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DEVELOPING AN APPROACH FOR A SYSTEMATIC ASSESSMENT OF POSITIVE SOCIAL IMPACTS

Report from an f3 project

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THE SWEDISH KNOWLEDGE CENTRE
FOR RENEWABLE TRANSPORTATION FUELS

PREFACE

This report is the result of a collaborative project within the Swedish Knowledge Centre for Renewable Transportation Fuels (f3). f3 is a networking organization, which focuses on development of environmentally, economically and socially sustainable biofuels, and

- Provides a broad, scientifically based and trustworthy source of knowledge for industry, governments and public authorities,
- Carries through system oriented research related to the entire renewable fuels value chain,
- Acts as national platform stimulating interaction nationally and internationally.

f3 partners include Sweden's most active universities and research institutes within the field, as well as a broad range of industry companies with high relevance. f3 has no political agenda and does not conduct lobbying activities for specific fuels or systems, nor for the f3 partners' respective areas of interest.

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EXECUTIVE SUMMARY

The aim in this project has been to examine the availability of data on positive social impacts for vehicle biofuels, in relevant sectors and geographical areas for the targeted fuels, based on the most commonly used biofuels in a Swedish context. We selected the following fuels: FAME from Lithuania, corn-based ethanol from the US, HVO from Indonesia and from Malaysia. The positive social impact chosen for the examination has been 'job creation'.

We aimed at collecting primary data for job creation for the selected fuels. In summary, the outcome in terms of number of jobs is presented in table S1 below:

Table S1. Number of jobs per GWh from the data collection.

Fuel	**Jobs/GWh**
FAME from Lithuania	*No data available*
HVO from Indonesia	8.90
HVO from Malaysia	2.51
Ethanol from the US	1.38

This outcome was compared to some figures from literature. The figure for Indonesia (8.90) was in that context considered an outlier. The lowest figure for jobs/GWh found in literature was 0.003, and the highest 3 (disregarding the outliers). The scale thus run from 0 to 3 jobs/GWh, and split in four parts, giving the following intervals for levels of assessment of potential positive impact in terms of job creation:

- 0–0.75 jobs/GWh corresponds to **low** potential positive impact (LPI)
- 0.76–1.5 jobs/GWh corresponds to **medium** potential positive impact (MPI)
- 1.6–2.25 jobs/GWh corresponds to **high** potential positive impact (HPI)
- 2.26≥ jobs/GWh corresponds to **very high** potential positive impact (VPI)

Based on this scheme, the outcome for the four assessed fuel are presented in table S2:

Table S2: Assessment of the positive impact in terms of jobs created for the selected fuels.

Fuel	Jobs/GWh	Level of positive impact
FAME from Lithuania	*No data available*	-
HVO from Indonesia	8.9 (outlier)	VPI
HVO from Malaysia	2.51	VPI
Ethanol from the US	1.38	MPI

The data collection proved to be difficult. Some countries have centralized data handled by a statistics department at the authorities. However, when that is not the case, data need in many cases to be retrieved from the businesses. They may have a lack of time and opportunity to help out, and sometime data linked to their commercial activities is considered confidential.

Some issues to consider in the future work for building up a methodology, and a database for the assessment of positive social impacts, are further discussed in the report. Among them is the issue of data quality.

SAMMANFATTNING

I detta projekt har syftet varit att undersöka tillgängligheten för data om positiva sociala konsekvenser från förnybara fordonsbränslen, med utgångspunkt från de vanligaste förnybara bränslena i ett svenskt sammanhang. Vi valde följande bränslen: FAME från Litauen, majsbaserad etanol från USA, HVO från Indonesien och HVO från Malaysia. Den positiva sociala påverkan som vi fokuserat på är jobbskapande.

Vi har försökt samla in primärdata för sociala positiva effekter för de valda bränslena i form av uppgifter om jobbskapande. Resultatet från datainsamlingen gällande antal arbetstillfällen som skapats sammanfattas i tabell S1.

Tabell S1. Antal jobb per GWh från datainsamlingen.

