

***A feasibility study to explore sustainable management of
agricultural green waste in Ireland***

***Prepared by the Irish Bioenergy Association (IrBEA)*
for the Department of Agriculture, Food and the Marine***

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Executive summary

The exemption for the practice of burning cut agricultural green waste will end on the 1st January 2023. The original four-year exemption in the 2009 waste management legislation has been extended on six occasions. During the period 2019 to 2021 inclusive, an average of 2,884 intention to burn notifications were received annually by local authorities, and as reported to the EPA. This feasibility study investigates sustainable alternative practices to the burning of cut agricultural green waste in Ireland – arising primarily from the maintenance and management of farm hedgerows (as field boundaries, for stock enclosure or shelter) and land maintenance activities, as covered by waste management legislation.

This study explores and considers sustainable alternatives to the burning of this material, including the broader circular economy and potential alternative uses. This study focuses on cut agricultural green waste arising on farmland only. It is distinguished from any other cutting or burning activities or fires, which is covered by other legislation (Government of Ireland, 2022) and codes of practice (Government of Ireland, 2012).

In practical terms this involves the managed burning of this cut material from the management of farm hedgerows or land maintenance, at some time after it has been organised in piles for it to dry out or ‘season’ prior to burning. It is important to not conflate this practice with other types of burning or fires – it does not cover controlled (or uncontrolled) burning of growing vegetation, or the burning of waste, which is illegal. In this report, cut agricultural green waste refers to woody residue and solid biomass material (the “material”) arising primarily in the course of ongoing management of farm hedgerows.

From a government policy perspective, the starting point for examining this particular burning practice is that of air quality concerns and its impact on human health. The notification to burn form asks farmers to sign a declaration that they have explored all the alternative options before burning as a last resort. It is clear from the direct farmer survey that farmers have not considered the alternatives (62%). If farmers adhere closely to the waste hierarchy within the notification form, the requirement for burning would be minimal. Chapter 7 herein sets out approaches for the prevention and reduction of this material. The fact that the waste hierarchy declaration as outlined in the notification form was not adhered to by most farmers who engaged in the process, with burning being the first consideration, could possibly be attributed to a lack of awareness and understanding of the potential alternatives. A key recommendation of this report is the importance of

communication, awareness-raising, knowledge transfer, training and support services for the alternatives to be successfully adopted.

A key element of the work assigned to this study was the carrying out of a direct survey of individual farmers and a broader, direct consultation with wider stakeholders. A majority of farmers surveyed directly (73%) responded that they were not aware that the exemption will expire on the 1st January 2023. Farmers are currently in the cycle of management of this material. Based on the farmer survey results, 71% of farmers cut their hedgerows in the autumn. This means that cut agricultural green waste piles are already in place, with a potential expectation of being able to burn this material in 2023. This material is potentially contaminated with stones, soil and fencing wire, which reduces the options for alternative uses. This coupled with the evidence of a lack of awareness of the ending of the exemption amongst the farming community points to the need for a flexible approach and potential transitional period to move from the burning scenario to the alternatives.

Direct feedback from individual farmers indicated that hedge-cutting with a flail, with its direct return of the cut material to the ground, was in their view, the most cost-effective and sustainable alternative to the burning of this material. Feedback from farmers also indicated that farmers are open to considering sustainable alternatives, on the basis that they be cost-neutral to the farmer.

The direct feedback from the farming community and the broader stakeholders is consistent with many of the findings of the recent United Nations Economic and Social Council's Economic Commission for Europe (UNESC-ECE) 'Draft guidance document on reduction of emissions from agricultural residue burning', 2021 (as adopted by the UNESC-ECE).

This report examines the UNESC-ECE guidance which provides clear direction that additional supportive measures (such as extension services, equipment, financing, market development, communication) be included with any regulatory piece in order to sustain a successful transition away from burning practices.

At a minimum, it is clear from the survey of farmers and the broader consultation with stakeholder groups that there is a piece of communications and outreach work required in order to engage with the farming community and to raise awareness of the ending of the exemption. In the broader context of climate action, the stakeholder engagement indicated an openness on the part of farmers to engage with practical solutions to addressing challenges of air quality and the related need for climate action.

Consistently, a cross-section of stakeholders, both within local authorities and the farming community have raised concerns in the consultation interviews that a closing-off of the

burning exemption without raising awareness of alternatives, and without an accompanying lead-in time could stimulate an increase in non-compliance. Stakeholders have indicated that there could be a risk of an increase in illegal burning of this material, over and above existing levels as a result. The local authorities have indicated through the stakeholder consultation that they have been challenged by the resourcing of the inspection of the existing notification to burn process. It has been indicated in the consultation that the ending of the notification to burn process could potentially increase pressure on local fire services and the need for resourcing of enforcement actions, if illegal burning takes place from 2023 onwards. Currently, there is a lack of knowledge, support and awareness of the measures that actively encourage alternatives.

From the broader consultation and particularly the direct survey process, it is clear that farmers are open to considering the alternatives. However, farmers are risk averse to any alternatives to burning cut agricultural green wastes based on additional cost and logistics. Farmers have raised concerns about the perceived potential additional greenhouse gases (GHG) emissions footprint through the use of fossil fuel for implementation of the alternatives.

The subject matter of this study is a cross-cutting public policy issue, which primarily concerns the environmental and farming remits of the Department of Agriculture, Food and the Marine (DAFM) and the Department of the Environment, Climate and Communications (DECC). The broader circular economy remit of DECC and the bioeconomy interest of DAFM are also relevant to this report and are reflected in the alternatives considered herein.

The purpose of this report is to explore, gather and consider the feasibility of sustainable alternatives to the burning of this cut agricultural green waste. The purpose of this report is not to carry out detailed life-cycle analysis (LCA) of any of the alternatives that may be possible in Ireland, although it has drawn on information or data that is available and relevant to the alternatives considered by it.

The feedback and comments from stakeholders consulted, and who responded, can be considered a valuable barometer or snapshot of the current thinking on this topic is amongst stakeholders.

Alternatives options to the business as usual (BAU) approach:

Arising from the low quality and volume of the material involved, inconsistency of its supply, and additional labour and fuel costs associated with alternatives off-site uses, low-level technology options offer the main alternatives to the BAU approach.

In terms of feasibility, current alternative practices and the technology currently commercially available, this study identifies the following as the most feasible in the short to medium term. These alternatives vary from small amounts of material being left in piles as a space for nature to potential cost-neutral options for larger amounts of material for utilisation as bioenergy. In summary, the alternatives are as follows:

- Cut and draw into a pile in a field corner, to leave it to de-compose over time (also acting as a haven for biodiversity)
- Regular maintenance and flailing (with *in situ* return to the ground of the material)
- Wood-fuel from cuttings (dependent on quality and size of the material)
- Alternative hedgerow management and practices – with practices such as coppicing and hedge-laying etc
- Alternative uses such as wood-chip, mulch and compost
- Biochar options – on-site production and use
- On-farm animal bedding in some cases, depending on the nature of the material arising
- For land clearance material, off-site use is the most preferable method – using specialist contractors, where an economic return is possible, but dependent on the individual situation and circumstances.

All of these options are further outlined and explored in the body of the report.

In tandem with these practical alternatives to burning, the study has identified that a communications and awareness effort and support measures are required to make the change-over from burning to the alternative uses.

Policy and practical challenges and opportunities arising include:

- A cross-section of stakeholders, both within local authorities and the farming community have indicated that the closing-off of the burning exemption in the absence of alternatives, and without an accompanying lead-in time, risks stimulating an increase in non-compliance – effectively risking an increase in illegal burning of this material, over and above existing levels.
- The survey of farmers, the feedback from representative organisations, local authorities and international guidance from other countries indicates that without an initial flexible approach, with supportive measures in place, what is now a legal activity will be driven to continue, albeit as an illegal one. This would undermine the opportunity to raise farmer awareness and get buy-in to the available alternative options for this material.

- In the stakeholder consultation, a lead-in time / transition period features repeatedly and across different sets of stakeholders. Stakeholders indicated that this period would be required to allow alternative measures to be mobilised, resourced and put in place.
- Communication with stakeholders on the alternative uses will be necessary for a successful transition.
- In exploring the alternatives, this report highlights that there may be a conflict where the best practice for air quality and climate is at odds with best practice for biodiversity in some instances. Any existing guidelines and agri-environmental actions on hedgerow management need to consider this and ensure that advice around best practice is balanced and not conflicting.
 - By way of example of the above, contradictory approaches regarding flailing and frequency of maintenance have been flagged in the consultation and in the literature reviewed. There is a need for regular flailing to minimise the generation of green waste. The proper use of a flail needs to be balanced with the concerns for biodiversity and hedgerow health around the use of this technique on a regular basis. Different organisations and regulations have different guidelines based on their own individual remits and priorities. This leads to mixed messaging and confusion from a farming perspective. This report recommends the appointment of a competent or lead authority to develop clear guidelines, which will balance all the competing priorities in terms of hedgerow management. This is something that merits further study and examination.
- Farmers indicated their anxiety about absorbing any additional cost – monetary or time, regarding the alternative practices. Whilst many of the alternatives are low-tech solutions, some will involve extra cost, time and labour.
- The CAP (Common Agricultural Policy) is seen by many non-farming stakeholders as a mechanism to fund alternative sustainable practices. However, feedback from the farming representative stakeholders is very clear, that the CAP budget is already under pressure and that any additional measures should not further diminish the existing budget and payments to farmers. Additional funding would need to be provided beyond the existing CAP programme to facilitate new alternative practices.
- As set out above, during the period 2019 to 2021 inclusive, an average of 2,884 intention to burn notifications were received annually by local authorities, and as reported to the EPA. As part of the notification, no estimation of the volume of material requiring management is provided. Based on the type of data available, it was not possible to estimate the volume of material arising.

- It has not been possible to identify levels of compliance, other than quantifying the number of notifications to burn and inspections. Over the period 2019 to 2021 inclusive, there was an average of 1,073 inspections completed by local authorities, as reported to the EPA. Local authorities in some instances have indicated that their capacity to monitor compliance has been limited due to lack of resources.
- Farmers are currently in the cycle of management of this material with 71% of farmers indicating that they cut their hedgerows in the autumn. Cut agricultural green waste piles are already in place. This material is potentially contaminated with stones, soil and fencing wire, which reduces the options for alternative uses. This coupled with the evidence of a lack of awareness of the ending of the exemption amongst the farming community (73% not aware) points to the need for a flexible approach to move from the burning scenario to the alternatives.

Whilst adhering to the fact that the exemption for burning of cut agricultural green wastes will end on the 1st January 2023, a key finding emerging from this study is that for any alternative measures to be successful, implementable and accepted by the farming community, it is recommended that the adequate support and agricultural extension services (UNESC-ECE, 2021) be put in place. These “extension services” refer to support for alternatives, knowledge transfer and training measures for the farming community on best practice hedge-row management (coppicing, hedge-laying etc) and subsequent biomass management.

The report authors acknowledge and thank the individual farmers surveyed, the stakeholder organisations that responded to the consultation, and all the public officials across the local authorities that contributed their time and valuable feedback, experience and insights to this study.

The report authors also acknowledge and thank the members of the steering group from DAFM, DECC and the local authorities for all their engagement and contributions to the work of the study.

1 Scope and methodology of this feasibility study

This feasibility study investigates alternative sustainable practices to the burning of agricultural green waste in Ireland. It considers the broader circular economy and potential alternative uses. This study focuses on cut agriculture green waste only. This report does not cover the controlled or uncontrolled burning of growing vegetation and waste. Cut agricultural green waste refers in this case to woody residue and solid biomass material. The wording from the legislation refers to the following types of material:

“Uncontaminated (free of dangerous substances, preservatives or other artificial impregnation or coating) wood, trees, tree trimmings, leaves, brush, or other similar waste generated by agricultural practices in controlled circumstances.”

This report utilises the above definition and notes that this material will arise from the following scenarios:

- Management of hedgerows
- Land clearance and maintenance activity
- Wind fall material
- Pest-infected and diseased material needing management

The nature of this material being woody/solid biomass means it is not suitable for biogas/biomethane production using anaerobic digestion technology.

1.1 Methodology and research design

This report is based on a short three-month feasibility study that took place between September and November 2022. The study was tasked with focusing on immediate or short-term alternatives to pile-burning of cut agricultural green wastes, the waste management legislation exemption for which will expire on the 1st January 2023. A mixture of quantitative and qualitative research methods was used.

This feasibility study report is based on:

1. data collated by the Environmental Protection Authority (EPA) and collected by the local authorities in relation to (i) formal intention to burn notifications made to them regarding the current exemption for pile burning under waste management legislation, and (ii) inspections carried out by them subsequent to a notification

2. a review of relevant technical and public policy literature, and case study reports was carried out during the study to explore the feasibility of state-of-the-art alternatives to pile-burning of cut agricultural green wastes
3. data collected in direct surveys with farmers, and
4. original interview research with a mix of relevant stakeholders (including a broad geographical distribution of local authorities' environmental services from around the country and relevant civil society and representative organisations) that replied to a direct consultation request.

Given the requirement to explore immediate solutions, particular attention was paid to the technology readiness levels in other similar scenarios in other jurisdictions to see what alternatives to pile-burning are being examined or used there.

A deliberate focus was taken to engage in a series of interviews with key policy stakeholders, partly in order to give them a voice, but also to ensure that original research findings were generated. Due to the relatively short timeframe available in which to carry out the work, and for reasons of sustainability, stakeholder organisation consultation interviews were primarily carried out using direct online meetings.

Strict confidentiality and anonymity was assured to the farmer survey participants, so that participants were not identifiable. This was also the case with the representatives of organisations other than the identification generally of the organisation itself as having responded to the consultation.

The direct farmer survey is included at Appendix 13.3. The survey was structured with the same questions asked of all respondents, with one question allowing for other 'comments' or observations as a possible opportunity for respondents to address anything not already addressed in the questions in their view. One of the methodological advantages of this approach was that it facilitated access to a diverse range of farmers and encouraged them to express their views in what was for them a 'safe space'. They were also enabled to be more reflective and forthright regarding current burning practices and the potential alternatives to it, than perhaps would occur in a public or collective forum.

The interview format for the stakeholder organisation consultation was semi-structured, with a number of typical questions and their sequence repeated over most interviewees. However, interviewees were also given scope to vary the format somewhat, and they were free to communicate their own insights, and feedback from their members, when and where they wanted to. Stakeholder organisations were also afforded the opportunity to return a written response in tandem with, or as an alternative to, the direct virtual consultation meetings. Most representative entities contacted with a request to participate in the stakeholder consultation meetings responded. In order to facilitate confidence in the interviewees, none of the interviews were recorded. However, detailed notes were taken.

Attention was paid to ensuring that those interviewed reflected a very wide range of policy stakeholders. However, not all those contacted directly responded to the authors' invitation / request to participate in the stakeholder consultation.

Interviews typically lasted between 50 and 60 minutes, but some were longer than this. An example of a typical interview questionnaire (together with collated, anonymised responses) is included in Appendix 13.5.

As such the findings have the general features inherent in such interview-based qualitative research: they provide a high level of detail and context, and a sharp focus snap-shot of current views and practices regarding the topic studied, yet the overall representativeness of the findings may be limited because one must be careful in drawing general conclusions from what inevitably must be a limited 'data' set of interviewees, based on responses received.

Regarding the quantitative data examined, the data for notifications of intention to burn was the best available data for the years from 2019 to 2021 inclusive. Data for preceding years is not available for examination. In that regard, the data reflects a current 'picture' of the volume and content of intention to burn notifications received. Data for a longer period would provide an opportunity for greater insights into trends since the exemption to burn was first provided for in 2009. Data on the number of inspections carried out since 2015 is available and was also examined in this study. Whilst it provides data over a longer period, it is of its nature limited to the number of inspections, and it can be inferred that the number of notifications exceeded the number of inspections. It is the best available data of its kind and was provided for examination by this study. The quantitative data from the survey of farmers indicates the possibility that much of the pile burning arising may not be captured by the data from the intention to burn notifications. Together, those two data-sets have been useful in getting a picture of the level of activity and exploring if alternatives are being considered in advance of burning. Overall, the best available data of its kind has been sought for, and generated by, this study.

This report was developed in conjunction with a steering committee mainly comprised of Department of Agriculture, Food and the Marine, Department of Environment, Climate and Communications and local authority officials.

2 Introduction

This report is being developed in the context of the exemption to the provisions of the Waste Management (Prohibition of Waste disposal by burning) (Amendment) Regulations 2022 which is due to expire on 1st of January 2023. Since the original four-year exemption in 2009, successive extensions have allowed farmers to dispose of agricultural green wastes by burning, following issuing of notification to the local authority, following consideration of the waste hierarchy steps it contains.

Burning agricultural green wastes does not benefit soil fertility: it is shown to reduce fertility through destruction of the nutrient-rich humus layer on the top of the soil, and through burning-off of carbon within the soil, which also reduces its moisture-retention qualities and exposes the remaining soil to erosion (UNESC-ECE, 2021).

The cutting of agricultural green waste is prohibited from the 1st of March to the 31st of August. Regular farm management practices in the maintenance of hedgerows and land leads to the generation of this agricultural green waste. Up to this, farmers, through their Common Agricultural Policy (CAP) support payments, were penalised for this scrub encroaching on land and impacting on their productive agriculture area. This has led to a situation where farmers were encouraged to remove this material, which resulted in a need to burn, as a management practice. The new CAP programme will reward farmers for ‘space for nature’ areas and non-productive areas. This should of itself reduce the volume of this material generated. There is also a potential that a future carbon farming initiative will recognise the value of leaving this agriculture green material in situ or growing and its value being realised from a carbon storage perspective.

This report does not promote or incentivise the introduction or development of a new green waste industry but focuses on (i) the minimisation of generation and (ii) sustainable alternative uses for when the material does arise, as an alternative to burning. The report makes a distinction between removing hedgerows compared to hedgerow management practice in the context of the Environment Impact Assessment (Agriculture) Regulations. An EIA may be applicable when generating green waste by “commencing to use uncultivated land or semi natural areas for intensive agriculture (over 5 hectares) or where proposed works are to be carried out (or may effect) a proposed NHA or nature reserve or works may have a significant effect on the environment.”

The quantity and consistency of this green cut material is an important consideration when assessing the alternatives. A life cycle analysis of the alternatives is beyond the remit of this report. Emissions from mobilising and transporting this material for alternative uses off site need to be factored in but are not within the terms of reference of this study. This is a significant concern emerging from the farmer and stakeholder consultation process and is dealt with later in the report.

