Transportation Research Part D 44 (2016) 211–218

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Environmental benefits from improving transportation efficiency in wood procurement systems

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ARTICLE INFO

Article history:
Available online 19 March 2016

Keywords:
Wood procurement
Greenhouse gas
Environmental benefits
Vehicle exhaust emissions

ABSTRACT

Forest operations use fossil fuels, which should be considered when environmental impact in the wood procurement is of concern. Road freight transportation is the most common operation in timber transportation, and thus is an important source of greenhouse gas emissions. This study assesses the impact of the new larger and heavier vehicles (LHV) on environmental emissions using the synchronized calculation method. The maximum (theoretical) and operational effects of 76 t LHV with calculations made for three weight limits (60, 64 and 68 t) are compared in Finland. Based on Enterprise Resource Planning (ERP) data, environmental energy efficiency (measured in relation to the trip) increased 9.2%. The reduction in fuel consumption was 12.5%, though this is likely to underestimate the long-term effects that will be achieved when forest operations are fully adjusted to the maximum weight limit. A comparison with the European countries and a preliminary sensitivity analysis of the system demonstrate that the technological development to improve the transporting efficiency is essential for realizing 76 t LHV utilization in Finland.

Introduction

The growth of road freight transport has been significant for many decades in Europe. The European Commission has anticipated that by 2030 the volume of freight transported by road could rise by 83% (tkm) over a 2005 level (European Commission, 2003; OECD, 2011). In Finland, timber transportation could rise by 15–20%. In wood procurement of the forest industry, 75% of timber is transported to the mill by 1700 trucks (Finnish statistical, 2014). The rest, 25% was transported to the mill either by train (22%) or waterways (3%), although these include timber trucking in the beginning of the transport chain, 50 km on average. The maximum weight, including payload, of the vehicle combination was limited to 60 t in 1993 (Palander et al., 2012). The typical 60 t vehicle combination was a three-axle truck pulling a four-axle trailer. In 2013, Ministry of Transport and Communications of Finland increased the maximum weight to 76 t for the larger and heavier vehicle combinations (LHV) equipped with nine axles, e.g., four axles in truck and five axles on trailer (Fig. 1).

In Finnish wood-procurement environment road freight transportation has been considered relatively competitive compared to other countries (Högnäs, 2001). Since 2000, the competitiveness of timber transportation has been based on a long-term development work, regional entrepreneurship agreements, investments in information, communication and optimization systems as well as on the high net carrying loads of the vehicle combinations (Palander et al., 2006, 2012;

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http://dx.doi.org/10.1016/j.trd.2016.03.004
1361-9209/

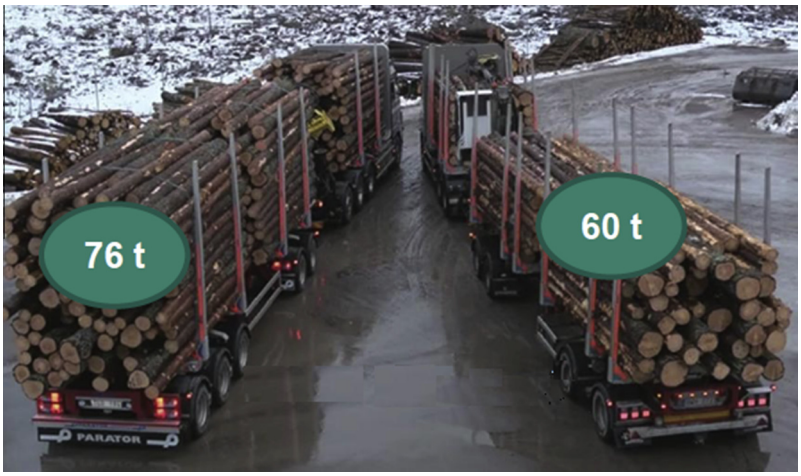

Fig. 1. Maximum payloads in 60 and 76 t vehicle combinations. photo: Metsähallitus

Malinen et al., 2014). Although road transportation has been cost-effective transportation method in wood procurement, there will be cost related environmental challenges to solve in the future, because trucks account for around 22% of total world carbon dioxide (CO_2) emissions from transport (ITF, 2008; McKinnon and Piecyk, 2009).

At an early stage in trucks' weight limit deliberation in 1996, the European Commission decided that only road vehicles meeting the Euro II emission standard or above would be allowed to travel at 44 t vehicle combinations (McKinnon, 2005). This standard set the maximum level of emissions for carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x) and particulates (PM), e.g. in UK condition 18, 78, 650 and 185 gm/km, respectively (McKinnon, 2005). Using Euro II standard for 60 t vehicle combinations on highway driving conditions the emission values can be calculated, respectively, 0.27, 0.13, 14 and 0.12 g/km (Lipasto, 2012). Since 1996, several new standards have been introduced by the Commission for new heavy trucks (DieselNet, 2014). These changing regulations are closely tied to climate change policy and associated commitments to reduce greenhouse gas emissions, and affect both the financial and environmental costs of timber transportation. Environmental costs include air pollution, climate change from greenhouse gas emissions, noise disturbance and traffic accidents (Korzhenevych et al., 2014).

In the changing operational environment, the Finnish forest industry has improved its cost-effectiveness by demanding larger and heavier loads for timber transportation vehicles. It is argued that an increase in the legal maximum weight of vehicles enables entrepreneurs to optimize loads and thus reduce the amount of vehicle movement required to deliver a given quantity of freight. Under certain operational conditions, LHV can yield both economic and environmental benefits (McKinnon, 2005; European Modular Systems, 2013; Nykänen and Liimatainen, 2014). However, LHV has been used only a couple of years and only in specific transport routes. Therefore, a novel knowledge about LHV is needed. In Sweden, a project ran LHV which had a gross weight up to 90 t, on some special public roads (Transport and Environment, 2012). The growth of maximum weights has been argued by lower transport costs and lower fuel consumption and therefore lower emissions of environmental contaminants (Löfroth and Svenson, 2012). Swedish studies have also argued that if the 60 t vehicle combinations are replaced with 90 t LHV it could reduce driven kilometers even 21%, if the LHV use the same routes and especially the same bridges (Haraldsson et al., 2012).

Finnish studies have reported that, if the 60 t vehicle combinations are replaced with 76 t LHV (Table 1) and the LHV use the same routes, the 76 t LHV could reduce CO_2 and NO_x even 32% and 41%, respectively (Ministry of Transport and Communications, 2013). The changes toward 76 t weight limit would therefore be used to accelerate the adoption of cleaner vehicle technology. In addition to the environmental benefits and lower haulage costs (200 million Euros per annum), the primary argument was global logistics and economy, especially the effect of the EU's sulfur directive to Finnish industry (Ministry of Transport and Communications, 2013). The sulfur directive restricts the sulfur content of fuel used in the shipping industry to 0.1% in the Baltic Sea, which is classified as a Sulfur Emission Control Area under the directive meaning

Table 1
Changes in maximum weights and axles of the vehicle combinations in Finland.

Old weight limit	New weight limit	Axles	Old payload	New payload	Increase%	Decree of change
60	64	7	40	44	10	Temporary[a]
60	68	8	37	45	22	Permanent
60	76	9	35	51	46	Permanent

[a] Temporary weight increase which is in force until the end of April 2018.