Bränsle	**Jobb/GWh**
FAME från Litauen	*Ingen tillgänglig data*
HVO från Indonesien	8,90
HVO från Malaysia	2,51
Etanol från USA	1,38

Detta resultat jämfördes med liknande siffror från litteraturen. Siffran 8,90 för Indonesien befanns då vara ett extremvärde. Den tillgängliga litteraturens lägsta siffra för antal jobb var 0,003 jobb/GWh och den högsta 3 jobb/GWh (extremvärden är borträknade). Skalan går därmed från 0 till 3 jobb/GWh, och delad i fyra delar ger det följande intervaller för nivåer av potentiell positiv påverkan:

- 0–0,75 jobb/GWh bedöms som **låg** potentiell positiv påverkan (LPI)
- 0,76–1,5 jobb/GWh bedöms som **medelstor** potentiell positiv påverkan (MPI)
- 1,6–2,25 jobb/GWh bedöms som **stor** potentiell positiv påverkan (HPI)
- 2,26≥ jobb/GWh bedöms som **mycket stor** potentiell positiv påverkan (VPI)

Resultaten för de fyra utvärderade bränslena, baserat på denna indelning, redovisas i tabell S2:

Tabell S2. Potentiell positiv påverkan från de valda bränslena vad gäller jobbskapande.

Bränsle	**Arbetstillfällen/GWh**	**Nivå på positiv påverkan**
FAME från Litauen	*Ingen tillgänglig data*	-
HVO från Indonesien	8,90	VPI
HVO från Malaysia	2,51	VPI
Etanol från USA	1,38	MPI

Datainsamlingen visade sig vara en utmaning. Vissa länder samlar in central statistik, men om så inte är fallet är man ofta hänvisad till producenterna. De kan ha brist på tid och möjligheter att hjälpa till, och ibland anses också denna typ av data vara en del av deras affärshemlighet.

Rapporten diskuterar några frågeställningar som kan vara viktiga att överväga ett framtida arbete med att konstruera en metod och bygga upp en databas för bedömning av positiva sociala konsekvenser, däribland frågan om datakvalitet.

CONTENTS

1 INTRODUCTION AND BACKGROUND

Social Life Cycle Assessment (S-LCA) is a methodology that aims at assessing social impacts from products in a life cycle perspective. To avoid sub-optimizing the efforts in strive for sustainable development[1], it is important to assess the social impacts alongside with the environmental. There are a large number of different social impacts, where often only one, or a few of them, are considered and assessed. S-LCA offers a systematic approach, taking a wide spectrum of social impacts into account.

In two previous projects, *Social and Socioeconomic Impacts from Vehicle Fuels* (Ekener-Petersen, Höglund et al. 2013) and *Integrated assessment of vehicle fuels with sustainability LCA – social and environmental impacts in a life cycle perspective* (Ekener, Hansson et al. 2016b), the importance of identifying a broad range of social impacts from vehicle fuels, biofuels as well as fossil fuels, in a life cycle perspective has been emphasized. Complemented with ways to integrate social issues with other sustainability impacts such as environmental impacts, a more holistic picture of the sustainability implications of these fuels could be attained.

S-LCA methodology was employed in the projects mentioned above, and some issues limiting the usefulness of the results achieved in those projects were identified in Ekener-Petersen et al. (2014) and Ekener et al. (2016a). Ekener et al. (2016a) discussed different approaches to better identify and take into account positive impacts in S-LCA. An attempt was made to systematically identify a broad range of positive social impacts from vehicle fuels. This was however found to be difficult, due to the limitations in appropriate assessment methodology and access to data.

A number of potential positive impacts could result from the value chains of the studied vehicle fuels, such as income and export opportunities, access to training, and different forms of social safety and infrastructure networks. These are however in many cases not taken into account in the assessments done so far. Not including positive social impact in the assessments may result in skewed picture of the total social impact of the products.

In general, there is a lack of robust social data to be used in S-LCA. The employment of social assessments is a rather new phenomenon. Lately, two databases providing such data have been established; the Social Hotspot Database (SHDB)[2], employed for data withdrawal in the conducted case studies discussed above, and the Product Social Impact Life Cycle Assessment database (PSILCA)[3], a more recent database. However, these databases are applying a risk perspective to social impacts; positive impacts are not assessed or represented in them. Thus, for the time being, the inclusion of positive social impacts will have to be done separately, collecting additional data to integrate with the risk-related S-LCA results retrieved from the current databases.

Ekener et al. (2016a) proposed to address the challenge of finding data on positive social impacts by building up a data hub, or a database, were positive social data are gathered. Thereby, practitioners could get a more easy access to positive impact data to include in their assessments. A

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[1] The definition here of sustainable development corresponds to the definition in Agenda 2030 and the UN Sustainable Development Goals, SDG's (UN, 2015).