This report assesses this material and options based on potential impacts of air quality on human health rather than greenhouse gas emissions produced. In exploring the alternatives, this report highlights that there may be a conflict where the best practice for air quality and climate is at odds with best practice for biodiversity in some instances. Any existing guidelines and agri-environmental actions on hedgerow management need to consider this and ensure that advice around best practice is balanced and not conflicting.

Stakeholder concerns were raised regarding fuel consumption during the deployment of the alternative options and the associated emissions from the alternative options to burning. It is clear that if the burning notification form's waste hierarchy were used by farmers, then there should never be a need for burning of this green material.

2.1 Assumptions

This report is prepared on the basis of the following assumptions:

- The current exemption to notify the local authority of an intention to burn cut agricultural green wastes will expire on the 1st of January 2023.
- Air quality is the public policy concern behind the removal of this exemption. As discussed further below, the original 2009 exemption has been extended six times.
- Alternative uses for this material should not generate an increase in the quantity or volume of this material.
- The direct surveys and consultation with stakeholders was a critical element of the work to be carried out.

2.2 Current Practice - legislative context

Legislation to end the practice of the burning of cut agricultural green wastes was introduced in 2009, with a four-year exemption provided therein. The exemption has since been extended six times, most recently in early 2022, which was announced as the final exemption that would be given.

S.I. No. 286/2009 - Waste Management (Prohibition of Waste Disposal by Burning) Regulations 2009 was introduced as a means to prevent the environmental pollution that can arise from the disposal of waste through the process of burning.

As set out in in the legislation:

In these Regulations—

“*burning*” means the combustion of waste—

- (a) with or without control of the combustion air, and
- (b) without an adequate stack or chimney so as to result in the emission of combustion products to the atmosphere in a manner that causes or is likely to cause environmental pollution.

At the time the regulations were passed however, it was provided that activities under section 5 of the regulations were permissible provided certain requirements were met. The section 5 activities refer to farmers who are permitted to burn what could be termed as cut, agricultural green waste, which is defined as the following:

Uncontaminated (free of dangerous substances, preservatives or other artificial impregnation or coating) wood, trees, tree trimmings, leaves, brush, or other similar waste generated by agricultural practices in controlled circumstances.

Burning of such wastes arising from agricultural activities may only be undertaken as a final measure following the application of the following waste hierarchy:

- waste arisings are reduced in accordance with best agricultural practice,
- waste is reused where practicable,
- waste is recycled through shredding and use as compost or wood chippings, where practicable, and
- waste is salvaged for use as fuel where practicable.

Section 5 also stipulates that, if none of the above options are practicable or economically viable such waste may be disposed of by burning subject to the following conditions:

- the person carrying out the disposal shall take all reasonable measures to limit the overall nuisance or possibilities for endangering human health or causing environmental pollution or damage to adjoining hedgerows or habitats,
- no accelerants may be used when undertaking the disposal activity,
- the person carrying out the disposal shall notify the local authority concerned in advance of the intention to carry out the disposal by providing the information set out in the Schedule,
- the waste is sent for disposal at a facility in accordance with the conditions of a waste licence or an IPPC licence which has been granted by the Agency,
- untreated or uncontaminated (free of preservatives, paints, varnishes, laminate or other artificial impregnation or coating) wood waste and other similar materials is used in barbecues for the purpose of cooking food, or
- burning of waste takes place at events as may be determined locally by a local authority.

The statutory instrument included the following explanatory note, at time of passing:

The purpose of these regulations is to abolish the practice of burning of waste, by making it an offence to do so under waste legislation. An exemption under these regulations exists to allow farmers, as a last resort, to dispose of wastes generated by agricultural practices.

Since the passing of this legislation, it has since been amended a total of six times, in 2013, 2015, 2017, 2019, 2020 and finally, 2022:

6. The burning of waste in compliance under Regulation 5(1)(a) and 5(1)(b) shall cease on 1 January 2023.

In effect, the exemptions and the existing legislation have meant that the burning of agricultural cut waste has been permissible providing that the farmer notify his/her local authority in advance of the burn taking place, and by filling out the required form as made available by the local authority, as found in appendix 13.2.

There are a number of scenarios outlined below that set out how a farmer might end up with volumes of mixed woody biomass material that needs management or disposal of. It is worth noting that other pieces of legislation may also apply to the management of this woody material - for instance, any tree that is 20cm or larger in diameter at a height of 1.3m within a hedgerow may necessitate applying for a felling licence as per the Forestry Act 2014. However, there are a number of exemptions to this legislation, therefore and so it is worth referring to the Frequently Asked Questions document produced by DAFM on the subject (DAFM, undated).

The Solid Fuel Regulations 2022 came into force on the 31st of October 2022: these regulations set out requirements for suppliers of solid fuels including firewood. The regulations were written to ensure that solid fuels such as firewood are correctly seasoned/dried before use in the domestic home. Seasoning/drying will ensure that the firewood is cleanly combusted, and with the minimum amount of particulate emissions released to the atmosphere. In the report below, firewood is a potential alternative use for the material arising. Any firewood production should be cognisant of the Solid Fuel Regulations 2022.

2.3 Emissions and impacts

While fire has long served as a management technique for dealing with volumes of unwanted biomass, where the express aim tends to be elimination of the material through combustion, this practice is increasingly being phased out due to its potential to give rise to

a series of negative impacts. These impacts can vary depending on the conditions of the biomass, the local climactic conditions, the fire management techniques as well as moisture content. But the following categories are usually mentioned:

- Impact on human health
- Impact on air quality
- Impact on environment

The primary concern from the burning of biomass in open field burn piles, compared to within combustion appliances for heat, is in the pollutants that are given off through combustion, which can then have negative impacts on health, air quality as well as to the environment, including the production of greenhouse gasses (GHGs).

An interactive map detailing the current air quality status for several parameters including pm2.5 and pm10 can be found online at <https://airquality.ie/> (EPA, 2021). As of 29th of November, 2022, the air quality active monitoring stations numbered 106 and the vast majority of these are located in urban centres, while conversely, the vast majority of pile burning activities is likely to take place in rural areas.

The pollutants' profile of any given fire has a number of determining factors, but of particular concern are the following:

| |
|---|
| NO _x (Nitrogen oxides) |
| NM VOC (Non methane volatile organic compounds) |
| SO ₂ (Sulphur Dioxides) |
| CO (Carbon Monoxide) |
| NH ₃ (Ammonia) |
| PM 2.5 (Particulate matter with a diameter < 2.5 micrometres) |
| PM 10 (Particulate matter with a diameter < 10 micrometres) |
| Ozone (O ₃) |

The levels and concentrations of these pollutants are typically determined by a variety of factors that determine the efficiency of the fire. According to the European Environment Agency, (EEA, 2019) these factors include:

| |
|------------------------|
| Oxygen availability |
| Combustion Temperature |
| Moisture content |

| |
|---|
| Residence time |
| Meteorological conditions |
| Fire management techniques |
| Biomass characteristics including chemical makeup, mass & orientation |

Impact on human health

Products of combustion and in particular, products of incomplete combustion (PIC) are known to give rise to negative effects on human health. Of particular concern are what are termed PM 2.5 and PM 10. The World Health Organisation (WHO, 2022) estimates that air pollution is responsible for approximately seven million premature deaths per year and that there is a strong correlation between air pollution and increased mortality and morbidity.

Air quality guidelines WHO Air quality guideline values (WHO, 2021)

The following table outlines the various thresholds of exposure for a number of pollutants that is deemed acceptable by the World Health Organisation, as well as some of the primary negative health effects that arise due to exposure.

| Name | Fine particulate matter (PM2.5) | Coarse particulate matter (PM10) | Ozone (O ₃) | Nitrogen dioxide (NO ₂) | Sulphur dioxide (SO ₂) |
|-----------------------------|---|---|--|--|---|
| WHO Guideline Values | 5 µg/m ³ annual mean 15 µg/m ³ 24-hour mean | 15 µg/m ³ annual mean 45 µg/m ³ 24-hour mean | 100 µg/m ³ , 8-hour daily maximum* 60 µg/m ³ 8-hour mean, peak season | 10 µg/m ³ annual mean 25 µg/m ³ 24-hour mean | 40 µg/m ³ 24-hour mean |
| Health Impacts | PM2.5 can penetrate the lung barrier and enter the blood system. Chronic exposure to particles contributes to the risk of developing cardiovascular and | PM10 can penetrate and lodge deep inside the lungs | Excessive ozone in the air can have a marked effect on human health. It can cause breathing problems, trigger asthma, reduce lung function and | Epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO ₂ . Reduced lung function growth is also linked to NO ₂ at concentrations currently measured (or observed) in cities of Europe and North America. | SO ₂ can affect the respiratory system and the functions of the lungs and causes irritation of the eyes. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and chronic bronchitis and makes people more prone to infections of the |

| | | | | | |
|--|--|--|----------------------|--|--|
| | respiratory diseases, as well as of lung cancer. | | cause lung diseases. | | respiratory tract. Hospital admissions for cardiac disease and mortality increase on days with higher SO ₂ levels. When SO ₂ combines with water, it forms sulfuric acid |
| | | | | | |

(Note: Table adapted from World Health Organisation (WHO, 2021)

Situation in Europe

Air pollution is awarded the number one spot in terms of environmental pollution within the European Union, being attributed to approximately 300,000 premature deaths each year. This has been the driving force behind development of EU policies aimed at tackling the issue. Among them is the Ambient Air Quality Directive (Directive 2008/50/EC).

- **Relevant European Legislation**
- Directive 2008/50/EC on ambient air quality and cleaner air for Europe
- Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air
- Commission Directive (EU) 2015/1480 amending several annexes to Directives 2004/107/EC and 2008/50/EC
- 2011/850/EU: Commission Implementing Decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality.

October 2022 saw an announcement of a proposal to revise the Ambient Air Quality Directives (European Commission, 2022) which might mean more stringent thresholds for various parameters. This, coupled with a stated ambition of reducing premature deaths from air pollution by 55% by 2030 and the share of EU ecosystems where air pollution threatens biodiversity by 25%, means it is likely that member states will have to revisit national legislation, monitoring and enforcement in the coming decade.

The European Commission's Towards a Zero Pollution for Air, Water and Soil action plan (European Commission, 2022) also sets out targets for air, water and soil, with aims to

reduce the number of premature deaths caused by air pollution by 55% and the EU ecosystems where air pollution threatens biodiversity by 25%, compared to 2005 levels., while the National Emission reduction Commitments (NEC) directive sets national commitments to reduce emissions for five pollutants that have significant negative impacts on human health and the environment, namely NO_x, NMVOCs, NH₃, SO₂ and PM_{2.5}. (EEA, 2022)

The NEC, among the other legislative instruments, is responsible for delivering the ambition of achieving of zero pollution and a toxic free environment that was announced as part of the European Green Deal.

According to the European Environmental Agency (EEA, 2022), under the NEC Directive, Member States are “obliged to draw up and implement national air pollution control programmes (NAPCPs), including measures to reduce emissions from relevant sectors in order to meet national emission reduction commitments and to contribute to improving air quality.”

Impact on Air Quality and Environment

| EMISSION | SOURCE | EFFECT | GHG POTENTIAL RELATIVE TO CO ₂ |
|-----------------------------------|--|-----------------|---|
| CO ₂ (carbon dioxide) | Complete combustion of carbon in fuel | Global warming | 1 |
| CO (carbon monoxide) | Incomplete combustion of carbon in fuel | Smog | |
| SO ₂ (sulphur dioxide) | Combustion of sulphur in fuel | Smog, acid rain | |
| NO _x (nitrogen oxides) | By-product of most combustion processes | Acid rain | |
| N ₂ O (nitrous oxide) | By-product of some combustion processes | Global warming | 310 |
| VOCs (volatile organic compounds) | Leakage and evaporation of liquid fuels (from, e.g., vehicles, fuel tanks, fuel pumps, refineries, solvents from paints) | Smog | |
| Particulates (dust, soot, fumes) | Unburned or partially burned carbon and hydrocarbons; also, ash and dirt in fuel | Smog | |

(Note: Table adapted from (Government of Canada, 2015))

The table above does not distinguish between renewable and non-renewable fuel sources.

3 Classification and generation scenarios

In a limited number of specific generation scenarios where land clearance is required, farmers should be aware of the potential requirement for an Environmental Impact Assessment (EIA). Details are outlined below.

3.1 Environmental Impact Assessment

The Environmental Impact Assessment (Agriculture) Regulations 2011 set out clear obligations on farmers who wish to remove field boundaries. Schedule 1 Part A requires that a Screening Application must be made where it is proposed to remove more than 500 meters of field boundary, or if the area of land to be restructured by field boundary removal is above 5 hectares.

Screening Application

A Screening Application must be made to the Minister for Agriculture Forestry and the Marine, who will make a screening decision. The application requirements are set out in the regulation as listed below. The Minister may consult with named consultation bodies, which are: other government departments, the EPA, National Parks and Wildlife, Inland Fisheries, the local authority and An Taisce.

The Minister will ultimately make a screening decision, where the farmer will be informed that they can a) proceed, or b) must gain a Section 9 Consent to proceed.

Section 9 Consent

A Consent is needed if the farmer is directed to acquire one by the Minister, or if the length of field boundary to be removed is greater than four kilometers, or if the area of lands to be restructured by removal of field boundaries is above 50 hectares.

The farmer needs to submit a Section 9 Consent, under this section the farmer must conduct either a Natura impact statement (NIS) or Environmental Impact Statement (EIS), depending on specifics. The Minister again may consider representations from the consultation bodies, again these are other government departments, the EPA, National Parks and Wildlife, Inland Fisheries, the local authority or An Taisce.

| Thresholds for screening applications and mandatory EIA <i>(Areas (or lengths) of works undertaken in any one year or the sum of such areas over a 5-yr period, beginning 8.9.2011.)</i> | | |
|--|------------------------------------|----------------------|
| Type of on-farm activity: | Screening by DAFM required: | Mandatory EIA |
| Restructuring of rural land holdings | | |
| - Length of field boundary to be removed | Above 500 metres | Above 4 kms |
| OR - Area of lands to be restructured by removal of field boundaries | Above 5 hectares | Above 50 hectares |
| - Recontouring (within farmholding) | Above 2 hectares | Above 5 hectares |
| Commencing to use uncultivated land or semi-natural areas for intensive agriculture | Above 5 hectares | Above 50 hectares |
| Land drainage works on lands used for agriculture | Above 15 hectares | Above 50 hectares |

Thresholds for screening applications and mandatory EIA (DAFM, EIA section; available at:
<https://assets.gov.ie/121587/9e4fba46-6363-4549-820f-0635ee9d6cd6.pdf>

3.2 Classification and Generation Scenarios

The green wastes covered by this report are sub divided into several categories depending on how they are generated.

| Scenario | Source | Management Practice | Equipment | Description of resulting material | Current use / Disposal practice |
|----------|--|--|---|---|--|
| 1 | Hedgerow | Annual maintenance | Flail hedge cutter | Coarsely chopped branch and leaf material | Material left in situ to fall back into hedgerow and biodegrade |
| 2a | Hedgerow | Medium term maintenance every 2-5 years | Saw blade hedge cutter | Long branches, typically 2-4meters long and 1-5cm diameter | Gathered in piles for burning. Left in piles to biodegrade. |
| 2b | Hedgerow restoration | Unmaintained for 3 years plus (on occasion for several decades). Farmer decides to trim down hedges to normal size for ease of management | Saw blade hedge cutter, chainsaw, mechanical sheers | Heavy timber mixed with lighter branches, lengths of 5-20 meters | Heavy timber used by farmer for firewood. Lighter branches gathered in piles for burning or left in piles to biodegrade |
| 3a | Land clearing and maintenance. Sub threshold of EIA (Agriculture) Regulations (<5Ha land clearance) in upland or lowland areas. | Typically occurs where land has not been maintained for many years, bushes and trees have established over a wide area. Farmer decides to clear land area for agricultural purposes | Chainsaw, mechanical sheers | Heavy timber mixed with lighter branches. Light bush material, often hawthorn, gorse, alder or other species. | Heavy timber used by farmer for firewood. Lighter branches gathered for burning or left in piles to biodegrade |
| 3b | Land clearing and maintenance Above threshold of EIA (Agriculture) Regulations (>5Ha land clearance) requiring EIA (Commencing to use uncultivated land or seminatural areas for intensive agriculture > 5Ha) in upland or lowland areas. | Typically occurs where land has not been maintained for many years, bushes and trees have established over a wide area. Farmer decides to clear land area >5Ha for agricultural purposes | Chainsaw, mechanical sheers | Heavy timber mixed with lighter branches. Light bush material, often hawthorn, gorse, alder or other species. | Heavy timber used by farmer for firewood. Lighter branches gathered for burning or left in piles to biodegrade |
| 4 | Windfall material | Material arising from wind/storm damage | Chainsaw | Heavy timber mixed with lighter branches | Heavy timber used by farmer for firewood. Lighter branches gathered for burning or left in piles to biodegrade |
| 5 | Material resulting from pest and disease death. E.g., Ash Dieback | Material rising from disease fall | Chainsaw | Heavy timber mixed with lighter branches | May be subject to controlled disposal, otherwise heavy timber may be used by farmer for firewood. Lighter branches gathered for burning or left in piles to biodegrade |

Generation Scenario 1: Hedgerow material maintained regularly

The current practice of flailing hedges regularly, and the resulting flailed material being incorporated back into the hedge is a well-established practice. This technique offers ease of management with light equipment travelling on the farmland during the cutting season 1st September – 28th February i.e., the cutting season. The farmer does not collect green waste from this action and there is no related issue from the disposal of this material. A significant added advantage to this practice is benefits to biodiversity, the green waste is incorporated back into the hedgerow where it acts as a platform for microbial action thus increasing biodiversity within the hedgerow environment. Nutrients present in the green waste are also returned to the soil.

Using regular flail-cutting of hedgerows is a practice that does not generate green waste that necessarily needs to be collected. From the farmer survey, this report concludes that flailing does not result in any green waste burning on-farm. The practice of regular flailing of hedgerows to keep them maintained is the best possible practice that farmers can undertake to reduce the generation of green waste.

Contradictory approaches regarding flailing and frequency of maintenance have been flagged in the consultation and in the literature reviewed. The proper use of a flail needs to be balanced with the concerns for biodiversity and hedgerow health around the use of this technique on a regular basis.

