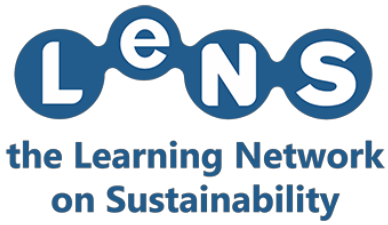


Incorporating sustainability into research projects

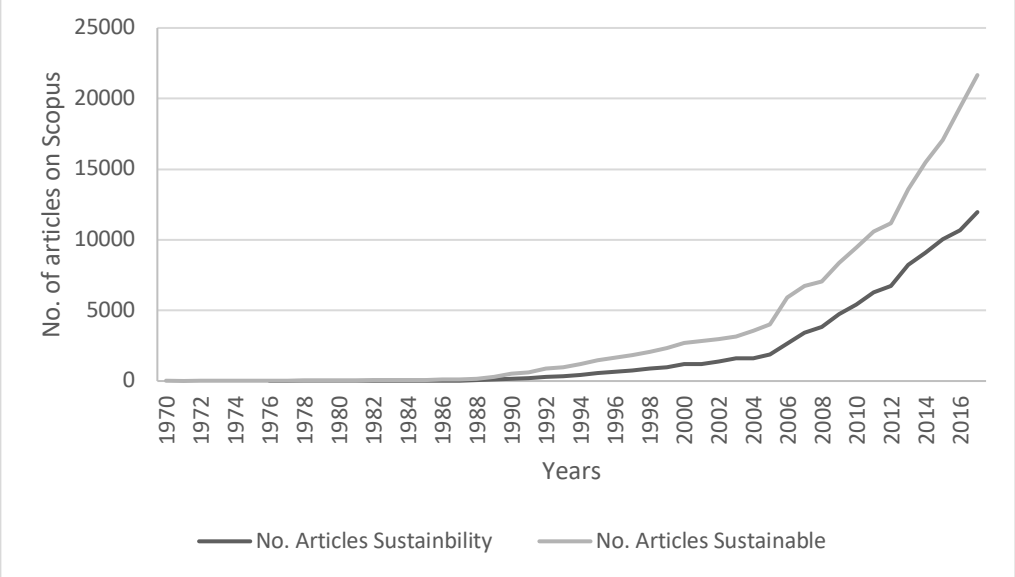
Ronan Coone
School of Engineering, National University of Ireland, Galway. Email: ronan.m.cooney@nuigalway.ie
Alexandre Tahar
Bioseciences Institute, Athlone Institute of Technology, Ireland. Email: atahar@ait.ie
Eoghan Clifford
School of Engineering, National University of Ireland, Galway. Email: eoghan.clifford@nuigalway.ie

ABSTRACT

Since the 1970's scientific publication concerning sustainability have increased from one to 11,962 in 2016. Like all activities, the research behind these publications have an indirect impact on the environment (resource use, vehicles etc). Researchers in the topic of sustainability have an onus to account for their own impacts as part of their work and where possible, implement interventions. A life-cycle approach is currently the most advanced method of assessing the impact of a group or organisation. In this study an organisational life cycle assessment (O-LCA) approach was applied to a research project which focused on sustainability in the aquaculture sector. The objectives of the study were to (i) determine the impact of a research project, (ii) determine impact reduction opportunities, and (iii) to assess the use of O-LCA as a project management tool for academic research groups and projects. The results of this study indicated that commuting had the greatest impact, followed by conferences. The alternative scenarios analysed indicated that reductions of 5-16% in greenhouse gas emissions could be feasibly achieved and that O-LCA approaches could be applied to help sustainably manage such projects.
Keywords: project management, organisational life cycle assessment (O-LCA), sustainability, social responsibility