[2] http://socialhotspot.org/

[3] http://www.psilca.net/)

database covering positive social data could be built in parallel to existing databases containing ‘negative’ social data, or the positive social data could be included in already existing databases. It is advisable that a complementary database is organized in a similar way as existing databases to facilitate integration of the results. To conduct this work, a step-by-step approach tackling the different positive social aspects successively was considered necessary.

1.1 AIM

This project will examine the availability of data on selected positive social impacts for a selection of the most commonly used vehicle biofuels in Sweden. To do this, data on job creation was selected as a first step. The aim is thus to find data on job creation in relevant sectors and geographical areas for the targeted fuels. Moreover, the aim is to try the assessment methodology proposed in Ekener et al. (2016a).

2 APPROACH AND METHOD

2.1 ASSESSMENT METHODOLOGY

In the previous project addressing positive social impacts (Ekener et al. 2016b), very few assessments of biofuels for transport that consider both positive and negative social impacts were found in the literature. Therefore, a tentative approach for assessing positive social impacts was developed. It aims to correspond to the risk assessment scheme in the SHDB, where risks for negative social impact are assessed in four risk levels: low, medium, high and very high. In alignment with this, the proposed levels of assessment are low, medium, high and very high potential positive impact. The aim is hence to divide the scale of positive impacts, measured in (estimated) magnitude of the impact, in four parts, just as was done for the risks. However, it is thereby not a given that a high risk has the same magnitude regarding its impact on individuals as a high positive impact. They are only related to other risks, or to other positive impacts, not to each other.

To illustrate a possible result, assumptions were made on the potential outcome of an assessment for an imaginary vehicle fuel (see Table 1).

Table 1: Illustrative example of an assessment of an imaginary vehicle fuel (Ekener et al. (2016b).

Lifecycle phase / Positive Social Aspect	Production of feed-stock (location 1)	Processing of feed-stock (location 2)	Transport (location 3)
Local employment	LPI	MPI	LPI
Social Benefits/Social Security	LPI	MPI	LPI
Local Economic development	MPI	MPI	-
Capacity building	MPI	HPI	-
Community engagement	-	-	-
Infrastructure development	-	MPI	-
Improved safe & healthy living conditions	-	-	-
Contribution to economic development	LPI	VPI	LPI
Public commitment to sustainability issues	LPI	LPI	-
Technological development	MPI	MPI	-
Prevention and mitigation of armed conflicts	-	-	-

LPI – Low potential positive impact
MPI – Medium potential positive impact
HPI – High potential positive impact
VPI – Very high potential positive impact
'-' – Indicates that no information is available to assess the aspect

In this project, an attempt is made to apply this assessment scheme for a selection of biofuels, using real data. The positive social impact 'job creation' (corresponding to 'Local employment' in Table 1) was addressed, based on an expectation that there would be a reasonable amount of data available, with an acceptable level of quality. This does not mean that it is the most important aspect, in terms of it potentially resulting in the highest positive social impact.

To put the collected data into context, literature was consulted. In order to make figures comparable, some conversions were made:

The production in tons was converted into PJ, using the factors 25.1 GJ/ton for ethanol, and 45 GJ/ton for crude oil.

2.2 SELECTION OF FUELS

The data for all biofuels consumed in Sweden were acquired from the yearly publication “Energy in Sweden” by the Swedish Energy Agency (2016). Based on these statistics, we selected the following fuels: FAME from Lithuania, corn-based ethanol from the US, HVO from Indonesia and from Malaysia respectively.

The quantities used in Sweden in 2011-2016 of the chosen fuels are given in Table 2. It shows that whereas the use of FAME from Lithuania is quite stable, US ethanol use is declining and HVO from the two different origins are increasingly used in Sweden with about a tenfold increase or above for the time period.

Table 2: Use of the selected biofuels in Sweden (Swedish Energy Agency, 2016).