Generation Scenario 2a: Hedgerows maintained on a 2-to-5-year cycle with a hedge cutting saw blade and/or flail

Cutting hedges on this medium time scale causes the generation of significant amounts of green waste that is generally more difficult to handle. The resulting green waste from this practice is long lengths of relatively narrow branches which is of use as a firewood for self-consumption. This practice will also result in smaller branch material which needs to be dealt with.

Generation Scenarios 2b: Hedgerow restoration

Hedgerow restoration is where a hedgerow has been left to grow unchecked for a long period of time often several decades. At this point the original hedgerow bushes have grown into semi mature trees and contain large volumes of woody material, often in these situations the lower side of the hedges have thinned out due to competition and are no

longer stock proof. In order for these hedges to function correctly farmers must cut these hedges back to allow resprouting of the bush rootstock into thick stock proof hedgerows.

Generation Scenarios 3a & 3b: Land clearance and maintenance

Land clearance in this report refers to the clearing land of scrub or gorse or other small bushes that have encroached onto the field area. Typically, this material is light and branchy with a small wood volume. The traditional method to deal with this material would be through cutting and burning. This land clearance may be above or below the threshold of EIA (Agriculture) Regulations (5ha land clearance, commencing to use uncultivated land or seminatural areas for intensive agriculture).

Generation Scenario 4: Windfall material

Windfall material refers to trees that have been felled by high winds, or trees that have died. Typically, these occurrences will have higher volumes of large wood material suitable for firewood, with a significant volume of branchy material.

Generation Scenario 5: Material from diseased or pest infected trees

Where trees or bushes are suspected to be infected by pests or diseases farmers are first advised to consult with the relevant statutory authority guidance notes. For example, contact the plant protection section of the Department of Agriculture, Forestry and the Marine if a farmer suspects a notifiable pest or disease. Department inspectors can then determine the nature of the infection and if the infection is notifiable and can advise or direct what form of disposal is required and who the waste material must be handled by.

If the infection is determined as not notifiable then the farmer is free to dispose of it as they please. The resulting material can be disposed of in line with other material as described above.

Note: The scenarios outlined are linked to the alternatives provided in chapter 8.

4 Reviewing compliance

Ireland has 31 local authorities, in the form of county and city councils, who are the responsible regulatory authorities for both receiving the notification to burn applications, subsequent inspections and for reporting the data centrally to the Environmental Protection Agency (EPA). Local authorities are required to produce and submit a Recommended Minimum Criteria for Environmental Inspections (RMCEI) plan to the EPA each year. The EPA maintains data on both the notifications to burn, but also on the number of subsequent inspections carried out by local authorities.

This data is reflected in the table below. Data regarding the number of notifications is only available for the years 2019, 2020 and 2021, while data on the number of inspections carried out is available as far back as 2015.

While the data below reflects the number of notifications made, it unfortunately doesn't provide a county-by-county breakdown to show the spatial variation. What it does show is that from a baseline figure of 2,086 notifications in 2019, that figure has increased steadily to a total of 3,759 in 2021. Inspections have fluctuated slightly but 2021 also saw the largest number of inspections recorded.

Based on feedback received from local authority Directors of Environmental Services, through the Local Government Management Agency (LGMA), it was evident that assessing levels of non-compliance would not be possible due to availability of resources. Any enforcement actions arising from incidents of noncompliance are not recorded separately to other incidents of environmental nuisance, making it not possible to distinguish between an offender burning cut green agricultural waste with other sources of combustion such as domestic waste burning.

Feedback received from the farmer survey provides some background information regarding the levels of compliance.

Of the 153 farmers surveyed, the following responses were received:

- 31% of respondents replied that they have used the burning of cut agricultural green waste as a management practice. 32% of those respondents said they have previously used the existing notification process in advance of burning, indicating that the level of compliance within this cohort was less than a third.

- 73% of those surveyed were unaware the exemption was due to expire at the end of 2022.
- When offered the chance to input “other comments” during the survey, it should be noted that numerous responses reflecting the intention to continue to burn or to burn at night were received.
- As part of the notification process, farmers are required to confirm by signing a declaration that they have considered other alternative uses for this cut material before resorting to burning of the waste, based on the waste hierarchy included on the form. Of the cohort of farmers who burn green waste only 38% had considered other alternative uses.

As part of the stakeholder consultation process with local authorities, it revealed inconsistencies of approach to the notification process that appear to exist between different counties. It is clear that some local authorities are of the view that they have a legal mandate to approve burning notifications or not.

| RMCEI REFERENCE | Investigation Type | Total 2021 | Total 2020 | Total 2019 | Total 2018 | Total 2017 | Total 2016 | Total 2015 |
|------------------------|--|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 3.14 | Notifications under Prohibition of Waste Disposal by Burning Regulations | 3,759 | 2,808 | 2,086 | No data | No data | No data | No data |
| 6.1.8 | Inspections of notifications under Prohibition of Waste Disposal by Burning Inspections | 1,489 | 923 | 807 | 858 | 941 | 1,165 | 727 |

5 Literature and document review

As part of this study, a literature review was carried out. A number of documents of note were identified during the course of this review.

The findings of the review and documents encountered are referenced throughout the report, rather than being specifically outlined in this section.

5.1 UNESC-ECE guidance on reducing emissions from agricultural residue burning

Due to the significance of the UNESC-ECE guidance document (as adopted), this report herein has outlined some of the relevant elements associated with this study.

As part of the Executive Body for the Convention on Long-range Transboundary Air Pollution, a working group was tasked with drafting a guidance document on the reduction of emissions from agricultural residue burning (ARB). Whilst the guidance document explores the various scenarios where fire has been traditionally used as a management technique, it makes specific reference to the following:

"Pile burns" refers to the practice of gathering residue off-site (normally along the edges of fields) in order to burn in a more controlled fashion. Such piles are also used to gather residue for alternate use (fodder, conversion to pellets, etc.)

The document outlines impacts, existing policy and regulatory measures, human health impacts, the impact to the climate as well as to our agricultural systems. The draft findings by the working group into how to successfully intervene in the prevention of ARBs is worth outlining here:

The most appropriate fire-free methods will vary dependent on a number of factors: crop, pasture, forestry etc; relative scale of cultivation; and availability of alternative equipment, including financing needs. Successful interventions have largely taken a "three legs" approach to introduction of fire-free agricultural systems:

- (a) Mapping and monitoring to define the problem.
 - (b) Education of farmers.
 - (c) Growing regulation in concert with farmer education and extension services, including potential incentives for adoption.
- It is important to note that these "three legs" should occur sequentially to ensure the most effective (in terms of both emission reductions and resource use) measures.

- Mapping should occur first to ensure that the most important sources are prioritized.
- Farmer education and support should occur prior to, or at least in concert with, any regulatory measures.
- The most significant failures in addressing open burning over the past 40 years (and there have been many) have occurred when authorities introduced burning bans without adequate support and extension services already in place.

The guidance continues with the following general points:

- With proper agriculture extension services and training, alternative methods help farmers save money on manual labour, fuel, water and fertilizer; and can equal or improve yields;
- Demonstrating the economic benefits of fire-free methods versus the economics of conventional aids adoption;
- With the proper resources (human and capital), burning in some examples has been reduced at very low or negative costs by 90 per cent or more.

The above recommendations detail how regional authorities should approach encouraging the cessation of ARB and the shift to fire free management techniques. The guidance document goes on to outline alternative use practices for woody biomass, as follows:

Alternative use practices

- Alternative ex situ uses of crop and forest residues range from low-tech, on-farm uses such as animal fodder and bedding, to advanced technologies such as pulp, bioplastics and district heating plants using biogas or pellets manufactured from crop or forest residue.
- Both require additional equipment and investment to gather the residue, and (for the high-tech alternatives) creation of a market value chain and, initially, high levels of investment in, for example, district heating plants.
- These high-tech alternatives are therefore more long-term in nature compared to in situ best practices and technologies and are also dependent on other market conditions such as costs for fossil fuels or creation of subsidies.
- In addition, emissions from transport of residues, and greater risk of plant disease spread from transported residues should be carefully considered.

Animal feed and bedding

- Some crop residues can also be used as animal food and bedding.
- Less digestible residues may be used for bedding.

Bioenergy

- Various crop and forest residues can be converted into biochar, pellets, briquettes and building materials.
- Compared to open burning, these techniques produce lower emissions of air pollutants, and at the same time can reduce reliance on fossil fuels for energy purposes.

- The use of agricultural residues for energy, unless it occurs directly on-farm, requires refineries, transportation and a distribution network.
- Nevertheless, especially with initial subsidies, this method is being increasingly practised at both the on-farm and regional levels in a number of ECE countries.

Forest/Orchard/Fallow land residues

- Emissions from forest/timber farms, orchard or fallow land residues comprise a potentially large source of emissions in the ECE region, especially when the risk of wildfire spread is taken into account.
- Timber farms produce large amounts of residue through both periodic clearing of underbrush to promote commercial tree growth, and during the harvesting process, when trees are entirely stripped of branches for easier transport.
- Underbrush or residue from forest harvest can present a fire risk, as well as present barriers for timber growth or regrowth.
- Orchards similarly require clearing of undergrowth, as well as periodic pruning of branches that need disposal.
- Fallow agricultural lands placed back into production require clearing of anything from low grass and brush to removal of larger trees and bushes.
- In all these cases, use of fire presents an easy and cheap method to remove the excess biomass, though often with extreme risk of wildfire spread due to the nature of all these land use types, which by definition are in close proximity to other forests and fields.
- Risk of wildfire spread has grown as a result of climate change, with more frequent periods of drought and high temperature. However, burning under wetter conditions produces larger amounts of PM2.5 and other pollutants due to the low fire temperature.
- Alternative fire-free methods do exist and are widely deployed in some ECE countries.
- In situ methods involve chopping and spreading the excess biomass, often with a single large machine, similar to no-till and low-till methods on croplands. This can be especially useful when clearing orchard understory or fallow lands for new production, building humus and decreasing the need for fertilizer.
- On timber farms, excess branches and biomass often are placed in large piles near timber roadways, where they can most easily be transported for conversion to pellets for district heating; to wood mills where they are mixed with other timber by-products for a variety of uses such as paper; or chipped into mulch.
- Unlike low-till and no-till methods on croplands however, these methods rarely prove negative cost to the producers, except over longer time spans. They therefore may require some level of supportive Government economic measures, to varying degrees based on rural economic conditions.

The above sections outline the findings from the UNESC-ECE taskforce as they relate to the material under consideration for this report. The report also details a series of other agricultural scenarios such as the burning of crop residue and the use of managed fire on living vegetation, but these practices are beyond the scope for this feasibility study.

The report concludes by outlining the necessary support services and measures that should be in place for any alternatives to be successful. They can be summarised by the following:

- Extension services – training and education
- Equipment
- Communication: awareness-raising, community engagement and advocacy
- Market development
- Financing
- Governance and regulatory measures

Alternative Uses for Woody Biomass Feedstock Humboldt County, California

A recent report (Clemente et al, 2020) completed for the Redwood Coast Energy Authority into the alternative uses for woody biomass feedstocks was carried out by the engineering department at Humboldt State University in California. It focused on examining suitable alternatives to the current combustion of biomass in a manner that would reduce both green house as emissions but also be in compliance with all air and water quality regulations. A number of scenarios was looked at, with composting processes coming out on top of potential solutions. The solutions considered can be summarised as the following:

| | |
|---|---|
| Biopower | Bioelectricity- power generation |
| Biofuels | Gasification, anaerobic digestion and pyrolysis |
| Compostable Materials | Biodegradable plastics, bioplastic, biomaterials |
| Biomass fertilizer | Digestate- not as relevant for woody biomass feedstocks |
| Composting | Aerobic decomposition of mixed biomass feedstocks- see compost section 8.4 below |
| Biochar | Thermal conversion of biomass into stable form of carbon with multi-sectoral uses and applications (see section 8.3 below) |
| Modular Gasification | Process in which small, mobile units use woody biomass as a fuel source under choked combustion conditions to create syngas and biochar as useable products |
| Woodchip Bioreactors and Bioswales | Denitrification of agricultural runoff and the removal of nutrients, metals, and trace organics within storm water treatment systems |

6 Green waste utilisation examples from Europe

Several examples of sustainable management practices for this type of cut agricultural green waste material are adopted in various countries across Europe. These examples will be outlined in this section. Aspects of these examples will be considered further also in chapter 9 'Circular economy and bioeconomy'. North-west France and some parts of southern England offer similar farming landscapes and climatic conditions (cool, temperate, maritime / oceanic) to those in much of Ireland, all influenced by the Atlantic.

Areas with similarity to Ireland include:

- France – *Bocage* in north-west France
- Germany (Baden Baden)
- United Kingdom (Devon, Cornwall, and Dorset in south-west England)

It is worth noting that while the phasing out of the practices of burning cut agricultural green waste are generally trending in one direction, individual countries will have their own legislation, and in some cases, within countries, there are different regional conditions that allow the burning of agricultural waste to take place under certain conditions, leading to a patchwork of measures. The paragraphs below details two such countries, Germany and the United Kingdom.

Situation in Germany

In Germany, a number of pieces of legislation exist that set out how the disposal of horticultural green waste outside of waste disposal plants can take place. Among them are the Waste Disposal Act, the Circular Economy Act (Government of the Federal Republic of Germany, 2012a) and the Biowaste Ordinance (Government of the Federal Republic of Germany, 2012b).

These set out the requirements for both producers and holders of waste that doesn't get recycled, that they be brought to approved facilities for management. However, individual state regulations differ based on locality and this has led to a patchwork of differing regulations and practices. In some regions, the practice of burning of residual cut green waste is banned outright, in others, the material must be composted. Some regions allow material to be burned that was generated on site but where they must follow notification procedures. Other regions only allow a certain class of agricultural or horticultural material be incinerated/burned. Interestingly, some regions allow the management practice to occur

in certain months of the year (e.g. March and October in the Saarland region), or only on certain days of the week (which they term burning days) and indeed, only on certain times of the day. There are other factors at play including minimum setback distances, risk of forest or wildfires being minimised or certain weather conditions. It is also worth noting that Germany has nationwide disposal options available to handle cut green waste, reducing the need for disposal through burning.

Situation in the UK

The UK Government has what is termed the D7 waste exemption (UK Government, 2019): burning waste in the open. This stipulates that a person can carry out burning of the following specific types of waste, which have their own waste code categories as follows:

- Plant tissue
- Sawdust, shavings and cuttings from untreated wood only
- Waste bark and wood

There are also specific limits on the quantity of material an individual can treat. You can:

- burn up to 10 tonnes of waste in any 24-hour period
- store up to 20 tonnes of waste at any one time
- store waste for up to 6 months before burning, to allow certain wood waste to dry out

And the following key conditions must be met:

- The burning must take place on open land, not in an incinerator or a building.
- You should be careful to position the bonfire where it will not cause nuisance to neighbours through excessive smoke or odour.
- The burning must take place only at the place where the waste is produced.

For those wishing to utilise the cut green waste within a boiler, for the provision of heat and power, separate exemptions apply. These are the U4 waste exemption: burning waste as fuel in a small appliance (UK Government, 2021).

For those wishing to convert these residues into compost, the T23 waste exemption: aerobic composting and associated prior treatment, is the one that applies (UK Government, 2014).

For those wishing to mechanically treat the waste, the following exemption is in place: T6 waste exemption: treating waste wood and waste plant matter by chipping, shredding, cutting or pulverising (UK Government, 2022).

And then finally, for those wishing to convert the waste to a source of animal bedding. Then U8 waste exemption: using waste for a specified purpose, is the exemption at play (UK Government, 2017).

6.1 Case Study – France

Regions of France, and, in particular around Brittany, Normandy and the Loire-Valley have similar landscape and climatic features to parts of southern Britain and more importantly, much of Ireland. Most notably is the use of hedgerows as field boundaries. In France, the word “*bocage*” is used.

Bocage is defined as a terrain of mixed woodland and pasture, or, countryside or landscape (as of western France) marked by intermingling patches of woodland and heath, small fields, tall hedgerows, and orchards. Recent years have seen a resurgence in interest in the practice of management of these hedgerow systems for a suite of benefits which include the following:

- biodiversity/nature corridors
- delineate field boundaries
- windbreak/shelter for farm animals
- agroforestry, and
- provision of wood fuels.

The following guidelines are taken, translated and adapted from a document titled “Guide-Bocage Air- Return to the Ground”, produced by CUMA (Cooperatives for the Use of Agricultural Equipment) which is agricultural co-operative where farmers pool resources (equipment, labour, sheds, workshops, etc.) necessary for their agricultural activity, and, AILE (Association of Local Initiatives for Energy and the Environment), a local energy agency that specialises in biomass recovery studies and actions, particularly as they relate to agricultural activities.

The document (AILE, 2019) sets out some of the considerations, technology options, variations and potential outputs and uses from the sustainable management of hedgerow material.

Guide- Bocage Air- Return to the Ground

RETURN TO THE SOIL OF SHREDDED WOOD CHIPS

The trees of the bocage constitute an essential resource for the farmer and the territory. Strong wood is the part of the tree (trunk and branches) whose diameter is greater than 7 cm. It offers many uses: lumber, manufacture of piles, firewood in the form of logs or chips, etc. The applications are not lacking, some more successful than others. Nevertheless, these are accompanied by the production of menu-wood, more difficult to recover, and still sometimes burned in the fields. More and more studies show the interest of recovery in the form of crushed wood (fibered and not shredded) brought back to the ground from these branches. This brochure is aimed at farmers and presents several feedbacks to arouse the interest or even comfort farmers wishing to develop their hedge in the most optimal way, by integrating wood management into their farming system. Other players in the area may also find this guide useful: road workers, green space services, landscapers and gardeners.

The production of logs and the lateral upkeep of bocage hedges produce small-diameter branches (< 7cm) which must be removed from agricultural plots so as not to disturb the cultivation of the land. In the Breton bocage, it is estimated that these branches represent 20 to 40% of the wood exploited on the productive hedge. Due to the disappearance of certain uses such as the making of bundles for bread ovens, animal fodder, gradually replaced by fodder crops, some farmers may practice burning this wood, and it is a practice very polluting. And if we go back even before that, a proverb said: "If a carter knew how good the wood is in the ground, he would throw his whip handle into it". So let's try to put this ancestral practice back in the saddle and apply it in our current conditions (significant size and distance of plots, impoverished and erosive soils).

WHAT ISSUES?