1. INTRODUCTION

The pursuit of greater knowledge on sustainability has created a significant increase in active research on the topic. Since the 1970's scientific publication concerning sustainability have increased from one to 11,962 in 2016 (Figure 1). As with all activities, the research behind these publications had an indirect impact on the environment in that, the data gathered to support the articles required the use of vehicles and resources. Researchers in the topic of sustainability have an onus to account for their own impacts as part of their work and where possible, implement adequate interventions. A major burden placed on the environment by researchers, apart from research activities themselves, is dissemination of results and networking (Ponette-González, 2011). Air travel emissions are one of the major hot spots in a research project (Achten et al., 2013; Caset et al., 2018), and recently an open letter was published by over 600 researchers in Danish Universities which called on their institutions to implement the necessary changes required to mitigate climate change (Andersen, 2018, November 19th). Given the momentum behind this body of work, it is appropriate that researchers, apply available techniques and objectivity to our own activities and investigate how to reduce negative environmental impacts of research projects while maintaining scientific rigour and meeting project objectives.



[Figure 1] The number of publications available on the academic database, SCOPUS (accessed May 2018).

In the context of an increase in the number of research projects funded investigating sustainability topics environmental social responsibility can be used by researchers as not just a concept but as a tool within their own work. Among all the sustainability metrics and tools currently available, a life-cycle approach is currently the best developed means of assessing the impact of a group or organisation (Forin et al., 2018; Martínez-Blanco et al., 2016). Life cycle assessment (LCA) was originally devised to assess the burden associated with production systems (Guinée, 2002), but its underlying principles and concepts have the potential to identify inefficiencies and promote positive changes in how organisations perform and the impacts associated with their operation.

In more recent years a technique called organisational life cycle assessment (O-LCA) has been developed with guidelines and technical documents having been published (Finkbeiner, 2016; Forin et al., 2018; Martínez-Blanco et al., 2015a, 2016; Martínez-Blanco et al., 2015b). As with any new techniques, the use of case studies to test the robustness and also to advance the concept are of the utmost importance (Forin et al., 2018). With this in mind, O-LCA was applied to a short-medium term research project investigating the topic of sustainable aquaculture in Ireland. The key objectives of this case study were to (i) determine the impact of a research project, by focusing on vehicle use and using a post hoc approach to (ii) determine impact reduction opportunities, during the life cycle of a research project by modelling interventions and alternative scenarios, and (iii) to assess the use of O-LCA as a project management tool for academic research groups and projects.

2. MATERIALS AND METHODS

2.1 Background

O-LCA provides a framework which allows for the quantification of environmental impacts and burdens associated with organisations whereby the underlying principles and approach of a process based LCA are applied to the organisation or group being studied. The differences between the two techniques occur in three areas (i) the object being studied is an organisation and not a good or service and is termed the reporting organisation, (ii) the unit of analysis is referred to as the reporting unit rather than the functional unit and (iii) the system boundaries encompass all the activities of the organisation rather than focusing on a production system. For detailed overviews see (Finkbeiner, 2016; Martínez-Blanco et al., 2015a, 2016; Martínez-Blanco et al., 2015b).

2.2 Scope of assessment

The goal of this study was; (i) to determine the environmental burden associated with a two-year research project in Ireland, (ii) investigate impact reduction opportunities and (iii) investigate the use of O-LCA as a project management tool for research groups. The reporting organisation was the MOREFISH project, a multi-disciplinary research group, across two research institutions, that focused on enhancing the sustainability and production efficiencies of freshwater aquaculture in Ireland.

2.2.1 System boundaries

The system boundaries applied in this were focused on the associated travel activities of the project personnel within the reference period. The reference period for this study was the 01/01/2015-31/08/2017, the period for which the project was funded. The activities which were included in the collation of the life cycle inventory (LCI) were; commuting, fieldwork, conferences, training and meetings.

2.3 Life cycle inventory and life cycle impact assessment

Inventory data was collected from LCI databases, interviews with project staff and attendance records regarding working hours, digital and hard copy travel records and external stakeholder attendance at and travel to project workshops (Table 1).

[Table 1] The inventory for the project. The distance travelled was collected using questionnaires and mileage claims. Fuel use and direct emissions were calculated using the vehicle manufacturers figures. The terms direct carbon dioxide (CO_2) and indirect CO_2 refer to tailpipe emissions due to combustion of fuel and the emissions associated with the production of the fuel uses, respectively.

