Policy Brief

Opportunities for natural gas & biogas vehicles in freight

Our 2050

This is one of a series of policy briefs to summarize ongoing findings related to the research project, 'Our 2050 – Opportunities for Ireland in a Low Carbon Economy', which is on the economic and societal opportunities arising from the transition to a low carbon economy and the policies needed to achieve this transition.

MaREI Centre for Marine and Renewable Energy
EPMG Energy Policy & Modelling Group
IERG Intelligent Efficiency Research Group
eri Environmental Research Institute
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The Our 2050 project is addressing four key questions:

1. What will Ireland's future energy use look like? In particular, how will we generate electricity? How will we heat our buildings? What modes of travel will we use?
2. What technologies are most likely to play leading roles in Ireland's transition to a low carbon economy?
3. What strengths can Ireland play to, and what opportunities can Irish-based firms avail of?
4. What policies are needed? What do government, firms, universities and individuals need to do, individually and collectively, to achieve the transition?

This policy brief addresses the critical challenge faced when answering the fourth question.

Transition opportunity for natural gas vehicle in road freight: enroute to biogas

Identifying a problem sector: the least diversified segment in road transport - freight

The road transport sector currently accounts for the largest share (20%) of fossil fuel energy demand and carbon emissions in Ireland. While the private car sector is slowly decarbonising in response to incentives and alternative fuel vehicle options, the freight sector is still in a carbon lock-in state, dominated by 99.8% diesel vehicles in 2016. With such market concentration, the transition to alternative and lower carbon emitting fuel vehicles is likely to require favourable policy attention and intervention. Within the freight sector, heavier goods vehicles account for longer vehicle kilometre travel. A proven alternative fuel vehicle for such longer distances and vehicle power is natural gas, which can be upgraded to biogas supply to achieve higher rates of decarbonisation. In response to the road transport sector having such low rates of fuel diversity, infrastructure support for alternative fuel vehicle is being promoted at a national and European (European Directive 94/2014/EU) level.

Opportunities for economic gains

Ireland largely depends on imports of oil and natural gas. As the least carbon intense fossil fuel, natural gas offers opportunities in a world a higher cost of carbon gives it a relative advantage to other fossil fuels; natural gas also provides an opportunity as a pathway to renewable gas. As a means of developing a new market, a policy that targets the price differential between gas and oil, which reduces the vehicle purchase payback period and operation cost, is a common practice to stimulate adoption of natural gas vehicles (NGVs). It is important that such policy decisions are bound to impact freight activities, investment and transportation development. Exploring the effects of these decisions, such as tax and subsidy policy levies, prior and post implementation, can be important to advise stakeholders and policy makers to avoid or minimize adverse effects of related actions.

The need to understand and test policies

The market promotion of NGV technology in an already established competitive market can be challenging, since it is difficult to know in advance how effective different incentives will be. To gain some insight to how different incentives might work, a new model framework was developed to explore the opportunity for natural gas and freight.

Model challenge and potential

To evaluate options to decarbonize road freight, several modelling techniques and approaches are commonly applied, resulting in various findings and recommendations. Many of these modelling approaches generate technology pathways that focus on technology mixes for a low carbon sector. A weakness of many of the technology-focused energy system models is the limitation or missing integration of human behaviour. This creates a research gap and opportunity to bridge this modelling limitation with enhanced integration of human decisions into energy frameworks. Agent based models can integrate such factors and also incorporate conditions based on theoretical foundations, such as transport theory, transition and economic theories. In this analysis, we used the agent model to observe scenarios for transition to goods natural gas vehicles (NGV) within the Irish road freight population. The simulation exercise also presents the effects of planned policies and fuel/gas prices.

Observations from model scenarios

The agent based model in this analysis includes parameters that account for vehicle features (e.g. efficiency, range of daily km travel, weight in tonnes), vehicle price range, vehicle purchase payback decision factors, tax levy, subsidy aid, planned gas price, expected diesel prices and other conditions. The results project opportunities for attainable rate of vehicle switching under 'business as usual - payback' and 'target business condition - reduced payback' scenarios. An example figure (1) summarizes the vehicle switching status and emissions savings level under the business as usual - payback scenario.

Findings suggest that, in a scenario that imposes a €20/CO2 tonne tax, vehicle switching is limited to higher vehicle goods weight groups (>10 tonnes). This corresponds to 17,010 NGVs that require 2344 GWh of gas and contributes emissions saving of 72.4 kt CO2. In comparison to 2016 base of total goods vehicle (341,426), this represents 5% of market share. To capture vehicle switching opportunities in lower goods vehicle weight groups (5-10 tonnes), alternative policy interventions are explored. Increasing the CO2 tax levy on diesel fuel increases vehicle switching and results in 24,554 NGVs requiring 2692 GWh of gas and emissions saving of 80.7 kt CO2. Increasing the CO2 tax levy on both diesel and natural gas fuels, up to €100/CO2 tonne (see fig. 1), makes no difference to the market transition dynamics.

