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Pros and cons of online education as a measure to reduce carbon emissions in higher education in the Netherlands

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Dutch institutions of higher education have to meet stringent requirements for energy efficiency and reduction of carbon emissions imposed by the national government and through voluntary agreements on energy-efficiency. This exploratory study reports the relative contribution of student (and staff) travel to the carbon emissions of Dutch higher education institutions (HEIs) and examines the arguments for and against online education as a means to reduce the carbon impact of student travel. Data on carbon emissions using the greenhouse gas (GHG) protocol, published by HEIs, were gathered and analysed. A comparison with data from other countries is presented. It was found that the contribution of the so-called scope three emissions (travel related) to the total carbon footprint of the HEIs is between 40 and 90 percent at the Dutch HEIs that were investigated. Online education (80 percent or more digitalisation of the educational processes) greatly decreases the carbon impact of student and staff travel.A series of interviews was held with HEI professionals of online education and ICT/sustainability. The interviews were analysed using the grounded theory approach. The professionals report as pros of online education its flexibility and power to personalise educational needs of individual students and the possibility to extend the learning environment with digital media. As an argument against online education professionals mention the non-committal behaviour of students. Only a few HEI professionals recognize the connection between online education and its potential for strongly reducing carbon emissions.

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Introduction

Under the United Nations Framework Convention on Climate Change in 2015 (the Paris agreement) 197 countries have committed themselves to keep global warming well below 2°C above pre-industrial levels (United Nations Framework Convention on Climate Change; URL: http://unfccc.int/2860.php). In April 2016 the European Union has ratified the Paris agreement. For the Netherlands this means a reduction of greenhouse gas (GHG) emissions of 85–95 percent in 2050 (baseline 1990) [1]. The awareness of the necessity of a responsible attitude towards the environment is growing in Dutch higher education (HE). An example of this attitude is the signing of a long-term agreement (LTA) with the government to improve energy efficiency by 30 percent from 2005 until 2020 [2,3] in 2001. Improving energy efficiency and using energy sources with less carbon emissions lead to a reduction of GHG emissions. However, a HEI may not only be held responsible for its own direct GHG emissions but also for the emissions as a consequence of its activities. One of these emission sources is student (and staff) travel. With the term student travel we designate all travelling associated with their study, such as the daily commute between student residence and their HEI, the travel between student residence and main home residence, and all other travelling for study activities, including going abroad to take courses. Transport is known to have a significant environmental impact. The Intergovernmental Panel on Climate Change (IPCC) states that 23 percent of global GHG emissions (in 2010) can be attributed to (passenger and freight) transport [4]. Given the opportunities of online education, the

current state of technology and the need for a sustainable travel policy, the choice for delivering online education for Dutch HEIs would seem logical, as stated by Perez Salgado [5]. However, up to now online education has not been widely introduced at HEIs in the Netherlands. The study presented in this article explores the following aspects:

1. the carbon emissions associated with student (and staff) travel of several Dutch HEIs,
2. the pros and cons related to implementing online education in Dutch HE, according to interviewed educational and ICT/sustainability professionals at HEIs.

This exploration consists of an analysis of reported GHG emissions from HEIs and results from in-depth interviews with HEI professionals.

The outline of this article is as follows. In the section 'Review of literature' we provide definitions and background information on reporting carbon emissions caused by student and staff travelling, and on online education. The approach (with its limitations) is explained in section 'Methods'. In section 'Results' we present several types of results: an analysis of the carbon emissions related to student travel and commute of staff of HEIs, the measures and difficulties to reduce carbon emissions for travelling, and the pros and cons of online education through an analysis of interviews held with HEI professionals. In last section, we end with a summary and conclusions, and propose suggestions for further research.

Review of literature

Measuring and reporting carbon emissions

One way of measuring the environmental impact an activity has on its surroundings, is to measure its carbon footprint. A definition of the carbon footprint is:'*a measure of the exclusive total amount of carbon dioxide (CO_2) emissions that is directly or indirectly caused by an activity or is accumulated over the life stages of a product*' [6]. Carbon dioxide is an important anthropogenic contributor to the GHGs, and often carbon dioxide equivalents (CO_2e) are used to express the amount of GHGs.

The Greenhouse Gas Protocol Initiative [7] is an internationally accepted GHG accounting and reporting standard for companies and organisations. It provides a guideline which companies can use to quantify and report their GHG emissions. The GHG protocol divides the emission sources into three scopes (Table 1). In Table 1 we show some examples of scope 3 emissions, including emission sources associated with student and staff travel.

According to the GHG protocol reporting on scope 3 emissions is optional. Institutions can choose which categories they wish to report on. This makes it difficult to compare scope 3 emissions across institutions.

Table 1

Classification of greenhouse gas emission sources based on the GHG protocol [7].

Scope	Description [7]	Examples
Scope 1	Direct emissions from sources that are owned and controlled by the institution	Heating and cooling systems, vehicles (owned by the institution)
Scope 2	Indirect emissions from the generation of the purchased electricity consumed by the institution	Purchased electricity
Scope 3	Other indirect emissions as a consequence of the activities of the institution, but that occur from sources not owned or not controlled by the institution	Waste, procurement, education-related student travel, commute of staff, business travel

Carbon emissions due to student travel

Internationally there are only a few environmental studies in which GHG-emissions of HEIs are calculated. These studies are based on the GHG protocol, so the accounting of scope 3 emission sources is optional and therefore the system boundary can be different [8,10,11•]. Studies on the environmental impact of HEIs often do not include student travel as one of the sources of carbon emissions [8–10]. Ozawa-Meida *et al.* [11•] included indirect emissions due to student and staff commute, business travel, students' trips home, and visitor travel in their calculations for a UK university. In the academic year 2008/2009 they report 300 kg CO_2e emissions per student for student commute and 750 kg CO_2e emissions per staff member for staff commute. The total of travel related emissions for this specific UK university is around 15 000 Ton CO_2e and that is about 30 percent of the overall emissions of the university.

Townsend and Barrett [10] base their calculations of the carbon footprint of another UK university on expenditure data, that is to say: determined by the university's spending policy. They do not include travel emissions because of the complexity of gathering reliable travel data of staff and students [10]. Research from the United States (US) [12,13] seems to confirm the difficulty of obtaining reliable travel data at HEIs. Bailey and LaPoint [12] and Klein-Banai and Theis [13] state that these data have a high degree of 'inaccessible data and methodological uncertainty' [12], because 'it may be based on surveys, parking permit counts, travel vouchers and various other sources of data' [13]. Bailey and LaPoint [12] report for a US-university in 2013 550 kg CO_2e emissions (per student per year) for student commute and 750 kg CO_2e emissions (per staff/faculty member per year) for staff/faculty commute. It follows that comparing scope 3 emissions has to be done with great care.

Roy *et al.* [14••] and Caird *et al.* [15••] in the UK used a different approach to calculate travel emissions in a