First issue: air quality

Burning agricultural green waste (brush, vine shoots, etc.) in air emits fine dust (PM10). Consequently, with the multiplication of episodes of air pollution, the agricultural profession may fear a strengthening of regulations on the burning of hedgerow wood and wishes to find sustainable and economically viable alternatives to this very polluting practice.

Second challenge: soil quality and its biodiversity, carbon storage.

Well known to market gardening production which carries out several rotations per year and thus exports a lot of chemical elements from the soil, BRP* can be adapted and suitable for all types of agriculture. Land cover can improve soil organic matter levels, and therefore increase carbon storage and soil water load.



Example from north-west France of chipping cut agricultural hedgerow material on-site (Bretagne Ile Armor, 2017)

Third challenge: the maintenance and development of the bocage to ensure the sustainability of water resources.

In the continuity of plantation programs in the agricultural sector driven by a few institutional structures, it seems important to provide technical solutions to carry out the operations linked to the CAP** mechanism on the maintenance of hedges. Once consolidated, the technical-economic models will be able to give a renewed interest in maintenance, a craze for an optimal and direct valorisation of tree products by the farmer and thus encourage new plantations.

Fourth challenge: complementarity with the wood-energy sector

The European standard for wood fuels (EN ISO 17225) imposes a particle size which limits the integration of menu-bois in the market for woodchips because they do not make it possible to obtain a work rate for the chipping operators and product quality. sufficient for industrial-type automatic boiler

* Fragmented Ramial Wood

** Common Agricultural Policy

| ADVANTAGES AND EXPECTED EFFECTS OF FRAGMENTED RAMIAL WOOD (RCW) | | |
|---|--|---|
| On the ground | On the water | On crops |
| <ul style="list-style-type: none"> • Increase in the most stable fractions of organic matter • Improved soil life • Improvement of soil structure (porosity, soil aggradation) and its fertility | <ul style="list-style-type: none"> • Reduced nutrient losses through leaching • Anti-runoff effect • Improved soil permeability and better resilience to climatic hazards (drought/heavy rains) | <ul style="list-style-type: none"> • Reduction of phytosanitary risks in cultivation • Increased yields • Improved quality of harvested products |

WHICH MATERIAL IS MOST FAVOURABLE?

When the bocage does not provide the necessary volumes, other resources can be mobilised locally.

Remarks:

- 1- the seasonality of hedge pruning sites makes it difficult to return to the ground in autumn.
- 2- Wood loaded with tannins can disrupt soil biodiversity

| Indicator | Result | Comments |
|--|--|---|
| C/N ratio: Indicator of humigenic potential (ability to decompose rapidly in the soil) | A result of 60% means that 100 kg of material will provide 60 kg of stable humus | Compared to compost of vegetable matter the wood chip can provide a lot of stable humus |

NITROGEN HUNGER

The crop that follows the contribution of RCW can undergo a “starvation of nitrogen” given the high C/N of RCW:

- Microorganisms use the mineral nitrogen of the soil and the material to degrade the carbon of the material
- Concerns materials with a C/N > 20
- Some recommendations to limit this phenomenon:
 - Annual rather than five-year spreading
 - Autumn application • Incorporate a plant cover rich in nitrogen (legume) when spreading
 - Favour soft woods (willows, poplars)
 - Apply preferably on living and lightly worked soil

ADVICE: given the abundant aspect of the branches, it is important to set up mechanised and organised chains in groups to reduce the costs of production and application of these products.

FROM HEDGE TO FIELD

SHREDDED AND NOT SHREDDED

To ensure a good quality of defibration, it is preferable to use a hammer mill rather than a blade chipper. The shredded material is more easily degraded by soil micro-organisms than the wood chip, all the more so when the soil is alive.

ORGANISATION OF SHREDDING SITES

Shredding sites are not organized in the same way depending on the configuration. In forests, orchards and vineyards, the amendment can be carried out at the same time as the shredding, whereas it is preferable to spread the shredded material later on other crops.

DYNAMIC SITES

During “dynamic” sites, the shredder moves as it goes, accompanied or not by a trailer. These sites are mainly carried out in orchards for maintenance or restructuring pruning. To facilitate the work of the

shredder, it is advisable to bring the windrowed branches to an easily accessible area. Slight tidying up of the swath is enough to allow the branches to train with each other and help feed the shredder. Depending on the type of shredder and the section of the branches it supports, the orientation of the branches in the windrow will not be the same. For large diameters, favour orientation with the base of the branches in the direction of the shredder feed. For shredders working with smaller diameters, the branches can be aligned perpendicular to the direction of progression of the shredder.

STATIC SITES

The static worksites correspond more to hedge maintenance worksites at the edge of plots. The objective is then to dissociate the shredding phase, which cleans up the site, from the phase of returning the shredded material to the ground. The site is then organized from the pruning phase of the hedge preferably easy to access in a corner of the plot. The tops are gathered and aligned with the thinnest end oriented in the same direction towards the entrance of the crusher to facilitate the recovery, which will be manual or with a machine and which will allow a progressive feeding of the crusher or with a machine to feed the crusher gradually. The shredded material can then be expelled via a chute or a belt, in a trailer

| | The branch goes to the grinder | | The grinder goes to the branch |
|----------------------------------|--|--|--|
| Max diameter | 15-20 cm | 35 cm | 13 cm |
| Tractor power | 20-100 cv | 120-200 cv | 60-170 cv |
| Type of training | Independent heat engine or power take-off | PTO | PTO |
| Presence of buffer storage | No | Yes: hopper or conveyor belt | No |
| Supply Mode | Manual. The branches are brought one by one | Bucket or claw present on the shredder or independent on a 2nd tractor or manual if carpet | The rotors collect the branches on the ground and feed the shredder |
| Recommended type of site | Static construction site | Static site with the possibility of small movements | Dynamic construction site |
| | Gather the branches in a pile in a corner of the plot. Orient the branches in the same direction to save time | | Gather the branches in a windrow Alternate the orientation of the branches to improve shredding efficiency |
| Preliminary site organisation | | | |
| | | Ability to split the pile of branches and gradually move the shredder | |
| Conveying of the crushed product | Recovery via a blower in a skip | | |
| | Storage in a heap on the ground Recovery via a belt in a dumpster | | The BRF is left on the ground as progress is made |

Adapted from AILE, 2019: https://aile.asso.fr/wp-content/uploads/2020/11/Guide-Bocag_Air_Retour-au-sol.pdf

Other organisations have also produced a series of information sheets and guidance documents relating to the practice of bocage management including the following:

<http://www.polebocage.fr/-Sustainable-management-of-bocage-.html>

There are guidance notes on the development of sustainable hedgerow management and of wood-based energy sectors within the region.

NOTE: Details on the types of equipment shown in the Bocage document above can be found within the reference section in the appendix.

6.2 Case study – United Kingdom

English counties such as Devon and Cornwall offer us another near neighbour example of similar use of hedgerows in farming landscapes as exists in much of Ireland. A case study from a farm in adjacent Dorset examined the economic viability of transitioning from annual flailing of hedgerows to a fifteen-year coppicing rotation for wood-fuel (Dickinson, 2018) (see also chapter 11 herein). Berkshire also offers us a study of the managed use of hedgerows for wood fuel as an alternative to the disposal of cuttings and trimmings in pile burns (Chambers et al, 2019).

A guide produced by a partnership of Devon County Council, Tamar Valley Area of Outstanding Natural Beauty and the Devon Hedge Group (Wolton, 2014) observes that:

For many centuries firewood from hedges was considered a valuable crop. It was only in the latter half of the 20th Century that this use fell out of fashion because of rising labour costs and ready availability of cheap alternative fuels.

Of interest also, this publication states also:

There is no suggestion that all hedges should be managed just for fuel. Many, perhaps the majority, should continue to be managed primarily for other reasons, for example as stock proof barriers, for wildlife or the provision of various ecosystem services. Importantly, these hedges can be managed in ways that help to keep traditional skills such as hedge laying alive. In general, across any farm, the aim should be for all hedges to be multifunctional, but with management for some being tailored towards fuel production, others for stock containment or for biodiversity, and so forth.

However, from a practical farming point of view, it is difficult to see how, other than with the use of flailing that, hedges can be maintained without giving rise to trimming and cutting wastes arising?

Long-term management of farm hedgerows rather than the use of flailing has been examined in the English counties mentioned herein. The circular economy and bioeconomy aspects, primarily as bioenergy in this example, are considered further in chapter 09 below.

6.3 Case Study – Baden Baden, Germany

Stadtwerke Baden-Baden (previously Eigenbetrieb Umwelttechnik der Stadt Baden Baden) operates a series of services for the region of Baden Baden, Germany. Along with the provision of electricity, gas, water, heat, telecommunications and transport, the in-house environmental team is responsible for the handling of all types of waste management for the municipality. These include both wastewater infrastructure as well as the operation of a green waste processing facility.

The facility is home to series of processing technologies that allow green waste in all its forms to be processed into a range of energetic and biomass-based products.

The green waste processing facility is co-located with the region's waste water treatment plant (WWTP), a biogas plant, as well as being the site of the first large scale Integrated generation of solid Fuel and Biogas from Biomass (IFBB) plant. IFBB is a processing technique that allows residual fibrous biomass and food waste to be converted into sources of combustion briquettes and biogas, used to power the site when fed through the CHP unit.

However, it is the green waste processing facility that is of interest. The region is heavily wooded and forested, giving rise to large volumes of mixed woody biomass.

The facility operates a drop-off point for cut green waste where members of the public can bring their biomass residues for processing. The municipality also utilise the facility for their land management material. While the site is used to process largely non-agricultural sources of woody biomass, the setup, processing techniques and equipment as well as the model for collection/drop off could be replicated and adapted to suit. The following information and photographs are taken from a case study, carried out as part of DANUBENERGY Project (DanubEnergy, 2014)

Green cut: Receiving station

- A broad range of substrates is processed, including branches, brushwood, leaves, grasses, garden waste, municipal green waste.
- At the receiving station, all material is separated into three categories:
 - Grass and leaves
 - Material with contamination of soil/stone
 - Wood and brush wood



Green cut facility: Chopper

- Larger parts of woody biomass are chopped



Green cut facility: Sieving

- The chopped fractions of biomass are passed through a number of sieving stages which separate out the wood chips into different grades/sizes.
- Wood chips 2-4cm in diameter are dried and sold as wood chips.
- Smaller fractions can be processed into compost
- Some wood chips serve a feedstock for biochar production on site.



Compost and Bark Mulch

- Aside from the production of different grades of wood chip which serve heating and biochar production purposes, the facility also mixed the more green cut material, leaf litter and grass cuttings with fractions of woodchips to produce compost which it then sells back to members of the public.
- The facility actually sells a combination of bark mulch, compost and potting soil from the material processed on site.

Heat and Biochar Production

- Smaller diameter wood chippings and other various sources of biomass can be thermally converted onsite through pyrolysis, providing biochar and a usable source of thermal energy that can be used for process heat or for drying incoming feedstocks.



(McCormack, S., 2022)

Sieve residues and pyrolysis plant

IFBB Process

- While the processing of fibrous grassy material is beyond the scope for this study, it is worth noting that the site at Baden Baden has been operating the first full scale IFBB plant since 2013.

- The process allows for the production of solid fuel briquettes and biogas from fibrous grassland material that has little to no nutritional value as animal feed. This tends to be landscape management material from conservation grasslands.
- The material gets chopped, mixed and ensiled and stored in bales until it is ready for use.
- The bales then get split open and put through a hydrothermal treatment system where the biomass is mixed in warm water before being put through a screw press.
- This results in a liquid phase, containing soluble minerals and digestible fractions which get fed to the biogas plant, and , a solid fibrous press cake which gets dried and briquetted into a solid fuel or as a feedstock for the pyrolysis plant.
- The process reduces problematic minerals from grassland material, allowing the substrate to be used as a combustion fuel in traditional biomass boilers.



Ensiling stage



Hydrothermal conditioning stage



Liquid and solid phase separation



Briquetting stage

While the site at Baden Baden has features that process a variety of municipal, domestic and urban sources of biomass and residues, much of the physical infrastructure for the handling of the cut green waste could be used as a guide for the type of central drop off and collection model that allows mixed cut green waste being processed into a variety of products including wood chip, wood briquettes, bark mulch and compost.

6.4 San Joaquin Valley, California (USA)

California, USA has a number of counties that are home to vineyards and orchards, with related agricultural prunings and cuttings arising there. San Joaquin Valley offers an example of the incentivisation of farmers to transition from the burning of cut agricultural green wastes to the shredding of this material for return to the ground. This is being implemented in tandem with the phasing-out of burning over a period of time. This example is examined further in the bioeconomy context in chapter 9 below.

7 Identify and assess approaches for prevention

Regular hedgerow maintenance, flailing, and good agricultural practice / land maintenance are the primary approaches for reducing the volume and prevention of the generation of this green waste.

It is clear that if the burning notification form's waste hierarchy were used by farmers to assess the alternatives for prevention, then the volumes generated requiring burning would be minimal.

Based on the farmer survey carried out, it is worth noting that, when asked, 81% of farmers responded that they had not considered alternative uses other than burning prior to being asked.

The notification to burn form contains the following declaration:

Declaration of suitability: I declare that such burning will be done as a final measure following the application of the following waste hierarchy:

- (i) reduction of waste arisings in accordance with best agricultural practise,
- (ii) reuse of waste where practicable,
- (iii) recycling of waste through shredding and use as compost or wood chippings where practicable,
- (iv) salvage of waste for use as fuel, where practicable,
- (v) disposal, where none of the options at (i) to (iv) above are practicable or economically viable but subject to the following conditions –
- (vi) adequate measures will be taken to limit the overall nuisance or possibilities for endangering human health or causing environmental pollution, and
- (vii) No accelerants will be used when undertaking the disposal activity

Whilst it is not possible to prevent this material from needing some form of management, one of the approaches to manage it effectively is to focus on management techniques developed with biodiversity and nature in mind.

In line with the waste hierarchy prevention principles, the following options are available to farmers to prevent the generation of waste in the first place:

Reduce

Reducing the volume of material that actually needs to be disposed of is the most sought after action in the waste hierarchy, however in the context of growing hedgerows these will grow at a specific rate producing specific quantities of green material. Some commentators have suggested that farmers could reduce the amount of hedge cutting they undertake to reduce the volume of green waste produced. However this practice would not reduce the amount of green material that a hedgerow produces, the hedgerow will continue to grow material until cut. Eventually the hedgerow will reach a size where the farmer must cut it back producing an equal volume of green material. A farmer could maintain hedgerows at a larger size for example just cutting sides and not tops however a stage will be reached where the same volume of material or perhaps more is produced on an annual basis. The only other options available to reduce volume would be reducing the amount of hedgerows this is obviously not desirable nor allowed under current farming practice requirements.

Reuse

The concept of reuse in the waste management hierarchy is to have items which can be reused for their original purpose i.e. refillable glass milk bottles. In the context of green waste produced from hedgerow management, cut material cannot be reused as a hedgerow. The only scenario where reuse could form a part of management of green waste would be where a farmer wishes to remove a hedge from one particular part of the farm and replace it with an equal length in another part of the farm. A reuse strategy in this scenario would be where the farmer is removing full bushes from the soil with roots attached from one location and replanting same in another location on the farm. This practice would dramatically reduce the volume of green waste material produced from the initial removing of the first hedgerow, and would result in much faster establishment of the new hedgerow. Negative factors from such a practice would be dramatically increased labor and machinery costs, and increased soil damage.

Recycle / Recovery

Recycling of green waste material proposes a number of possible uses for the material. The term Recovery is used to describe the recovery of imbedded energy – i.e. using the material as a fuel for a useful purpose. Fuels derived from green waste are categorised as renewable and are collectively termed “bioenergy”. European Standards exist under EN17225-1 to categorise and describe solid biomass used for combustion, in addition the Renewable

Energy Directive as amended and updated contains strict criteria that must be adhered to in order for the fuel to be considered renewable and sustainable.

Potential uses for solid biomass are varied and wide, it would not be possible to encapsulate all such uses in this report. This study has categorised a number of potential uses that have merit for consideration in Ireland in the short to medium term. While there are many potential uses, using advanced technology, we have not gone into detail in this report what technologies that presently still in development.

7.1 Biodiversity and management for nature

There are a number of organisations that have their own specific guidance notes and documents for the sustainable management of hedgerows for the benefit of nature and biodiversity. The relevant guidance is summaries in this section.

Management for nature may result in the generation of green waste. Different organisations and regulations have different guidelines based on their own individual remits and priorities. This leads to mixed messaging and confusion from a farming perspective. The guidance notes below suggest that the use of a flail is the least preferable option from a biodiversity perspective, however it is evident from other stakeholders that the use of a flail leads to reduction in the volume of cut agricultural green waste that requires management.

It is the goal of different stakeholders to work to put measures in place to not only halt further biodiversity loss but also to begin to repair and reverse some of the damage that has already been done. According to the National Biodiversity Data Centre (NBDC), Ireland is home to some 31,000 species but the conservation status of only approximately 10% of these is known, indicating that there is a large knowledge gap there. Reporting on The Intergovernmental Panel on Biodiversity and Ecosystem Service (IPBES) assessment report, (NBDC, 2020) they state that one in every third of our bee species is at risk of extinction, 37 species of our birds are of huge conservation concern and that our pollinators and insects are declining. While the factors affecting biodiversity decline can be complex and varied, undoubtedly the loss of habitat is one of the more contributing factors.

This has led to a number of publications and guidance documents produced by The National Biodiversity Data Centre, the Hedge Layers Association of Ireland and groups such as the Farming for Nature Group. Ireland has an All Ireland Pollinator Plan as a means to guide stakeholders through the measures and steps that can be taken at a local and national level, to attempt to reduce the biodiversity loss and increase habitat for our pollinating insects.

7.2 Management of hedgerows

Hedgerows are known habitats for native species and can act as food sources, habitats and as wildlife corridors, connecting areas of nature. With this in mind, the various groups mentioned above have developed hedge management guidance notes where the focus is on management for nature and how best to go about it.

Benefits of Hedgerows – The Hedge Laying Association of Ireland (HLAI)

Hedgerows are multi-functional habitats and were previously planted to mark townland boundaries and enclose livestock in fields, however, they are now recognised to also have many ecosystems service benefits. For example, they sequester carbon, provide wildlife habitat, control flooding, improve water quality, and improve the scenic appearance of our landscape (HLAI, 2022).