To attain a similar market share with an alternative policy approach, combined with €20/CO2 tonne tax on diesel only, an additional subsidy cost of €32.67 million was required, which increased vehicles switching by 7545, requiring 348 GWh gas and contributing 8363 CO2 tonne emissions savings. Under the alternative policy approach of combined carbon tax levy on NG and diesel fuels, subsidy cost range of €29.42-30.12 million was required, in respective combination of €50-€100/CO2 per tonne carbon tax levy under business as usual.

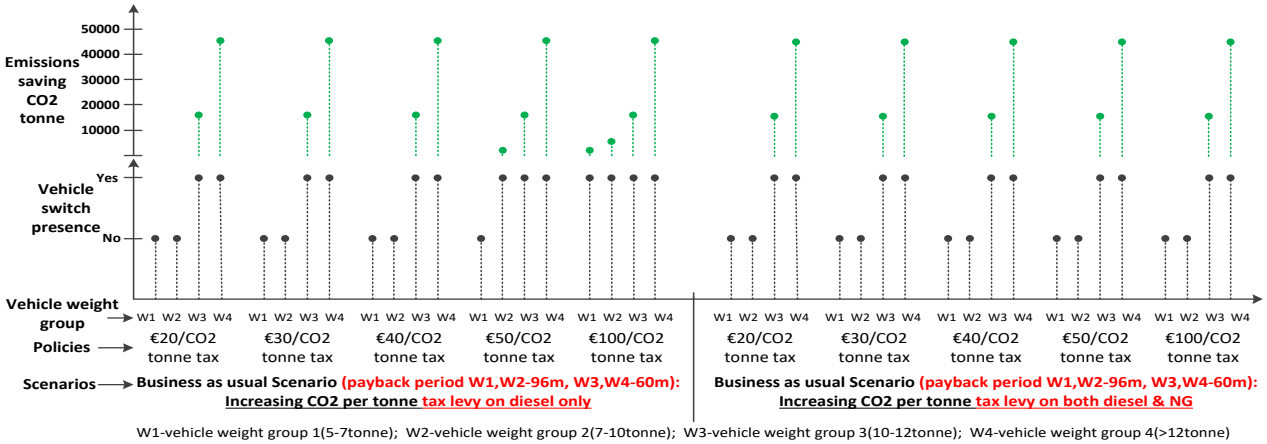


Figure 1: Business as usual payback scenarios – 2030 observation under increasing CO2 per tonne tax policy

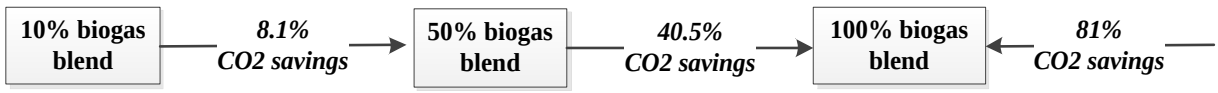
Key observations and policy conclusion

Model development, application and expansion opportunity

1. There is a need for modelling exercises that contribute to model options and comparison in transportation research. These contribute to presentation of opportunities for policy evaluation to identify best suited policy options, associated costs and benefits. It also presents a model that can be extended to account for integration of wider vehicle features, wider vehicle price range, and other spheres of transportation.

Market opportunity and environmental benefit

2. There is potential for natural gas vehicle technology in road freight but with limited potential for emissions saving opportunities. Given a working system with existing NGV infrastructure and market service, the business as usual payback scenario presents an opportunity for 12.6% of CO2 savings from 0.57 million CO2 tonnes; from goods vehicles >10 tonnes in 2030. With combined increasing carbon tax and or subsidy incentive policies, emissions savings opportunity comes to 11.8% from 0.68 million CO2 tonnes; from goods vehicles >5 tonnes. A biogas substitution of the natural gas in the switching vehicles presents an improved opportunity for CO2 emissions savings by up to 81% with 100% blend. This suggests the need for policy makers to look beyond solo natural gas fuelling solution.



3. There is need for increased attention on policy approach and interventions to increase the scale of market opportunity, especially towards the lower vehicle weight categories and kilometre travelling goods vehicle.

Moving forward

4. There is a need to increase awareness of planned policies such as gas price and gap to diesel, infrastructural development, and technology advance in natural gas vehicle such as efficiency and refill time, inorder to stimulate vehicle purchase or switching decisions by freight operators. Observed feedback comments from a survey of 37 haulage operators in Ireland pointed to these issues. Therefore, engagement between stakeholders for awareness of planned policies, technology advantage and infrastructural development is suggested to improve the market development opportunity.

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