Biofuels used in Sweden based on country of origin, cubic meter				
	FAME Lithuania	Ethanol USA	HVO Indonesia	HVO Malaysia
2011	51 750	15 897	-	-
2012	*70 950*	17 373	8 502	6 734
2013	60 065	10 271	49 239	24 892
2014	64 092	3 884	56 110	17 874
2015	57 469	2 400	86 107	20 310
2016	56 113	8 953	*182 596*	73 104

2.3 DATA COLLECTION AND AVAILABILITY

We aimed at collecting primary data for social positive impact job creation for the selected fuels. The data collection was done via email and telephone. The collection of data required many attempts; several different actors had to be contacted to locate the source for accessing primary data. Jobs can be calculated per person (Papong, Rewlay-ngoen et al. 2017), or as in most cases, given in FTE (full time equivalent). This difference needs to be considered, so the data collected is comparable.

2.4 ASSESSMENT SCHEME

Based on the assessment methodology and the collected data described above, a specific assessment scheme was created for this trial.

The choice for scale for the positives was proposed in (Ekener et al. 2016b) to correspond to the risk scale in SHDB, an assessment in four levels of risk (low, medium, high and very high). Since then, PSILCA has emerged as an alternative set up for assessing positive social impacts. In this more recent database and assessment scheme, the assessment levels are expanded to be six, adding the level of ‘no risk’ and ‘very low risk’ in the on the low impacts end of the scale. This enables the assessment of ‘no risk’ for an impact. It would be possible to make the same change for the assessments of positive impacts.

However, we decided not to use a more detailed scale. The reason was that, given the uncertainty and low accurateness of the values handle in this work, a more detailed scale would only give the impression of precision that is not reflected in the actual data collected. Thus, we settled for the four levels proposed in Ekener et al. (2016b), illustrated in Table 1 above.

In constructing the scale for this particular assessment, the lowest figure for jobs/GWh found in the population was 0.003, and the highest 3 (not considering the outliers, as previously mentioned). The scale was thus constructed to run from 0 to 3 jobs/GWh, and divided into four levels; it gives the following intervals for potential positive impact in terms of job creation:

- 0–0.75 jobs/GWh corresponds to low potential positive impact (LPI)
- 0.76–1.5 jobs/GWh corresponds to medium potential positive impact (MPI)
- 1.6–2.25 jobs/GWh corresponds to high potential positive impact (HPI)
- 2.26≥ jobs/GWh corresponds to very high potential positive impact (VPI)

3 RESULTS

Below, the result of the data collection for the selected biofuels is reported.

3.1 FAME FROM LITHUANIA

We were not able to get any data on job creation from FAME production in Lithuania. As an indication only, the jobs created from ethanol production in Lithuania are 4 500/100 000 m^3 (RRELP 2012), i.e. 0.045/m^3.

3.2 HVO FROM INDONESIA

The total number of workers in the palm oil industry in Indonesia was 1 850 000 in 2006 (WorldGrowth 2011). The total palm oil production in Indonesia in 2008 was 19 200 000 tons (IndonesiaInvestment 2017), which gives 21 694 915 m^3, as palm oil density is 885 kg/m^3. Converted to GJ, with 34.5 GJ/m^3 biodiesel, it gives a total of 748 474 576 GJ, in turn equaling 207 910 GWh. The number of direct jobs created was then 8.9 jobs/GWh.

3.3 HVO FROM MALAYSIA

The jobs created from HVO production in Malaysia were 2.51/GWh. This was based on a total number of direct jobs in the palm oil industry of 570 000 in 2014 (MPOC 2014), and a total palm oil production in Malaysia of 21 000 000 tons in 2016 (IndonesiaInvestment 2017). Based on the same conversion factors as above, this gives an energy content of 227 401 GWh.

3.4 ETHANOL FROM THE US

The ethanol industry in the US gave rise to a total of 383 361 direct, indirect and induced jobs in 2012 (Urbanchuk 2013). The same year the industry produced in total 50 345 977 m^3 ethanol (Urbanchuk 2013). Applying the same calculations as above, but with the factor 19.8 GJ/m^3 for ethanol, the energy content was 276 903 GWh. The number of jobs generated by ethanol production was then calculated to 1.38 jobs/GWh.

3.5 COLLECTIVE OUTCOME FROM THE DATA COLLECTION

In summary, the outcome in terms of number of jobs is displayed in Table 3:

Table 3. Number of jobs per GWh from the data collection.

