wüstenhagen et al. (2007). The greatest risk of trust being overlooked is likely to arise where social factors are considered in a general sense without drawing on any particular framework or guidelines.

In addition to the opportunity for energy cropping studies to benefit by drawing on the SLO literature, there is also an opportunity for SLO frameworks to benefit from a consideration of the specific factors relating to energy cropping. Through this review, three key factors were identified that may be more prominent in the bioenergy sector than in mining, forestry or wind energy. These are: (1) community values around whether land should be used for food, fuel or other purposes; (2) the connection between energy cropping and the construction of new bioenergy facilities; and (3) the potential for cellulosic energy crops to remediate soils, mitigate salinity and enhance ecosystem services.

The food security issue has some parallels in mining and forestry in relation to the conversion of farmland, but the bioenergy sector may offer additional insights through the expanding use of bioenergy sustainability certification schemes. For example, the Roundtable on Sustainable Biomaterials (2011) requires explicit consideration of local food security. Regarding the construction of new facilities, this also has parallels with mining and forestry, in terms of both benefits such as employment as well as costs such as air pollution and heavy vehicle traffic. However, energy crops may have greater potential to be developed incrementally and go “under the radar” of local communities until cumulative impacts reach a tipping point, such as the construction of a local processing facility. Lastly, the potential to provide ecosystem services is something that energy cropping shares with other land uses, such as agroforestry (Stanturf 2015), but one unique aspect of the bioenergy sector is its interaction with a wide range of renewable energy policies that could be tailored to promote forms of energy cropping that provide both social and environmental benefits (Baumber 2017).

Future research into energy crops and SLO could expand beyond the academic publications reviewed here to look at regulatory instruments or certification schemes. For example, the global principles and criteria of the Roundtable on Sustainable Biomaterials (2011), which do not employ the term “social licence”, tend to have a focus on distributional factors (e.g. food security, economic development, impacts on soil and water), procedural factors (e.g. consultation and consent) and adaptability (i.e. “continuous improvement”), but not on trust, credibility or legitimacy. Future research could assess whether this pattern is common across other certification schemes and whether the application of a SLO framework could increase the focus on trust. Another potential research question relates to whether more explicit consideration of resilience and systems thinking (e.g. using the framework developed by Prno and Slocombe 2014) could lead to an increased focus on adaptability and trust in SLO studies.

7 Conclusion

As cellulosic energy cropping becomes a more common land use activity, the risk of conflict within local communities is likely to increase. Distributional factors such as employment, aesthetics, food security and environmental impacts can all have an impact on community relations. However, equally important are procedural factors relating to engagement, participation and governance, as well as the ability of industry stakeholders to adapt to changing circumstances and the extent to which trustful relationships can be built with local communities. To date, the social licence to operate (SLO) concept has been applied to cellulosic energy cropping to a limited degree, but offers a mechanism for systematically considering these key variables.

As shown by this review, trust is the key variable that is currently under-represented in studies focusing on the social dimensions of cellulosic energy cropping. Greater application of the SLO concept may help to increase the likelihood that trust will be explicitly considered in future energy cropping studies. The experiences gained through the application of SLO in mining and other land use sectors represent a valuable body of knowledge on which to draw as cellulosic energy cropping expands. Conversely, the energy cropping sector has the potential to add to the existing body of knowledge around SLO, particularly in the areas of food security, provision of ecosystem services and the interconnection between energy cropping and the construction of bioenergy facilities.

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