Personnel	% Time on Project	Total KMs	Total Fuel	Direct CO_2 (kg)	Indirect CO_2 (kg)	NO_x[1] (kg)	PM (kg)
Principal Investigator 1 - PI1	10%	1,268	50	69	24	0.1	0.0
Principal Investigator 2 - PI2	10%	2,470	116	277	55	0.1	0.1
Research Fellow 1 - RF1	-	11,083	113	482	53	1.0	0.0
Post-Doctoral Researcher 1 - PD1	100%	43,790	1,972	3,321	1,109	1.7	0.0
Post-Doctoral Researcher 2 - PD2	100%	26,738	60	791	34	0.4	0.0
Project Manager - PM	100%	15,115	856	2,187	473	1.0	0.1
Postgraduate Researcher 1 - PG1	100%	24,075	808	2,105	382	5.2	0.6
Postgraduate Researcher 2 - PG2	100%	18,560	1,031	2,741	443	8	0.8
Stakeholder meetings		19,537	640	2,490	286	1.6	3.2
Totals		162,636	5,646	14,461	2,573	19.1	4.7

Life cycle impact assessment was carried out using the CML baseline characterisation factors (Guinée, 2002). The characterisation factors assessed in this study included; abiotic depletion potential (ABP) in both kilograms of antimony and megajoules (MJ), global warming potential (GWP), ozone layer depletion (ODP), human toxicity potential (HTP), freshwater aquatic ecotoxicity potential (FWAETP), marine aquatic ecotoxicity potential (MAETP), terrestrial ecotoxicity potential (TETP), photochemical oxidation potential (POP), acidification potential (AP) and eutrophication potential (EP).

[1] Nitrous oxides - NO_x

2.4 Scenarios

Three scenarios were developed, to examine emission reduction potential. These were to assess the impact reduction potential of a modal switch to electric vehicles (EVs), flexible working arrangements and interventions in stakeholder workshops.

2.4.1 Reference Scenario

This scenario assessed the environmental impact of the MOREFSIH project is regarded as the reference scenario. This scenario essentially formed the LCI for the rest of the study.

2.4.2 EV scenario

This scenario considered the impact reduction opportunities if the project personnel operated electric vehicles (EV). For this scenario hybrid electric vehicles (HEVs), battery electric vehicles (BEVs) and plug in hybrid electric vehicles (PHEVs) were all considered. This scenario was considered likely as individuals who work in this area and people who possess advanced degrees are generally early adopters of new technologies such as EVs (Egbue and Long, 2012; Hidrue et al., 2011; Plötz et al., 2014; Ziegler, 2012). Vehicles operated by the project personnel were substituted based on the closest comparable EV. This was achieved by creating a matrix of projected vehicle value, vehicle class and the age of the vehicle operated during the reference period. Utility vehicles such as vans and SUVs were also substituted for the closest possible EV alternative.

2.4.3 Working from home

This scenario investigated the impact reduction opportunities which may have been available to the project due to the recent trend of organisations offering their staff the option of flexible working arrangements, such as working from home (Kelliher and Anderson, 2009). As part of this, personnel who were working 100% of time on the project were modelled as working one day a week from home.

2.4.4 Stakeholder meetings

The stakeholder scenario considered the likely reduction in emissions, if attendees at these events were encouraged to use public transportation rather than private transportation. There were three such meetings which took place over the project, each with a greater number of attendees, distances travelled and associated emissions than the preceding meeting.

3. RESULTS

In total the distance travelled to achieve the projects aims amounted to 143,098 km. Fuel use for the project totalled 5,956 L, with tailpipe carbon emissions being 14,503 kg CO_2eq. The results of the reference scenario indicated that the bulk of the projects burden was associated with the commuting activity, at an average of 42% of the total burden across all impact categories. This was followed by conference and training events at 32% of total impacts, fieldwork at 16% and meetings at 10%. In the EV scenario there was an average reduction of 16% in the total impact across all categories when compared with the reference. A shift in rank was observed in the order of activities which contributed the most to the total impact. Commuting was displaced by conference and training, which increased its impact to 41%. Commuting impacts were reduced to an average of 37% across the impact categories. Fieldwork averaged 12% with meetings representing 11%. This shift in the contribution to impacts was due to the reduction in car related impacts as a result of reduced fossil fuels combustion and their production. The use of air travel in conference and training activities became the major contributor as a result.