Biofuel	Jobs/GWh
FAME from Lithuania	*No data available*
HVO from Indonesia	8.90
HVO from Malaysia	2.51
Ethanol from the US	1.38

3.6 CONTEXTUAL COMPARISON WITH DATA FROM LITERATURE

To put the collected data into context, literature was consulted. In Ekener et al. 2016b some data regarding the number of jobs were collected for four types of fuels, namely oil from Nigeria and Russia, respectively, and ethanol from USA and Brazil, respectively. Table 4 displays the production in tons and per petajoule (1 PJ = 10^{15} joule = 1 000 terajoule), and the related number of jobs (numerical and jobs/PJ). The production in tons was in Ekener et al (2016b) converted into PJ, using the factors 25.1 GJ/ton for ethanol, and 45 GJ/ton for crude oil.

Table 4. Production of fuels/country and number of associated direct and indirect jobs, adapted from Ekener et al. (2016b).

Country	Production [million ton]	Production/PJ • factor$_{ethanol}$ = 25.1 GJ/ton • Factor$_{cride\ oil}$ = 45 GJ/ton	Number of jobs [numerical]	Number of jobs/PJ
Nigeria (oil)	110.9	4,993	130 000–150 000	28
Russia (oil)	528.6	23,786	610 000–730 000	28
USA (ethanol)	44.2	1,110	357407	322
Brazil (ethanol)	21.2	532	503 000	946

To make the figures from Ekener et al (2016b) comparable in this work, we have converted them into GWh. The outcome is shown in Table 5.

Table 5. Fuel production and number of jobs per GWh for the different fuels and production countries. Calculations based on Ekener, Hansson et al. (2016).

	Nigeria (oil)	Russia (oil)	USA (ethanol)	Brazil (ethanol)
Production, GWh	1 386 944	6 607 222	30 833	147 778
No of jobs/GWh	0.10	0.10	11.6	3.40

From Peck (2017) some data on job creation from different biofuels was collected, displayed in Table 6. Note that this is a compilation of results from different sources, thus the way they are constructed may vary, and they should not be considered as fully comparable. Yet they are interesting as an indication of the range of figures.

Table 6. Figures for number of jobs per GWh for selected transportation biofuels (Peck (2017).

Biofuel	Direct jobs/GWh	Total jobs/GWh
Ethanol, Germany (FZID) Reference/High diffusion scenarios		0.45/0.73 (net)
Ethanol, Australia		0.25
Ethanol, the US (POET)	0.02 – 0.04	0.7 - 1.1
Ethanol, Sweden (Lantmännen)	0.08	0.13
Biodiesel, the US (production)	0.02	
Biodiesel , the US (full chain)	0. 30 – 0.36	1.01 – 1.23
Biodiesel, Sweden (Perstorp)	0.01	0.03

Against this background, the data collected for the four biofuels considered in this report was assessed based on the assessment scheme presented in section 2.4 above. The outcome is given in Table 7.

Table 7. Assessment results for the selected biofuels.

Biofuel	Jobs/GWh	Level of positive impact*
FAME from Lithuania	*No data available*	-
HVO from Indonesia	8.9 (outlier)	VPI
HVO from Malaysia	2.51	VPI
Ethanol from the US	1.38	MPI
*LPI, low potential positive impact = 0–0.75 jobs/GWh MPI, medium potential positive impact = 0.76–1.5 jobs/GWh HPI, high potential positive impact = 1.6–2.25 jobs/GWh VPI, very high potential positive impact = 2.26≥ jobs/GWh		

4 DISCUSSION AND CONCLUSIONS

Looking at the result of this project, what is noticeable is the large spread among the results on jobs/GWh from the different sources. They are sometimes not even in the same order of magnitude. Examples are the results for HVO from Indonesia in this work (8.90 jobs/GWh) and for US ethanol from the work in Ekener, Hansson et al. (2016) (11.6 jobs/GWh). These are considerable higher than all the other values, rather positioned around or below 1 job/GWh, with third highest value at 2.51 job per/GWh (HVO from Malaysia). This calls for a more in-depth analysis, to identify the factors behind such a large spread.

There is no evident relation between the type of biofuel (ethanol or biodiesel) and the number of jobs created; the data shows a mixed picture in this respect. However, even though we only collected data for biofuels in this project, data from literature indicates that employment created is substantially larger for biofuels than for fossil fuels (Malik, Lenzen et al. 2014, Ekener et al. 2016a). Papong, Rewlay-ngoen et al. (2017) estimated it to be 15 to 18 times larger for biofuels than for fossil fuels.