Hedgerow management for pollinators - The National Biodiversity Data Centre (NBDC)

The National Biodiversity Data Centre and Hedge Layers Association of Ireland have co-produced some guidance notes on hedgerow management (NBDC, 2016) where consideration has been focused on management with pollinators in mind. Among some of the points made are the following:

Good quality hedgerows provide the four essential needs of pollinators:

- Sources of pollen and nectar for food
- Places to breed
- Places to overwinter
- Corridors and pathways to travel across the landscape

Hedgerows should not be over-managed. If hedgerows are to be trimmed, cut them on a two or three year cycle in rotation. This will result in there being some areas producing flowers each year. Where annual cutting is necessary try and cut a few centimetres further out each year (especially for whitethorn) – this will leave a small amount of older wood on which the plant can produce flowers. When planting up any gaps in hedgerows try and increase the diversity of species. Hedge banks, especially sheltered south-facing ones, are important nesting and over-wintering sites for solitary bees. Cutting hedges between November and January is likely to be less disruptive to pollinators. In the longer term virtually all hedgerows will need to be periodically rejuvenated through coppicing or laying if they are to remain sustainable. Laying should be the preferred option for rejuvenation as laid hedges will continue to flower and provide food for pollinators. Most coppiced hedges will not return to a flowering mode for a number of years.

Hedgerow Management - Farming for Nature

Groups like the Farming for Nature group have also been involved in producing guidance notes and documents for good hedgerow management practices. There are a number of recommendations and actions that are highlighted by the group as best practice, but of particular note are the following:

The ideal hedgerow for wildlife is tall, wide and dense at the base, with a wide, uncultivated, grassy margin. Such hedgerows really are 'networks for nature'.

- When planning hedgerow management, tailor the management to suit the hedgerow. Tall hedges with plenty of trees should be given just a side trim, hedges with wide grass or wildflower margins and short hedges without trees are better cut in 'A-shape' so the broad base allows light and encourages a dense growth at a ground level which is better for ground-nesting birds
- Avoid cutting all your hedgerows at once, consider a 3-5 year rotation to allow flowers and berries to grow in alternate sections. Gradually reduce cutting intensity each year to allow your hedgerow to expand and diversify. This is especially relevant for the young hedges which are just getting established
- Hedgerow cutting is usually undertaken with a flail, but a circular saw is a less damaging alternative which results in a cleaner cut and encourages better regrowth
- Delay trimming as late as possible – maybe until January and February (though make sure the ground isn't too wet/soft) as the surviving berry crop will provide valuable food for wildlife
- Avoid over-management; tightly cut hedges mean there are fewer flowers and berries, thus reducing available habitats, feeding sources and suitable nesting sites
- Avoid removing hedgerows, even the dying ones - where they are not a hazard or they don't prevent younger trees from growing, retain them as they may support insect communities, bat roosts and cavity-nesting birds (Farming For Nature, undated).

Hedgerows Ireland

Another hedgerow group, Hedgerows Ireland, presented to the Oireachtas Joint Committee on Agriculture, Food and the Marine on the 9th of February 2022. Dr. Alan Moore of Hedgerows Ireland provided the committee with insight into the benefits of properly managed hedgerows, their vital role in providing habitats, carbon sequestration, flood control, impacts on water and soil quality as well as being defining features within the Irish countryside that need supporting and protection. The committee heard how there is a need

for further education and training and that farmers should be properly rewarded for maintaining good quality hedgerows.

Agri Climate Rural Environmental Scheme (ACRES)

The new Agri Climate Rural Environmental Scheme (ACRES) has a few measures related to hedgerow management that could see farmers paid per meter of hedgerow maintained. This will provide opportunities for both farmers and the environment.

| Action | Minimum | Maximum | Completion Deadline | Payment Rate |
|------------------------|---------|---------|---------------------|--------------|
| Laying of hedgerows | 10m* | 400m | 31 December 2024 | €5.47/m/yr. |
| Coppicing of hedgerows | 10m* | 400m | 31 December 2024 | €2.87/m/yr. |

8 Identify and assess alternatives

This chapter outlines the various alternative uses for cut agricultural green waste materials generated on farm as described in chapter 5. Various material types (e.g. light woody material) may be generated from a variety of sources, and in most cases can be dealt with in a similar fashion. The descriptions below detail various practical methods for utilising these materials.

In addition to the described uses below we refer the reader to the European Innovation Partnership (EIP) Sustainable Uplands Agriculture-environment Scheme (SUAS) project which has identified alternative uses for woody and scrub material generated from upland areas (SUAS, 2020).

8.1 Alternative Uses

8.1.1 Flailed material

Generation Scenario 1 as outlined in chapter 3 refers to the material that results from regularly flailed hedgerows is currently incorporated back into the hedgerow ecosystem. Flailed hedgerow green waste is used by various microorganisms and broken down into useful organic material. Removal of this material is not considered to be substantially beneficial to the farmer and it would result in removing material which feeds into an active ecosystem.

The current practice as identified is considered an excellent method of maintaining hedgerows without generating green waste that must be otherwise disposed of or managed by the farmer.

Contradictory approaches regarding flailing and frequency of maintenance have been flagged in the consultation and in the literature reviewed. There is a need for regular flailing to minimise the generation of green waste. The proper use of a flail needs to be balanced with the concerns for biodiversity and hedgerow health around the use of this technique on a regular basis.

It is possible to collect the green waste from hedgerow flailing using a suction system attached on to the flail head, the green waste is then collected in trailers and transported either elsewhere on the farm or off farm for alternative use. Green material which contains a high amount of woody material and minimal green leaf material can be used as a fuel and

would generate some income. Green waste collected on farm could also be used as a bedding material.

Knowledge and awareness around the management of hedgerows and the manner in which they are maintained particularly the shaping of hedgerows is an area where further development is needed. The current practice in Ireland is to maintain the shape of hedgerows in a square profile with upright sides and flat top, this is known to affect the health of the hedgerow in the longer term, and in time causes breakdown of stock proofing of the hedge. Best practice as advised by all literature is to maintain hedgerows in a triangular profile with sloped sides meeting a sharp point in the middle, this allows additional light into, maintains and more even growth profile across the hedgerow, assists in greater usage as a habitat for fauna, and maintains stock proofing ability of the hedgerow.

8.1.2 Small diameter branchy material resulting from various activities

In chapter 3 various scenarios are described that will produce small diameter branchy material, specifically Generation Scenarios 2a, 2b, 3a, 3b, 4 and 5. The material may be resulting from a wide variety of activities such as, medium term maintenance of hedgerows, sporadic maintenance of hedgerows, land clearance, windfall, and diseased material. The material would be typical branch type material of length 2 to 5 meters with timber cross section diameters of typically less than 5 cm. The typical method used to manage this material was via burning. The following sections outline the alternatives.

Biodiversity support / Habitat creation

Green waste material can be stockpiled on the farm in designated locations, e.g. corners of fields, and allowed to decompose in situ over extended periods of time. This green waste material will act as a platform for a multitude of microfauna, macrofauna, and native flora. Green waste material would tend to take several years to decompose, the end result would be the material being broken down back to soil and organic matter within the soil.

The green waste material could be stockpiled in the form in which it was originally cut, this would result in particularly bulky piles which would take long periods of time to break down. An additional practice which could be undertaken is to physically break down the branch material either with normal farm machinery, or a woodchipper. Breaking down the material would reduce the volume significantly and reduce the area that the green waste pile would take up on the farm. The broken-down material would also be subject to much faster degradation and rotting back down into soil organic matter.

Farmers will need to dedicate particular patches of land for this practice. It is likely that some farmers may take aversion to such a method as they would see it as being unsightly, without recognising the broader environmental and biodiversity haven value. For farmers to undertake this activity they may need some form of encouragement or support to compensate them for the area of land which no longer can be utilised for farm practice.



Animal Bedding Material

Green waste material can be chipped and utilised as a winter bedding material for livestock. It is also common practice for overwintering pads for livestock to be constructed using wood chip material. Utilizing green waste in this manner would be an excellent method of reusing the material as well as providing a means for its final disposal onto land with the animal manure. A significant advantage of this practice would be that the animal manure mixed with woody green waste would be subject to faster degradation in the soil. A potential issue has been raised by stakeholders that thorns and/or other contaminants could present a challenge for the use of this material in animal bedding.

Off Farm Fuel (woodchip)

Sometimes large quantities of small diameter branching material is produced as part of land maintenance and clearing activities. This practice where the management of the farm or the farm ownership changes. From the farmer survey, we identified that a substantial portion of green cut agricultural waste that farmers have traditionally burned has resulted from scenario 3a and 3b



Forestry forwarder collecting green waste

In Ireland, there is now a vibrant market for woodchip material which is used as a fuel in commercial and industrial heating plants. These plants are able to utilize woody material which had been chipped with specialized wood chipping machines. A number of forest contractors have purchased these specialized woodchippers and are actively using them to chip forestry byproduct material into woodchip fuel.

There are circumstances where large quantities of this light material and/or coupled with larger diameter woody material is produced following substantial hedgerow recovery activities, land clearance, wind blow, or disease fall. On these occasions the quantity may warrant hiring in specialist contractors to gather and chip these large volumes of material. This material has an economic value which can potentially offset the cost of hiring a



Forestry forwarder with biomass picking head

specialist contractors. This potentially gives the farmer with some additional revenue following this activity.

Removal of large volumes of material through woodchipping does come with some material management constraints. Woodchippers contain blades which much must be maintained in a sharp condition. If the green waste material is contaminated by soil, stones or fence wire it will not be possible to chip this material. The normal farm practice of

pushing green waste material into large piles with a tractor loader or other farm equipment will inevitably contaminate the green waste material with soil or stones. Specialist contractor techniques utilising specialist equipment that picks the green material directly off the ground, will eliminating the potential for contamination. Material gathered with this specialist equipment will be free of contamination and can be chipped and used as a wood chip type fuel.

Following collection of this material by a specialist contractors it can be chipped directly into road trucks and transported to a site of use. This material if correctly selected gathered and chipped is suitable for use in large biomass combustion facilities which used the biomass for the production of heat and/or electricity.

This material has an economic value, in situations where quantities are sufficient it is possible for contractors to carry out the work at either zero cost, or on occasion by also

providing the farmer with a payment based on the tonnage of material collected. Consideration must be given not to encourage or over-incentivise the development of a green waste material industry as a revenue generating exercise, at the cost of the biodiversity value. From the farmer stakeholder consultation, the opportunity that offsite energy use provides is dependent on a number of factors, including:

- Accessibility of the site
- Soil & land type and quality
- Weather conditions
- Proximity to the energy user

In developing this report, a consultation was completed with a specific biomass harvesting contractor actively engaged in biomass recovery. This contractor suggested that the breakeven point for zero cost to the farmer in scenario 3 would occur where:

- the length of overgrowth along the field boundaries to be cut back exceeds 2km
- where there is a minimum of 200 tonnes of material
- where there is a high percentage of stem wood in the material

In situations exceeding the above thresholds described, there would likely be a payment back to the farmer, whereas situations below the thresholds described may result in a cost to the farmer. Undertaking this work is costly for any farmer to undertake themselves. Each situation should be assessed on a case-by-case basis.

If farmers are carrying out land clearance and/or maintenance activities, as described in scenario 3 above and where large volumes of material are expected, it is better that they liaise with a specialist contractor prior to tackling any of the work. This will allow the contractor to advise whether there is a cost or a return to be had from removal of the material offsite for energy use. More importantly, it allows the contractor to advise against the contamination of the material with soil/stones/fence wire. This will prevent the possibility of damage to equipment and maximise any potential return for the farmer.

8.1.3 Large diameter stem wood

Large Diameter stem wood can be generated from a number of on farm activities, in chapter 5 we refer to Generation Scenarios 2b, 3a, 3b, 4 and 5. Typically, large diameter woodfuel will result from land clearance, windfall, disease fall material, and occasions where hedgerows which have not been maintained for greater than one decade are tackled by the farmer.

Methods to process this material usually involve chainsaws and farm machinery but may on occasion involve specialist forestry machinery.

On farm energy / wood fuel

There is a long established practice of recovering firewood from larger woody materials from hedgerows, land clearance, wind blow and potentially disease damaged trees. The use of woody material is very efficient, practical, economically viable and sustainable.



Hedgerow cut with firewood material segregated

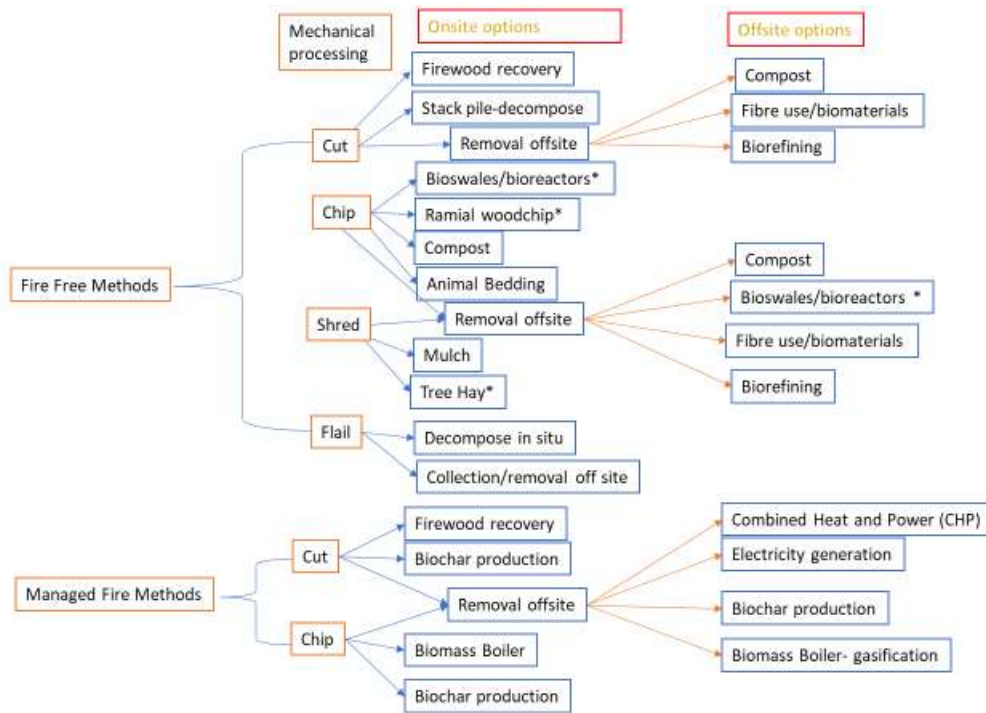
Firewood is an excellent sustainable source of energy, continuing to utilise this material on farm to heat the domestic home is a practice that should be encouraged. We note the Solid Fuel Regulations 2022, please refer to reference section 4.1 for further information.

Off Farm Fuel (woodchip)

In recent years woodchip boilers have become increasingly common for the provision of heat for heating buildings, animal sheds (poultry), providing process heating for industry and for the provision of electricity. Where significant volumes of material are available it has proven to be economically viable to collect the green waste material, chip it and use it to supply fuel to the above. Large diameter wood resulting from hedgerow maintenance, windblow, disease fall or other farm occurrences is ideal for chipping and use as a commercial/industrial fuel.

8.2 General alternative uses for all scenarios

The following section outlines a summary of potential alternative uses for cut agricultural green waste that could be employed, but suitability will be very much determined by the local situation, access to conversion technologies or facilities, markets to serve, transport distances, economics and perception/understanding. The following flow chart attempts to further define the various options into “Fire Free Methods” and “Managed Fire Methods”, as well as “On site” and “Off Site” management options.



Alternative uses for cut agricultural green waste

* The above are further explained in the section below.

8.2.1 Energy/electricity

The off-site energy uses for this material include production of bioenergy and electricity through CHP technology.

8.2.2 Heat Generation

The heat generation potential (both on-site and off-site) for this material includes its use in:

- Biomass boilers
- District heating
- Wood-fuels: logs and chip, less likely, pellet and briquette production
- CHAB: combined heat and biochar, gasification, pyrolysis, torrefaction

8.2.3 Fibre Use

The fibre uses for this material include:

- Off-site use for landscape mulch

- Animal bedding on-farm
- Fibre products- non-structural panels etc- unlikely but technically possible
- Tree hay/leaf fodder: the practice of cutting and storing the branches and green leaves of certain deciduous trees, when in full leaf, nutrient and mineral levels at their optimum, to be bundled and stored in dry conditions and used as an alternative source of animal fodder. Tree species suitable for this practice can include holly, ivy and ash (ORC, 2016).
- Ramial woodchip: “Ramial Chipped Wood (RCW) is fresh un-composted woodchip made from smaller diameter material. Young branches are nutritionally the richest part of a tree and can contain as much as 75% of the minerals, amino acids, proteins, and enzymes found in the whole tree. There is some evidence to suggest that the application of RCW to cultivated soils has benefits for soil health (ORC, 2019).”