The third scenario investigated if project personnel were offered flexible working arrangements. That is that they were afforded the opportunity of working from home at least one day per week. Across all impact categories there was a reduction of 5%. The rank structure was not affected in this scenario but there were increases in all other actives apart from commuting. Commuting had an average of 39% of total impacts, conferences and training at 33%, fieldwork at 17% and meetings at 11%.

The fourth scenario considered as part of this case study was that of a stakeholder intervention in the form of encouraging delegates attending a series of three workshops organised as part of the MOREFISH project to avail of public transportation rather than use their personal vehicles. The results of this scenario indicated that in terms of environmental burden and the time required to travel to the workshops that public transportation (bus and rail) was not the most environmentally informed choice. For the first workshop, which had an attendance of 4 individual from industry, there was an average decrease of 49% in total impact. This was due to the relatively short and direct public transportation routes. However, time required to attend did increase by 9 hours. The second workshop saw an

increase in attendance to 21 individuals, these individuals came from further afield and included attendees from overseas. As a result of this the alternative for this workshop saw an increase in the environmental burden across all impact categories of 140% compared to the reference. There was also an additional 38 hours of travel required for the individuals to attend. The third workshop in this series saw a total of 26 attendees. Similar to the second workshop there were attendees from overseas and remote areas of the country with indirect public transportation options. There was an increase of 304% across the impact categories and an increase of 106 hours travel time. The results of this scenario reflect the nature of the Irish aquaculture sector in that it occurs in rural areas away from major urban areas with well-developed public transportation routes.

4. DISCUSSION

Data availability determined the scope of this study. For instance, for the EV scenario the allocation of the closest equivalent alternative vehicle was based on the vehicle age, vehicle class and the projected price for a vehicle of that age.

The shift to EVs from traditional internal combustion engine vehicles, offers very real impact reduction opportunities by using currently available models. In terms of an organisation this would indicate that organisations which wish to improve their sustainability could propose that EVs can be hired or rented from a project budget in lieu of using private cars. Or organisations can mandate that for suitable trips in-house EVs must be booked and used wherever possible. Utility vehicles in this project accounted for 6892 km, 3,055.7 kg CO_2 and 476.9 L of fuel. By switching to the closest alternative commercial vehicles, the average reduction for tailpipe emissions was 85%.

Most research projects are financed through public funding. As such, there is a social responsibility for researchers and projects working on and researching the areas of sustainability and efficiency to conduct their work using the most environmentally sustainable and efficient means available. The introspective approach outlined in this study allows for an initial post-hoc approach to incorporate the concept of life cycle thinking and its application to a research project and its management using relatively simple and readily available information. The extent to which a research project can implement significant changes in its operation may be somewhat limited, as they are generally a smaller collective in a larger organisation. Research groups will generally not be in a position to purchase vehicles or other means of transportation from research budgets but can approach funding organisations and their own institutes with recommendations to phase the organisations vehicle fleet with the most environmentally conscious option when upgrading. Particularly for ICE utility vehicles such as vans and 4x4s as there are currently alternate EVs models available. Furthermore, an O-LCA should as a matter of course be implemented at third level institutions along the lines of Lo-Iacono-Ferreira et al. (2016). As these institutions house and promote the research of sustainability and its application to the wider world.

5. CONCLUSIONS

Applying an O-LCA approach proved to be an appropriate tool for assessing the environmental burden of a research group and that it has potential to better inform the management of academic projects and events. The use of O-LCA can allow organisers to better plan and implement more environmentally conscious choices through the identification of knowledge gaps and reduction opportunities, particularly in terms of workshop and event management. The ability of research groups and projects to enact changes is somewhat limited, due to their placement within a larger organisation, typically a higher education institute. Therefore, there is a requirement for universities to carry out O-LCA studies on themselves. It is recommended that principal investigators, organisations and funding bodies incorporate O-LCA into their practices to foster responsible and sustainable research practices.

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