The data collection was conducted with varying success. The employment data for the United States specific to the ethanol industry was well developed and obtained from national secondary databases. However, no such databases were found for biofuels from Malaysia or Indonesia. Although a relatively large volume of literature was available on palm oil plantations in these regions, no direct information pertaining to employment in the specific biofuels sectors was found. This could potentially be due to the fact the informal economy is commonly substantial in low-income countries such as Indonesia, where a varying number of day laborers are used to work in the palm oil plantations. These work hours are often inadequately accounted for in national statistics. Yet, the large volume of literature available on the topic of palm oil plantations could indicate a growing international interest in the social and the environmental conditions that effect sustainable development in these regions. Thus, over time, work hours and working conditions in the sector could expectedly be better covered in literature. Further, although national statistical databases were available in Lithuania, information specific to the employment in the biofuels sector of interest could not be retrieved. A request for acquiring employment information was declined by the department of statistics, stating its inability to share information that was seen as confidential in the industry.

A main reflection is that data on job creation is difficult to collect and handle. Not only is this information deemed confidential at times; data is given in many different formats, covering varying aspects. Some issues further issues to consider in forthcoming work in this area were identified in the project:

It is of importance to align the data collected. Jobs can be calculated per person or in FTE. This need to be clearly defined, so that all data used is calculated in the same way. Further, it is not always clear which parts of the supply chain are included in the collected data. Is it only the final, processing step for the biofuel, or is it the full life cycle with all phases, including e.g. cultivation? The range of included life cycle phases may influence the outcome substantially. Thus, it is important to specify this for each figure collected. When collecting data with the aim of entering it into a database like the SHDB, it is important that the data, such as employment data, only cover the life cycle phase/sector for which it is entered, and nothing else. Otherwise, summing up the life cycle impacts based on data retrieved from the database would result in double counting. A reflection from this study is the importance of including all life cycle phases in a total assessment.

In interpreting the results, it is of importance to consider the system boundaries. In some cases, the employment effects in the reviewed data sources have been calculated as net effects, i.e. also considering the job losses in the sector that loses business due to the production assessed. This might be relevant, but if these effects are included, they must be specified, and results should only be compared to other results calculated with the same approach. Another issue is how to view job creation. How far out in the economy should the jobs created because of a specific production be calculated in terms of dynamic effects on other sectors? The data found has sometimes been only direct jobs, sometimes direct and indirect jobs, and sometimes so called induced jobs. This needs to be considered in the design of the assessment, as well as for the data collected from different sources.

Further, when should a specific life cycle be credited for creating jobs? For example, if the crops that are used for biofuel production had not been cultivated for this purpose, the land could have been used for something else, potentially creating an equivalent amount of jobs. Thus, should these jobs be credited to the biofuel life cycle? For fossil fuels, the situation is somewhat different as there is no obvious other use for an oil well. On the other hand, land devastated in connection to the well might have an alternative usage, for example cultivation or forest management. Should these potential other uses be looked upon as causing lost jobs?

This kind of systems thinking – considering impacts in relation to other sectors and other uses of resources – could be argued for, but is probably context-dependent. In some cases, jobs created in connection to biofuel production might be completely new, and add to the total of available jobs. These choices would probably need to be discussed and motivated on a case-by-case basis. In fact, this kind of thinking might be relevant in all sectors, not only biofuel production. In a well-functioning market, all resources made available would be utilized for some other purposes, including labor. This emphasizes the importance of being transparent regarding the system boundaries in each assessment, and to carefully consider potential differences in system boundaries when comparing of results from different studies.

In this work, the quality of the jobs created has not been taken into account. In a more in-depth analysis, the jobs created could be classified according to e.g. required qualification or wage level. Constructing a database for the positive impacts, with possibilities to select numbers of indicators for each social issue, could easily be achieved technically. Different indicators could be constructed with quotas for the relation of highly qualified jobs in relation to less qualified ones. The challenge, as has already been mentioned, would rather be collecting the data for these indicators in the first place.

Further, experiences from the field illustrate that social aspects are often not really straight-forward, but rather complex. In the case of job creation, immigrant and/or temporary workers may be offered the jobs that are created. If the aim is to boost the local community by offering local employment, the potential positive impact for job creation in a longer run is reduced in this case. This is why the aspect of who actually is employed for a job that has been created is important in the assessment.