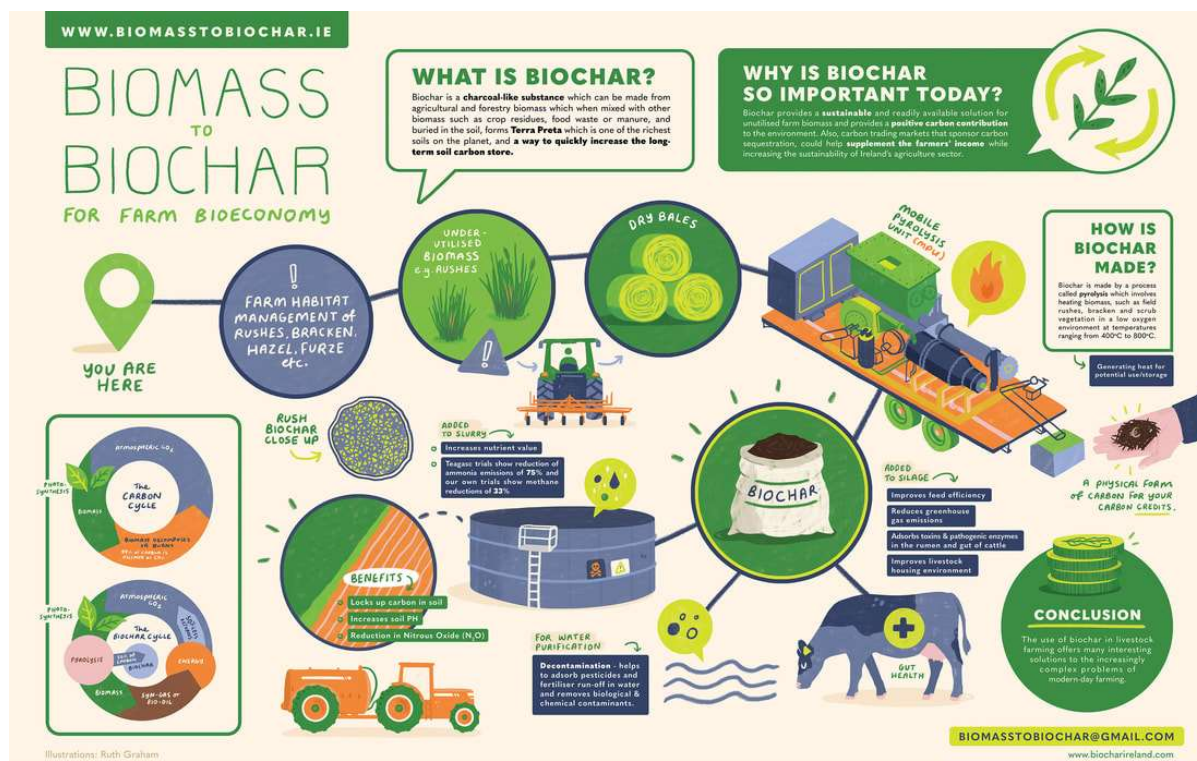
8.2.4 Bioeconomy/circular economy and biomass use

The bioeconomy / circular economy and biomass uses for this material potentially include:

- Bioswales/woodchip reactors
- Denitrification of agricultural runoff and the removal of nutrients, metals, and trace organics within storm water treatment systems
- Biomaterials- bioplastics, bio composites, wood foams
- Biorefinery- production of synthetic biofuels
- Extractives- lignin, wood vinegar, bio-oil etc.
- Biochar production (See Section 8.3 below)
- Composting process (See section 8.4 below)

8.3 Biochar

Biochar is increasingly being recognised as having a role in the sequestration of carbon, waste management as well as having numerous potential agricultural and environmental applications. The Intergovernmental Panel on Climate Change (IPCC, 2018) has identified biochar as one of the most promising NET or Negative Emissions Technology, capable of carbon dioxide removal (CDR).



The Biomass to Biochar for Farm Economy Project is a European Innovation Partnership (EIP) funded by the Department of Agriculture, Food, and the Marine (DAFM) under the Rural Development Programme 2014-2020.

An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine



What is biochar? (Biomass to Biochar for Farm Bioeconomy project - DAFM EIP-funded; to view infographic / schematic in full size, please visit <https://www.biomasstobiochar.ie/information.html>)

Biochar is a recalcitrant form of carbon, created when biomass is thermally converted through the process of pyrolysis. Thermal conversion is distinctly different to combustion in that the intended output is the production of co-products such as biochar, and not the elimination of a material through combustion. It can be made from a wide variety of biomass feedstocks and woody biomass is one of the more common feedstocks utilised. Biochar, once created, can have a really high carbon content that pervades in the environment for decades, if not beyond, to hundreds of years. It is this characteristic that makes biochar an effective means to remove carbon dioxide from the atmosphere through the conversion of biomass into this stable carbon, which can then be put to use in a number of scenarios. On average, every one unit of biochar is equivalent to approximately 3 units of carbon dioxide sequestered.

It tends to have an extremely large surface area due to the porous nature of the material, making it particularly good as an adsorbent, and useful in reduction of a range of emissions. Its' porous nature means that it in soil application or when it's added to other organics, it

can provide plenty of surface area for microbiology and fungi to colonise. Its surface chemistry and Cation Exchange Capacity (CEC) means biochar can bind to and retain nutrients and moisture. Certain types of biochar can prove effective at binding to and immobilising heavy metals and other pollutants.

The production process can be done in low technology options such as flame cap kilns or in fully automated industrial systems capable of processing larger volumes of feedstock. The process itself can give rise to large amounts of usable thermal energy, which can be utilised to provide process heat, district heat or otherwise. In some commercial setups, the whole process can be said to be providing carbon negative district heating- that is that a feedstock is processed into biochar for sale, the biochar gets sequestered in environmental or agricultural applications, and the heat generated by the process can feed a local district heating system.

Certain processing set-ups are capable of condensing and capturing what is often termed wood vinegar, which is a pyroligneous acid that is seeing a surge of interest from some involved with agriculture and horticulture. It is finding use as a fertiliser, antifungal and antimicrobial agents, as a pesticide and herbicide, as a flavour enhancer, as a foliar spray and as a soil enhancer, all requiring different dilutions. While it is not evident that there is anybody producing wood vinegar in Ireland at present, there are overseas companies that are offering wood vinegar for sale into the Irish market.

Biochar and carbon removal markets

Recent years have seen the development of a number of carbon markets that are selling voluntary carbon removal certificates to individuals and companies looking to offset some of their emissions. While other carbon removal mechanisms exist that allow quantifiable amounts of CO₂ to be accounted for and removed within wooden building material for example, biochar produced in facilities that have undergone life cycle analysis and where the usable heat is being captured and/or used, is adding value to the production process. Some of the carbon removal platforms are trading removal certificates that equate to an additional source of revenue in the region of €150 per tonne of biochar produced. Some of the platforms are even selling pre-removal certificates, a mechanism that allows start up biochar production companies sell future removal certificates which can aid in the financing and development of facilities.

While currently those facilities trading carbon removal credits based on biochar tend to be large scale, industrial and continuously operated, there is an appetite to see farmers using

farm scale production units and farm-based biomass be able to tap into these carbon markets and be rewarded, potentially as part of wider carbon farming initiatives.

Note: It is worth noting that biochar is one of the recommended findings listed as alternative uses for woody biomass in both the UNESC-ECE Draft Guidelines in preventing ARB, and the Humboldt County report. It was also the subject of feedback received during consultation process, particularly from the National Parks and Wildlife Service (NPWS).

On site, low tech processing equipment



Exeter Retort (Carbon Compost Co., 2010)



Kon Tiki Kiln (Finger Lakes Biochar, 2022)



Oregon Kiln (Wilson Biochar LLC, 2022)

The above biochar production units work using the flame cap technique. This in effect means that any pyrolytic gases that are given off by the process are angled by the slope of the kiln walls and burned directly on top of the kiln, in effect ensuring a clean combustion, with reduced smoke and particulates, and which starves the biomass feedstock at the bottom of the kiln, converting the biomass to biochar. This approach, as with many biochar production techniques, requires that the hot material be quenched entirely to prevent it from re-igniting.

On site, medium tech processing equipment



BurnBoss (Airburners, Inc. 2022)



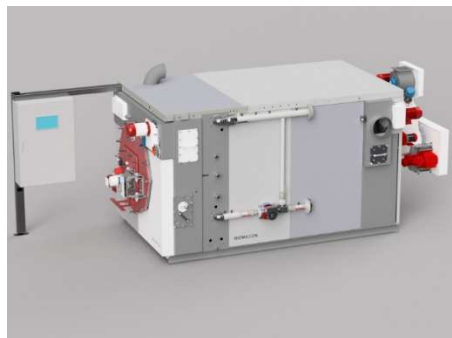
TrenchBurner (Airburners, Inc. 2022)



Carbonator (Tigercat International Inc., 2022)

The above “air curtain” style devices operate in a similar fashion to the flame cap kilns with the exception that a curtain of air is forced over the top of the combustion chamber, preventing the particulates escaping and reducing the woody material at the bottom of the chamber to biochar.

On farm pyrolysis technology



DECARBO Energy Systems - Farm Edition (BioMaCon GmbH., 2020)

There is continuous fed farm-based pyrolysis units capable of handling mixed woody biomass feedstocks where the heat generated by the process can be captured and out to use on site. The biochar can then be sold or used on farm in a variety of potential

applications. The Biomacon unit pictured here is one that is commercially available and which outlines the carbon negative heating aspect that can be attained under the right conditions. There are a number of other companies looking at developing farm scale equipment that are likely to be coming online in the near future.

United States Agriculture Department (USDA) US Forest Service

The US Forest Service has been turning to the conversion of woody biomass through the use of mobile biochar production kilns, which can be brought to site rather than transporting feedstock to a central processing site. This allows for sustainable management of pest infected timber as well as woody biomass that represents fire risks. The resultant biochar can then be returned to the forest soil, particularly during reforestation efforts. For further information, the USDA have produced an A-Z of the biochar basics (USDA, 2022).

Biochar uses on farm

- Soil amendment
- Biofertiliser component
- Compost additive
- Slurry/manure additive
- Filtration medium

Biochar uses off farm

There are a growing number of facilities, both in Ireland and abroad, capable of producing biochar from residual biomass including mixed wood. These facilities typically operate as continuous fed systems, capable of throughput of tonnes of material per hour. They vary in size, complexity, throughput and cost. But they all serve the purpose of conversion of biomass to biochar, with co-products such as syngas & biooil often being burned to sustain the reaction. Again, there is potential to integrate the excess heat generated into heat networks. The biochar is often then sold, with average prices ranging from €600 to €1500 per tonne. This biochar can go on to serve a number of different applications and product lines including, but not limited to, the following:

- Animal feed additive
- Soil amendment
- Peat moss replacement (when mixed with other organics)
- Green roof substrates
- Additives for construction material such as asphalt/tarmac, mortar and concrete

- Filler for thermoplastics and biomaterials
- Water filtration media for SUDS, swales, rain gardens, constructed wetlands etc.
- Animal bedding additive
- Compost additive
- Media for land reclamation- e.g. former brownfield or mine sites

Depending on the use of the biochar, often it gets returned to soil once it has served a function in a circular economy approach and what is sometimes referred to as a cascading use of the carbon. Take the example of the addition of biochar to winter slurry storage tanks. It can aid in the reduction of fugitive emissions from the storage tanks, it can bind to and adsorb much of the nutrient content within the slurry and then when time comes to land spreading the slurry, it can return the carbon contained within the biochar to the soil, building up the soil carbon content. The carbon is also charged with nutrients and the biochar can act as a slow release mechanism for the nutrients, preventing excess leaching during high rainfall events.

The use of biochar as a means to tackle surface water runoff, eutrophication and incidents of harmful algal blooms (HABs) arising from excess nutrients making their way into watercourses is also showing promise. The incorporating of biochar within sediment traps, filtration ponds or bioswales/biofilters may represent an opportunity to tackle deteriorating water quality and reduce the levels of nutrients being lost from farms. It is also the subject of a project called REFORM WATER (University of Eastern Finland, 2020) where biochar is being trialled in drainage ditch networks coming off forested peatland areas, in an attempt to reduce levels of dissolved organic matter (DOM).

Top-down fire management

In the absence of biochar production equipment, and in the event that a further extension to the exemption were granted, to be mobilised and take effect and in order to minimise any negative air quality impacts arising from the burning of existing piles, simple fire management techniques, employing the “top down” burning approach should be employed. Evidence suggests that burning from the top down, rather than the bottom up, reduces the emission of pollutants significantly.

Along with careful arrangement and stacking of the pile so that largest material gets stacked on the bottom, and it graduates upwards, by igniting the smaller material at the top of the pile and allowing it to burn from the top down, it greatly reduces the amount of smoke and particulate that is produced. Farmers should be made aware of this approach compared to

setting fire to the base of a pile which produces far more smoke and particulates. This approach can also yield some biochar at the end, although the yield will be less than biochar produced in a kiln. But importantly, it can effectively be considered cost neutral.

As part of the farmer survey, the level of awareness around the potential of biochar production from this material was quite low, indicating that communication efforts around the topic could be strengthened. Conversely, it was suggested as a beneficial viable alternative method, through feedback received during the consultation process.

8.4 Composting

The use of residual, low value mixed woody biomass to produce compost and soil amendments is possibly one of the more beneficial processes that can be employed as an alternative to the burning of cut green waste. The composting of biomass involves the aerobic decomposition through the action of microbiology. To produce a well-balanced compost product, a mixing of both carbon sources (woody biomass) and nitrogen sources (fresh green biomass or food waste) is needed, alongside access to moisture and air.

A typical design for a composting site will involve a series of windrows set out on a pad. Biomass arrives and depending on its origin and composition, it will be mechanically processed and added to the windrow piles. These piles then get periodically turned using pile turners, allowing aeration and mixing to take place and speeding up the decomposition of the feedstocks. The incoming feedstocks often get screened and then processed using some form of shredding/grinding process. Other equipment onsite includes conveyor systems and various loaders, pushers, and transport vehicles. The whole process, from a site taking delivery of biomass feedstocks, to the production of a usable and saleable compost product can take between 8 and 12 weeks although that figure can vary depending on set up.

Cré, as the representative body for the composting sector in Ireland, has the expertise and knowledge about best practice in terms of composting, which should be utilised by farmers if they are to adopt composting techniques, as an alternative use of this green cut material. As part of the farmer survey process, 18% of farmers responded with compost being considered as an alternative use for this green waste material. Several local authorities provided feedback regarding the potential for local authority run composting facilities or by expanding the use of civic amenity sites to be able to receive this material arising from agricultural practices. These could be developed in locations co-located with anaerobic digestion and biochar production facilities to enable maximum material and resource efficiency as well as energetic recovery

9 Circular economy and bioeconomy

The only scenario that generates significant volume of material is likely to be scenario 3 (Scenarios 3a and 3b in chapter 3 above), and this chapter herein specifically references off-site utilisation and value-added uses to produce other products and/or services from this resource. There is a challenge here in this regard in that on the one hand, the work of this study / report is tasked with not bringing forward options that lead to generation of more of this cut agricultural green waste material, yet on the other hand quantities of supply are relevant in the context of making circular economy and bioeconomy alternatives available on a commercially cost-neutral basis, at a minimum. Whilst it is not within the remit of this report herein to carry out a life-cycle analysis (LCA) of the current practice versus potential circular and bioeconomy alternatives, the report is alert to this as something that requires due consideration.

Another important economic, and indeed commercial factor to bear in mind in terms of potential circular economy or bioeconomy alternatives is that any bio-based product option that can act as a 'drop-in' or fossil-fuel substitute in an existing value chain (Hasegawa et al, 2022) will enjoy a cost and market advantage versus efforts to develop new value chains.

9.1 National Policy Statement on the Bioeconomy 2018

The National Policy Statement on the Bioeconomy 2018 sets out the current over-arching Government of Ireland policy framework for the development of the bioeconomy in Ireland.

Regarding 'residues', it states that:

"the bioeconomy emphasises the importance of using an increasing list of renewable biological resources and in some cases what would have hitherto been discarded as residues or waste and putting them to more productive uses. It extends across sectors - from farming and the agri-food businesses, marine and maritime industries, forestry, novel protein production, water and waste management, energy suppliers, and biopharmaceutical products. Ireland has many promising pioneers in all of these sectors" (p.4).

The National Policy Statement on the Bioeconomy was reflective of the strategic direction of the European Union Bioeconomy Strategy (2012) at the time. It also reflected the 'Cascading Principle' in terms of valorising bio-based residues and resources. More recently, the EU

Progress Report 2022 (European Commission, 2022a) on the updated EU Bioeconomy Strategy (European Commission, 2022b) emphasised the Cascading Principle.

In practical terms, ‘Cascading’ means getting as much higher-value use, for as long as possible, out of as much of the biomass material as is possible.



Cascading and the United Nations Sustainable Development Goals (European Commission, 2018)

"Where no other use for woody biomass is economically viable or environmentally appropriate, energy recovery helps to reduce energy generation from non-renewable sources.

In some circumstances, energy recovery may be the only option."

- Guidance on cascading use of biomass, European Commission, 2018

It is noted here that a new Bioeconomy Action Plan for Ireland has been published in consultation draft format, with a focus on over-arching policy objectives. These have been considered in the context of the potential circular economy and bioeconomy alternatives.

9.2 Circular economy and bioeconomy parameters

From first principles, the circular economy and bioeconomy work within the following legislative and policy parameters:

- Waste Hierarchy (EU and national implementing legislation) - waste prevention first, waste disposal as a last resort; the circular economy and the bioeconomy sit between these two opposite ends of the Waste Hierarchy
- Proximity Principle of managing the material as close to its source location as possible (EEA)
- Cascading Principle
- Value Chains.

The Waste Hierarchy and the Cascading Principle are complementary to each other, ultimately waste disposal of material being a last resort.



The waste hierarchy (EU, DG Environment)

The Landfill Directive 2014 aimed to phase out the landfilling of bio-waste, amongst others.

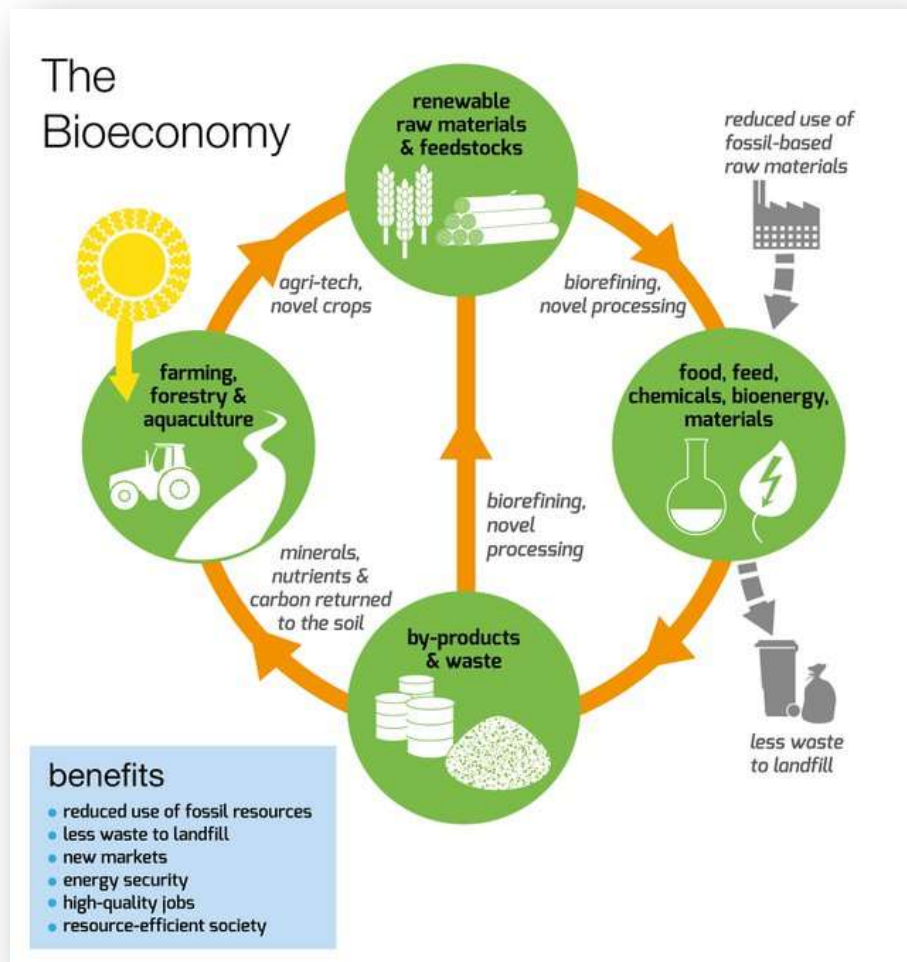
It is noted from the farmers who kindly participated in the survey that a little over half of those who had sent a notification of intention to burn to a local authority, replied that they had not considered the alternatives to burning in advance of doing so. The notification to burn form requires that consideration be given to the various options set out above regarding reference to the waste hierarchy.

For the cut agricultural green wastes, the focus of this study, there are potentially a range of bioeconomy destinations for those materials. This can range from the higher value-added area of bio-chemicals through to lower-value, but commercially available technologies such as chipping and mulching for landscaping or bioenergy. The challenge is that the type of material involved in cut agricultural green waste in Ireland is not of consistent woody biomass type, quality or consistency, with the challenge of contamination also involved. Potential contamination can include soil, stones, wire fencing, animal manures, and unfortunately along public road-sides, the risk of invasive species.

The challenge of consistency of the material includes the potential for it to include 'thorny' species such as hawthorn or blackthorn, as well as briars or brambles, making it more suitable for machine-cutting and handling rather than manual labour.

Regarding value chains, whilst there has been much research, innovation and demonstration in Ireland for over a decade in terms of potential circular economy and bioeconomy uses for woody biomass materials, and continues to be, much of the focus remains on lower technology readiness levels (TRLs). The TRL levels involved are often at a laboratory scale, tied to funding models that have sought out of necessity to link higher education research with industry, yet with a gap to bridge between proof of concept and commercial deployment. This gap between proof of concept, piloting and demonstration through to commercialisation is referred to as the ‘valley of death.’

From a value chain perspective, there is more potential and adaptability where a bio-based material and use offers a ‘drop-in’ solution or fossil-fuel alternative to an existing value chain. This is particularly relevant in terms of short-term to medium alternatives to the current option to burn cut agricultural wastes from hedgerows and over-growth of field boundaries.



The Bioeconomy (BioVale, UK, 2015 – project member with some Irish institutes in BioBase4SME)

Potentially, as set out in chapter 10 above, from a proof of concept perspective, woody waste materials can be a bio-based source material (thereby fossil alternative) for the production of bio-based chemicals, bio-materials, bio-polymers, bio-char, pulp, fibre, wood-chips, wood pellets or wood briquettes. Chipped woody waste of a sufficient quality can also potentially be used for animal bedding.

In 2022, the Government of Ireland has published its current waste management and resource recovery plan, the Waste Action Plan for a Circular Economy (Government of Ireland, 2022). The current waste action plan notes that the term ‘circular economy’ is

becoming more widely known among the general public and economic sectors such as agriculture. It also recognises the role for research into biochemicals, biomaterials, biofuels and bioenergy as potential destinations for biomass wastes in “addressing waste management and the achievement of a circular economy”.

The National Policy Statement on the Bioeconomy reflects that policy coherence across government departments and state agencies is required to realise the potential of this multi-disciplinary sector of the economy. Since its publication the EU Green Deal and Farm to Fork Strategies have come into play as over-arching policy frameworks for farming, the bioeconomy, and the wider circular economy.

The more recently updated, new Circular Economy Action Plan, in the context of the EU Green Deal (2019) re-iterates the commitment to reduce pressure on natural resources and stimulate sustainable economic growth and jobs. In practical ‘real world’ terms, the circular economy model is about reducing waste in resource-intensive sectors and keeping materials in higher value-added products for as long as possible. The bioeconomy, arguably inherently circular in any event, can be distinguished here from the circular economy policy model as being more focused on de-carbonising economic sectors that are very fossil-fuel focused at present. Applied to cut agricultural green wastes, the challenge then is to identify destinations for these materials that offer economies of scale within the circular economy and the bioeconomy. The nature of the materials is such that they are not currently viewed as presenting a farmer or a contractor with a high-grade raw material that can be directed towards a high-value value chain.

9.3 What’s technologically possible, and what’s feasible?

The UNESC-ECE’s guidance document on reduction of emissions from agricultural residue burning (UNESC-ECE, 2021; UNESC-ECE, 2022) reflects the technologically possible opportunities for cut agricultural green waste in bioenergy generally, specifically wood pellets and biochar. Outside on-farm use as on-site bioenergy use for heating, the challenge comes back to economies of scale in terms of volume of supply, proximity of supply to a processing or recovery site or facility and quality and consistency of supply for the particular circular economy or bioeconomy alternative.

Feedback from the direct surveys of farmers dealing directly with cut agricultural green wastes indicates that they do not currently see it as having a value. Those surveys indicated that it is seen more as presenting a net cost if anything other than burning of cuttings or the use of flailing and return to the soil. This aligns with observations from work carried out previously in south-west England:

"To be healthy and ultimately to survive, hedges have to some value to farmers. They must be seen as an asset, not a drain on resources. If they can pay their way, or better still provide an income for the farmer or contractor, so much the better."

- Dr. R. Wolton, Hedgelink & Chairman, Devon Hedge Group (2018)

9.3.1 Learnings from our neighbours: north-west France and south-west England

A number of regions in north-west France have similar agricultural practices to Ireland and use hedgerows for enclosing fields, particularly stock-proofing field boundaries in pasturelands. This would require more intensive engagement by the farmer and possibly more collective engagement by neighbouring farmers to maintain, improve and put in place new raised banks and hedging. It would involve the use of coppiced material for bioenergy for heating.

"The coppicing of hedges for woodfuel not only reduces the cost of managing hedges but provides farmers and local communities with a renewable, low cost energy source whilst supporting wildlife and improving the health of hedges."

- Chambers et al, 2019

It is likely that a programme or scheme of education, training, support and incentivisation would be required to encourage farmers to embrace or re-embrace the bocage-type practices that were arguably in place in Ireland until this type of work became too labour-intensive and cost prohibitive within the overall demands of the farm. This has developed in the context of the frameworks of successive EU CAP programmes that funnelled farmers down particular avenues towards today's current scenarios.

Devon and Cornwall in south-west England, are other neighbouring regions to Ireland that have looked at *bocage* practices, as alternatives to burning, with an emphasis on sustainably planting and managing hedgerows, and providing a steady supply of biomass fuel from the cuttings (Wolton, R., for Devon County Council, Tamar Valley AONB and The Devon Hedge Group, 2014). This work drew on the French bocage experience in Normandy and Brittany in particular.



**Example from north-west France of chipping cut agricultural hedgerow material on-site (Bretagne Ille
Armor, 2017)**

In another case study from south-west England (from Dorset), the assertion has been made that it is possible to transition farm hedgerows from annual flailing to a 15-year coppicing rotation (Dickinson, 2018). Whilst the Dorset case study cautioned that there were too many variables in the individual farm scenario used, for it to present anything other than a general guide, it did offer the finding that it was potentially economically viable to transition a hedge from an annual flailing regime to a fifteen-year coppicing system (Dickinson, 2018). Whilst this may require a process of engagement with the farming community, in the context of an end to the burning of cut agricultural green waste, it may present an opportunity for farmers to generate value, in the medium- to long-term, rather than carry the cost and time attrition associated with current management of hedgerows on the farm.

"Changing farmers' perception of hedges so they are viewed as a useful resource rather than a cost gives hedges a securer future."

- Dickinson and Westaway, 2019.

In a review linked to the same Dorset farm case study, Dickinson and Westaway (2019) have highlighted that taking hedgerows out of annual flailing and into coppicing for wood fuel can be “economically viable.”

A relevant factor to bear in mind for Ireland, in terms of its weather during the autumn, winter and early spring months, is the risk that ground conditions will not be conducive to bringing machinery on to land for either trimming or transporting farm hedgerow cuttings. This has been flagged in the Devon County Council and others’ analysis of this topic.

9.3.2 Italy - vineyard and olive pruning residues for bioenergy

A study in Italy (Toscano et al, 2018) has tested the use of a patented pruning harvester (chipping the vine cuttings) and a mobile pelleting unit specifically designed for the vineyard agri-pellet chain. It found that this on-site / in-field pelleting using this technology compared well with existing commercial solutions. The study notes that on-site pelleting was the most cost-effective solution, as transport costs diminished the economic return towards the threshold of 50km distance from the source of the material. The study also notes that there are environmental and social benefits to the sustainable valorisation of this cut agricultural green waste within a local production chain (as an alternative to burning).

9.4 California – cut agricultural green wastes arising from orchards and vineyards

San Joaquin Valley, California (wine and fruit-growing region) has put in place a combined phase-out of burning of woody agricultural wastes in tandem with a support programme for farmers and chipping / shredding operators (San Joaquin Valley Air Pollution Control Board, 2021).

Initial indications from the San Joaquin Valley experience are that the move away from burning of agricultural green wastes (mainly woody / lignin materials) to circular economy options such as chipping and shredding on-site for application to the originating farm / orchard / vineyard soil is being encouraged by the publicly-funded support programme. This includes public funding provision to cover the cost of chipping and shredding by contractors.

Circular bioeconomy options for cut agricultural green wastes have been considered there ranging from biomass use in power plants, on-site chipping and re-incorporation to the soil,

composting, cellulosic ethanol production, air curtain burners, to name a few (Kneeland, Yunker and Clements, 2020).

Napa County, California, another of its wine-growing regions currently retains the practice of burning of cut agricultural wastes from its vineyards and orchards, in particular, but highlights the following bio-based alternatives to those seeking information about burning notifications:

Agricultural Burn Information

Alternatives to Burning

When managing vineyard debris from pruning and vineyard removals, consider these alternatives to burning:

- Chipping/grinding plant material and disking into soil, or
- Chipping/grinding plant material for composting on-site or at a facility licensed to conduct composting, or
- Removing all waste material and transporting to a licensed facility capable of handling it properly.

Alternatives to burning – Agricultural Commissioner’s Office, Napa County, California, USA (2022)

Napa County is located close to large centres of population in the cities of Santa Rosa, San Francisco, San José and Sacramento in California. Increasing public health and climate concerns in that area have put a greater focus on the consideration of alternatives to burning of cut agricultural wastes (Bazán, D., 2018). Again, bioeconomy alternatives such as chipping, mulching, biochar and biofuel have been examined in that region (Bazán, D., 2018).

9.4.1 Agricultural Chipping Programme, Bay Area, California, USA

California’s Bay Area Agricultural Chipping Programme (covering nine counties) encourages “qualifying agricultural operations” to apply for free chipping services “in lieu of open burning the material” (Bay Area Air Quality Management District, 2022).

10 Proposal for establishing alternatives

This study identifies alternative uses for cut agricultural green waste in Ireland. The alternative uses have been assessed from a feasibility, and practical perspective. There are examples of alternative uses at a European level which are detailed earlier in this report. Success in establishing alternatives is dependent on the following:

- Agricultural extension services – training and education
- Equipment
- Communication: awareness-raising, community engagement and advocacy
- Market development
- Financing
- Governance and regulatory measures

Clear communication is required on all the options available to ensure farmer buy-in and uptake. Farmers are familiar with collection and drop-off facilities for plastic, tyres, medicines etc. Policy needs to promote the opportunity for central collection or drop-off of agricultural green waste similar to models that exist across Europe. From the consultation and survey processes, it is clear that farmers are open to the alternatives, but are risk averse to any alternatives to burning cut agricultural green wastes based on additional cost, logistics, practicality and the perceived potential additional GHG emissions footprint of the alternatives, many of which require fuel for mechanical processing and transport. Dedicated, tailored and properly communicated messaging is essential to the uptake of the alternatives.

On-farm alternatives

It has become clear that only some of the alternative uses are currently practised, which could be attributed to the lack of supporting measures for the alternatives. There is a need for a knowledge and awareness programme to be developed and implemented for farmers and contractors regarding best practice for cutting and maintenance of hedges and management of green wastes. Recognition is required for farmers for green waste piles from an ecological perspective in the various farm schemes. There is evidence for support for this option, with 57% of farmers surveyed identifying this as an alternative option. Inclusion of measures within the Targeted Agricultural Modernisation scheme (TAMS) programme for equipment to process green wastes by individual farmers. Funding should be provided, (separate to TAMS), for contractors to invest in the equipment necessary to

complete chipping, mulching or processing. Any direct support to farmers to cover the cost of this chipping / mulching could be via a payment, received using a vouched invoice system. Policy and regulation should consider the allowance of certain low-tech on-farm biochar production methods, to be considered as a separate class of activity, distinguishable from “backyard burning” by the local authority/ EPA provided appropriate flame cap kiln type devices are used. It is important that where farmers are recovering firewood for their own use that adequate seasoning / drying of the material occurs, in line with best practice.

Off-farm alternatives

If biomass recovery for energy purposes is to take place, the development of both supply chains and the market for woodchip / wood fuels needs to be supported so that the biomass is being used locally, with transport distances kept to a minimum. Consideration could be given to the further deployment of biomass boilers in public buildings and district heating schemes, that would drive the development of a market for recovered biomass. Government support needs to be provided for the establishment of local authority-based compost facilities, potentially incorporating biochar production and/or biogas facilities as an outlet for this green material. The current network of civic amenity sites could be expanded to assume this additional remit, beyond their offering to domestic customers. Transport costs of cut agricultural green waste material to centralised collection / composting sites for off-site processing will require subsidisation. This scenario is distinguished from where the farmer sells excess cut green waste material to a specialist contractor for off-site energy use, where a return is received by the farmer.

11 Conclusions and recommendations

This report has been developed in the context of the exemption to the burning of cut agricultural green waste, under waste management legislation, due to expire on the 1st of January 2023. This report has drawn on direct engagement with a range of stakeholders in this regard. This section outlines the main conclusions and recommended next steps, both from a policy and practical perspective.

This report has examined international practices to draw lessons that may be useful in terms of sustainable alternatives for Irish farmers.

In broad terms, the main conclusions, and recommendations centre around the need for the implementation of supports, knowledge transfer and training services, coupled with a flexible approach and potential transitional period to move from the burning scenario to the alternatives. There exists a need to resource, mobilise and implement the various alternatives to burning. The evidence is clear regarding the need for the introduction of supporting measures to assist the farmer's transition from a burning practice to the alternatives. The notification to burn form asks farmers to sign a declaration that they have explored all the alternative options before burning as a last resort. It is clear from the direct farmer survey that farmers have not considered the alternatives (62%). If farmers use the waste hierarchy within the notification form, the requirement for burning would be minimal.

Notwithstanding that it was announced in early 2022 that this would be the last extension of the exemption, overarching feedback from all representative body stakeholders is that there exists a need for flexibility. Farmer feedback received indicates that 73% are not aware that the exemption is due to expire, and local authorities' feedback is that viable alternatives need to be in place.

As outlined in the UNESC-ECE guidance on this topic, consideration should be given to the following:

- Extension services – training and education
- Equipment
- Communication: awareness-raising, community engagement and advocacy
- Market development
- Financing

- Governance and regulatory measures

Based on this study's farmer survey, farmers are currently implementing an annual cutting cycle with regards management of this material and green piles are already within this annual cycle. This, coupled with the lack of awareness among the farming community signifies the need for more supportive measures. The survey also reinforced the nature of this cycle, with 71% responding that they cut in Autumn.

Clear communication is required on all the options available to ensure farmer buy-in and uptake of the alternatives.

This study identifies the following as the most feasible in the short to medium term:

- Cut and draw materials arising into a pile in a field corner, to leave it to de-compose over time (also acting as a haven for biodiversity)
- Regular maintenance and flailing (with *in situ* return to the ground of the material)
- Wood-fuel from cuttings (dependent on quality of the material)
- Alternative hedgerow management and practices – with practices such as coppicing and hedge-laying etc
- Alternative uses such as wood-chip, mulch and compost
- Biochar options – on-site production and use
- On-farm animal bedding in some cases, depending on the nature of the material arising
- For land clearance material, off-site use is the most preferable method – using specialist contractors, where an economic return is possible, but dependent on the individual situation and circumstances

During the study, reports, data and guidance from other regions and, based on the feedback received from the consultation process, the following conclusions and recommendations have become evident:

11.1 Conclusions

- During the period 2019 to 2021 inclusive, an average of 2,884 intention to burn notifications were received annually by local authorities, and as reported to the EPA. As part of the notification, no estimation of the volume of material requiring management is provided. Based on the type of data available, it was not possible to estimate the volume of material arising.

- It has not been possible to identify levels of compliance, other than quantifying the number of notifications to burn and inspections. Over the period 2019 to 2021 inclusive, there was an average of 1,073 inspections completed by local authorities, as reported to the EPA. Local authorities in some instances have indicated that their capacity to monitor compliance has been limited due to lack of resources.
- Significantly, from a public awareness of public policy perspective, a large majority of farmers surveyed directly were not aware that the exemption will end on the 1st January 2023. It would be expected that awareness levels amongst individual farmers would be greater, given the level of public discussion of this topic in early 2022. This points to a need for greater and dedicated, ongoing communication and outreach activities on the topic, including the alternatives.
- The elimination of burning of cut agricultural green waste will ensure a shift to potential sustainable alternative uses for this material, some of which are currently being implemented on-farm.
- Open-air, in-field burning of this cut agricultural green waste in the past has been the lowest-cost and least labour-intensive option for management of this material, although this can come with its own environmental cost and impacts (these impacts are outlined in this report). Some of the sustainable alternatives identified in this report have associated financial outlay and labour costs.
- During the course of the consultation process, it has become clear that only some of the alternative uses are currently practised, which could be attributed to the lack of supporting measures for the alternatives.
- The notification to burn form asks farmers to sign a declaration that they have explored all the alternative options before burning as a last resort. It is clear from the direct farmer survey that farmers have not considered the alternatives (62%). If farmers use the waste hierarchy within the notification form, the requirement for burning would be minimal.
- Drawing lessons from the UNESCO-ECE guidance (2021), the learning from other jurisdictions where banning of burning has been introduced, the most significant failures in addressing open burning have occurred when authorities introduced burning bans without adequate support and extension services already in place. This report's recommendations point to the types of supports and extension services that are required to drive uptake of the alternatives to burning.
- From the consultation and survey process, it is clear that farmers are open to the alternatives, but are risk averse to any alternatives to burning cut agricultural green wastes based on additional cost, logistics, practicality and the perceived potential

additional GHG emissions footprint of the alternatives, many of which require fuel for mechanical processing and transport.