Measuring the mere creation or loss of jobs is not the same as identifying the social impact. The social impact on an individual level could be substantially different depending on context because of differing national/regional social security systems globally. In a country like Sweden, with a well-developed social security system, the impact would be different from that in a country, region or context where there is little support, potentially resulting in very different outcomes on an individual level.

The figures here only address jobs created for biofuels. So, can this approach be used also for fossil fuels? As the scale in the assessment scheme departs at zero jobs and goes upwards, it would allow for assessing all transportation fuels, including the fossil-based, in the same scheme. However, should there in the future emerge new fuel types, which give rise to a substantially larger number of jobs, the scale would have to be adjusted to that, in order to mirror the different levels of potential positive impacts in a relevant way. Consequently, the number of jobs created in one fuel production industry would have to be substantially higher than presently to result in the assessment VPI (very high potential positive impact) in such case, as the scale is relative.

In conclusion, the availability of data on the positive social impacts (job creation) for the selected biofuels was found to be restricted, and the data collection activities, as well as the interpretation and use of the data, displayed several problems to overcome. Difficulties have been encountered in terms of data availability, data quality, the comparability for data retrieved from different sources. The assessment scheme employed worked well and it was possible to arrive at an assessment outcome, although based on data with big uncertainties.

This project indicates that it will be a big challenge to build a database for positive social data with an impact assessment model included. Still, this work must continue in order to strive for a better-balanced social life cycle assessment including both positive and negative social impacts.

REFERENCES

Ekener-Petersen, E., J. Höglund and G. Finnveden (2013). Social and socioeconomic impacts from vehicle fuels. Report No 2013:20. Sweden, Available: www.f3centre.se, f3 The Swedish Knowledge Centre for Renewable Transportation Fuels.

Ekener, E., J. Hansson and M. Gustavsson (2016a). "Addressing positive impacts in social LCA—discussing current and new approaches exemplified by the case of vehicle fuels." International Journal of Life Cycle Assessment: 1-13.

Ekener, E., J. Hansson, M. Gustavsson and P. Peck (2016b). Integrated assessment of vehicle fuels with Lifecycle Sustainability Assessment – tested for two petrol and two biofuel value chains. Report No 2016:12. Sweden, Available: www.f3centre.se, f3 The Swedish Knowledge Centre for Renewable Transportation Fuels.

IndonesiaInvestment. (2017). Available: "https://www.indonesia-investments.com/business/commodities/palm-oil/item166?".

Malik, A., Lenzen, M., Ely, R. N. & Dietzenbacher, E. 2014. Simulating the impact of new industries on the economy: The case of biorefining in Australia. *Ecological Economics*, Volume 107, November 2014, Pages 84-93.

MPOC (Malaysian Palm Oil Council). 2014. *Malaysian Palm Oil - Moving Forward and Addressing Challenges in a Changing Global Scenario.* Presentation by Tan Sri Datuk Dr. Yusof Basiron at the Palm Oil Trade Fair & Seminar, 28 October 2014. Available: http://www.mpoc.org.my/upload/Palm-Oil-Trade-Fair-and-Seminar-POTS-KL-2014-P2-Tan-Sri-Yusof-Basiron.pdf.

Papong, S., C. Rewlay-ngoen, N. Itsubo and P. Malakul (2017). "Environmental life cycle assessment and social impacts of bioethanol production in Thailand." Journal of Cleaner Production **157**: 254-266.

Peck, P. (2017). *Socio-Economic Metrics For Transport Biofuels: A Review.* A support analysis for the project "Environmental and socio-economic benefits from Swedish biofuel production" within the f3 and Swedish Energy Agency collaborative research program "Renewable transportation fuels and systems". Forthcoming.

RRELP. (2012). "Renewable Resources Energy Legislation Project". Available: http://www3.lrs.lt/docs2/ZPUINBZG.PDF."

Urbanchuk, J. M. (2013). *Contribution of the Ethanol Industry to the Economy of the United States*. Prepared for the Renewable Fuels Association. Cardno ENTRIX. Available: http://www.ethanolrfa.org/wp-content/uploads/2015/09/2012-Ethanol-Economic-Impact.pdf.

WorldGrowth. (2011). The Economic Benefit of Palm Oil to Indonesia. Available: "http://worldgrowth.org/site/wp-content/uploads/2012/06/WG_Indonesian_Palm_Oil_Benefits_Report-2_11.pdf."

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