- If biomass recovery for energy purposes is to take place, the development of both supply chains and the market for woodchip / wood fuels needs to be supported so that the biomass is being used locally, with transport distances kept to a minimum.
- Policy needs to promote the opportunity for central collection or drop-off of agricultural green waste similar to models that exist across Europe.
- The alternatives involve both non-fire (composting, mulching, chipping etc) and managed fire approaches (wood-fuel, biochar production, off-site energy recovery). The unique opportunity, value and environmental co-benefits of biochar production on Irish farms, which uses managed fire approaches, using specific technology and techniques should not be mistaken or confused with the open pile-burning the subject of the waste management legislation ban. It is important to recognise that biochar production is a thermal conversion process rather than a combustion process.
- Novel biorefining techniques that could valorise agricultural cut green waste are more likely to look to single source feedstock. Therefore, mixed cut agricultural green waste of different species and properties may not be suitable for conversion to innovative bio-based products (e.g. bio-chemicals and bio-materials).
- Contamination of the residues with stone, soil, manures, plastic or fencing wire represent a big challenge to overcome should this biomass need to be mechanically processed through chipping and mulching machines for alternative uses.

11.2 Policy recommendations

The recommendations here are a mix of urgent, short-, medium- and long-term recommendations.

- There is a need for a knowledge and awareness programme to be developed and implemented for farmers and contractors regarding best practice for cutting and maintenance of hedges and management of green wastes.
- Recognition is required for these green waste piles from an ecological perspective in the various farm schemes. There is evidence for support for this option, with 57% of farmers surveyed identifying this as an alternative option. Farmers were clear that they should not be penalised for this non-productive area, in terms of the Nitrates directive area calculations and Common Agricultural Policy land eligibility rules.
- The primary focus for this waste stream should be local (on-site or off-site) composting and re-incorporation into the soil.

- Regulatory and best practice guidance need to align (Nitrates Directive 3-year cycle for cutting) around the best practice for reducing volumes of this material, culminating in the development of a code of practice that aligns all relevant legislative and waste management hierarchies.
- Existing guidance documents need to be updated based on the alternative uses outlined in this report, with potential for new guidance documents to be produced for new areas.
- There is a need to unify the messaging to farmers around hedgerow management, alternative uses for cut agricultural green waste and best practice techniques.
 - o Teagasc, as the State research and advisory body, to lead the provision of best advice, guidance and information, to farmers regarding hedgerow management techniques and best practice and deployment of the sustainable alternatives to burning.
 - o There are currently several organisations with conflicting views on the approach to hedgerow management that are active in this space.
 - o Different organisations and regulations have different guidelines based on their own individual remits and priorities. This leads to mixed messaging and confusion from a farming perspective.
 - o For example, contradictory approaches regarding flailing and frequency of maintenance have been flagged in the consultation and in the literature reviewed. There is a need for regular flailing to minimise the generation of green waste. The proper use of a flail needs to be balanced with the concerns for biodiversity and hedgerow health around the use of this technique on a regular basis.
- Inclusion of measures within the Targeted Agricultural Modernisation scheme (TAMS) programme for equipment to process green wastes by individual farmers.
- Funding be provided, (separate to TAMS), for contractors to invest in the equipment necessary to complete chipping, mulching or processing. Any direct support to farmers to cover the cost of this chipping / mulching could be via a payment, received using a vouched invoice system.
- Engagement with and upskilling of relevant stakeholders to identify best practices or to identify future options, be added to existing arenas (open days, farm walks, knowledge transfer events) in which farmers and contractors participate currently.
- Dedicated, tailored and properly communicated messaging is essential to the uptake of the alternatives.

- Consideration could be given to the further deployment of biomass boilers in public buildings and district heating schemes, that would drive the development of a market for recovered biomass.
- Policy and regulation should consider the allowance of certain low-tech on-farm biochar production methods, to be considered as a separate class of activity, distinguishable from “back yard burning” by the local authority/ EPA provided appropriate flame cap kiln type devices are used.
- Government support needs to be provided for the establishment of local authority-based compost facilities, potentially incorporating biochar production and/or biogas facilities as an outlet for this green material.
- The current network of civic amenity sites could be expanded to assume this additional remit, beyond their offering to domestic customers.
- Transport costs of cut agricultural green waste material to centralised collection / composting sites for off-site processing will require subsidisation- this could be in the form of a voucher or payment based on an invoice system. This scenario is distinguished from where the farmer sells excess cut green waste material to a specialist contractor for off-site energy use, where a return is received by the farmer.
- Any firewood produced from this agricultural green waste must be adequately dried / seasoned to below 20% moisture content so as not to contribute to air quality impacts. Best practice for quality wood fuels is available through the Wood Fuel Quality Assurance Scheme (WFQA) (WFQA, 2022).
- Further life cycle analysis, which was outside the remit of this report, is required to fully explore any emissions impacts of the alternative uses for this green waste, and to eliminate the concerns of farmers around the environmental impact of the alternatives, particularly regarding the use of engine fuels and mechanisation.
- Additional next steps should include a detailed cost estimate of the various different proposed alternative uses for this material, the processing equipment required, the impact transport distances might have in order to allow more effective management decisions to be made. This was beyond the scope of this study.

11.3 Practical recommendations

- Farmers wishing to manage their hedgerow and lands for the maximum benefit to nature and biodiversity should look to some to the existing guidance documents available, as per the links in the references.

- The existing waste hierarchy in the current legislation should be effectively communicated and explained as a means of outlining a high-level overview of the alternatives.
- In the event that a further extension to the exemption were granted, to be mobilised and take effect and in order to minimise any negative air quality impacts arising from the burning of existing piles, simple fire management techniques, employing the “top down” burning approach should be employed. Evidence suggests that burning from the top down, rather than the bottom up, reduces the emission of pollutants significantly.
- It is important that where farmers are recovering firewood for their own use that adequate seasoning / drying of the material occurs, in line with best practice.
- If farmers are carrying out land clearance and/or maintenance activities, as described in scenario 3 above and where large volumes of material are expected, it is better that they liaise with a specialist contractor prior to tackling any of the work. This will allow the contractor to advise whether there is a cost or a return to be had from removal of the material offsite for energy use. More importantly, it allows the contractor to advise against the contamination of the material with soil/stones. This will prevent the possibility of damage to equipment and maximise any potential return for the farmer. Farmers to be cognisant of the EIA threshold requirements as outlined of the main body of the report herein.
- The use of newly acquired mechanical equipment should be approached with a firm focus on health and safety aspects to prevent unforeseen consequences.

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13 Appendices

13.1 Consultation Details

IrBEA undertook a consultation on the management of agricultural green waste and alternatives to the burning of green waste. The consultation process was completed in two streams:

- Farmer survey
- Stakeholder engagement

Farmer Consultation

A survey questionnaire / feedback form was developed to consult with individual farmers. This focus of this consultation was individual farmers that are impacted and need to embrace sustainable management of agricultural green waste in Ireland. IrBEA completed this survey at the National Ploughing Championship which was an opportunity to engage with farmer stakeholders. 153 surveys were completed. The results of which are outlined in section 13.3. The feedback from this survey is incorporated in the report.

Stakeholders' Consultation

A stakeholder consultation was completed in developing this report. Invitations were issued to each stakeholder listed, to participate in an online meeting and, each organisation was provided with the opportunity to provide written feedback by a specific date. The feedback and this stakeholder consultation is included in section 15.4. The feedback from the consultation is also included through the report.

| Organisation | Consultation meeting held | Written response received |
|---|----------------------------------|----------------------------------|
| Irish Farmers Association (IFA) | Yes | Yes |
| Irish Creamery Milk Suppliers Association (ICMSA) | Yes | No |
| Irish Cattle and Sheep Farmers Association (ICSA) | Yes | No |
| Irish Natura and Hill Farmers Association (INHFA) | No | No |
| Macra na Feirme | Yes | No |
| Irish Co-Operative Organisation Society (ICOS) | Yes | No |
| Farm Contractors Ireland (FCI) | Yes | Yes |

| | | |
|--|-----|-----|
| Professional Agricultural Contractors of Ireland (PAC) | No | No |
| Agricultural Consultants Association (ACA) | No | No |
| Teagasc- Countryside Specialist | Yes | No |
| Teagasc – Renewables Specialist | Yes | No |
| Environmental Pillar | No | No |
| Irish Environmental Network | No | No |
| National Park and Wildlife Service (NPWS) | No | Yes |

| |
|--|
| Local Authorities Director of Services for Environment- Written responses received through the Local Government Management Agency (LGMA) from the following local authorities: |
| Leitrim Co. Co. |
| Clare Co. Co. |
| Cork Co. Co. |
| Donegal Co. Co. |
| Sligo Co. Co. |
| Westmeath Co. Co |

13.2 Local Authority Notification Form

This appendix shows the notification form used by local authorities for farmer notification of the burning of agricultural green wastes.

Statutory Notice

Checklist of advance information to be provided by a person to a local authority concerning the proposed burning of agricultural waste in accordance with the provisions of Regulation 5(1)(a).

Name:

Address: (correspondence address)

Telephone:

Local authority administrative area:

I hereby give notice to (give the name of the local authority) of my intention to burn waste solely consisting of uncontaminated (free of dangerous substances, preservatives or other artificial impregnation or coating) wood, trees, tree

trimmings, leaves, or brush, or other similar waste generated by agricultural practices (but excluding garden and park wastes and cemetery wastes and waste arising from infrastructural development works)

on (give the proposed date of the burning) at (location where proposed burning will take place).

Declaration of suitability: I declare that such burning will be done as a final measure following the application of the following waste hierarchy:

- i. reduction of waste arisings in accordance with best agricultural practice,
- ii. reuse of waste where practicable,
- iii. recycling of waste through shredding and use as compost or wood chippings, where practicable,
- iv. salvage of waste for use as fuel, where practicable,
- v. disposal, where none of the options at (i) to (iv) above are practicable or economically viable but subject to the following conditions—
 - (I) adequate measures will be taken to limit the overall nuisance or possibilities for endangering human health or causing environmental pollution, and
 - (II) no accelerants will be used when undertaking the disposal activity.

.....Name (block capitals)

Date

13.3 Farmer survey findings

This farmer survey was completed over the 20th, 21st and 22nd of September 2022 at the National Ploughing Championships at Ratheniska, Co. Laois.

| | | Total | % | |
|---|-----------------|--------------|------------|----------|
| 1.Are you happy to provide feedback? | Yes | 153 | 100 | % |
| | No | 0 | 0 | % |
| 2.Are you a farmer? | Yes | 153 | 100 | % |
| | No | 0 | 0 | % |
| 3.What province are you based in? | Ulster | 18 | 12 | % |
| | Munster | 48 | 31 | % |
| | Leinster | 57 | 37 | % |
| | Connacht | 30 | 20 | % |



| | | | | |
|---|----------------|-----------|-----------|----------|
| 4. What is your main farming enterprise? | Beef | 78 | 51 | % |
| | Dairy | 32 | 21 | % |
| | Tillage | 22 | 14 | % |
| | Sheep | 14 | 9 | % |
| | Other | 7 | 5 | % |

| | | | | |
|---|---------------|------------|-----------|----------|
| 5. What time of year do you normally cut hedges? | Autumn | 108 | 71 | % |
| | Winter | 30 | 20 | % |
| | Spring | 13 | 8 | % |
| | Never | 2 | 1 | % |

| | | | | |
|---|------------------------------|-----------|-----------|----------|
| 6. How often would you cut hedges or use machinery to clear scrub? | Annually | 93 | 61 | % |
| | Every 2-5 years | 52 | 34 | % |
| | Every 5 years or more | 7 | 5 | % |
| | Never | 1 | 1 | % |

| | | | | |
|--|---------------------------|------------|-----------|----------|
| 7. If so, what equipment have you used? | Flail | 120 | 78 | % |
| | Circular Saw | 3 | 2 | % |
| | Both | 23 | 15 | % |
| | Other | 6 | 4 | % |
| | N/A if never in Q6 | 1 | 1 | % |

| | | | | |
|--|---------------------------|------------|-----------|----------|
| 8. Do you use an agricultural/hedge cutting contractor or do you perform the task yourself? | Contractor | 118 | 77 | % |
| | Self | 34 | 22 | % |
| | N/A if never in Q6 | 1 | 1 | % |

| | | | | |
|--|---------------------------|------------|-----------|----------|
| 9. Do you burn cut agricultural green waste as a management practice? | Yes | 47 | 31 | % |
| | No | 105 | 69 | % |
| | N/A if never in Q6 | 1 | 1 | % |

| | | | | |
|--|-------------------------------|------------|-----------|----------|
| 10. What time of year do you burn cut material? | Autumn | 19 | 12 | % |
| | Winter | 11 | 7 | % |
| | Spring | 10 | 7 | % |
| | Summer | 7 | 5 | % |
| | N/A if No or N/A in Q9 | 106 | 69 | % |

| | | | | |
|---|-------------------------------|------------|-----------|----------|
| 11. Have you ever issue a notification to your local authority for the burning of cut green waste? | Yes | 15 | 32 | % |
| | No | 32 | 68 | % |
| | N/A if No or N/A in Q9 | 106 | | |

| | | | | |
|--|-----|-----|----|---|
| 12. Are you aware that the exemption on the burning of green waste is due to expire at the end of 2022? | Yes | 42 | 27 | % |
| | No | 111 | 73 | % |

| | | | | |
|---|-----|-----|----|---|
| 13. Have you ever considered other alternative uses for his cut material before resorting to burning of the waste? | Yes | 18 | 38 | % |
| | No | 29 | 62 | % |
| | N/A | 106 | | |

| | | | | |
|---|-------------------------|-----|----|---|
| 14. If yes, which of this might you have considered? | reduction | 5 | 28 | % |
| | reuse | 1 | 6 | % |
| | recycling | 4 | 22 | % |
| | use as fuel | 7 | 39 | % |
| | disposal | 1 | 6 | % |
| | N/A if No or N/A in Q13 | 135 | | |

| | | | | |
|---|------------------------|-----|----|---|
| 15. Have you ever used accelerants in the burning of agricultural cut green waste? | Yes | 19 | 40 | % |
| | No | 28 | 60 | % |
| | N/A if No or N/A to Q9 | 106 | | |

| | | | | |
|---|-----|-----|----|---|
| 16. Have you given any thought to what potential suitable alternatives to burning might be employed to deal with cut green waste material? | Yes | 29 | 19 | % |
| | No | 124 | 81 | % |

| | | | | |
|---|-----------------------------|-----|----|---|
| 17. Which would you see as being the most practical or viable alternative to burning of cut green agricultural waste? Please pick 2. | Animal bedding material | 27 | 18 | % |
| | Composting | 27 | 18 | % |
| | Mulch for landscaping | 19 | 12 | % |
| | Firewood for own use | 119 | 78 | % |
| | Energy (offsite energy use) | 9 | 6 | % |
| | Biochar production | 3 | 2 | % |
| | Natural decay of material | 91 | 59 | % |
| | None of the above | 9 | 6 | % |
| | Other (please specify) | 2 | 1 | % |

| |
|--|
| 18. Any other comments |
| Natural decay takes up space, Fire service asked if had approval, cost of mulching |
| Bedding - Green and wet, get more out of the straw |
| Burn it without notifying and will continue to do so |
| A chipper for 2 days is 1000 euros if grant for PTO chipper would buy one |
| Will burn it anyway, licenses or no license |
| Branch loggers should be used more |

| |
|---|
| Will continue to burn regardless of the ban |
| Low value high volume - cheapest way is to burn it |
| Dispose by burying |
| Alternatives are a way forward |
| Contractor - Burning is weather related and transporting it would be a pointless exercise |
| Burn when material is dry and weather is dry but not dry enough the fire will spread |
| A lot of people let it rot in the field |
| GLAS cut every 3 years |
| If needed to burn would burn regardless of law |
| Will burn anyway no notification issued |
| Should be TAMS grant for chippers, use as bedding if way of drying it |
| Never burn, if did have material would give it away |
| Burned in the past with no notification issued |
| Burning the easiest and most cheapest option |
| Other: Burn at night |
| Cut with flail no big volume arising |
| Educate contractors on the uses and alternatives |
| I will continue to burn even if no exemption |
| Currently shredding it and use it between trees as a habitat for biodiversity |
| Burn but do not notify |
| Burn with no notification, have the ashes as a fertiliser |
| Keep it cut every year and no problem arising |
| Burning without notification for years and never an issue |
| If I need to burn I will and do so without a notification |
| Grant for shears to cut and grants for contractors for chipping machines |
| Material arose from clearing land that was bought, issued notification to council and rang fire service |
| Burn but do not complete notification |
| Burn at night without issuing notification - never had issue |
| Grants for chippers, consider central collection |
| Ask Fire brigade for permission, no notification, only a once off |
| Wasn't aware of the burning ban coming |
| Publicity of ban has driven work, contractors need volume and grants, cost the farmer nothing |
| Any alternatives involve diesel and cost |
| Any alternative to burning need to be cheap and a practical solution |

13.4 Steering Committee details

This report was developed in conjunction with a steering committee mainly comprised of Department of Agriculture, Food and the Marine, Department of Environment, Climate and Communications and local authority officials.

13.5 Representative bodies, state and statutory authorities collated feedback

1. Are you aware that the exemption on the burning of agricultural green waste expires at the end of 2022?

- “We are aware of the exemption on the burning of green waste is to expire on 1st January 2023”

2. How much of an issue is this for your members / clients?

- “Removal of the exemption is a major concern for our members”
- “Burning is a cost-effective management practice for the disposal of agricultural green waste”
- “The practice of burning green waste is not a regular occurrence on farms”
- “Burning does not typically take place annually on farms, but rather when green waste is generated from land or hedgerow maintenance”
- “No practical cost neutral alternatives have been identified for the disposal of this waste”
- “The practicality and financial viability of alternatives must be fully considered”
- “The viability of some alternatives proposed may be localised and may not be viable at a national level”
- “The exemption must remain in place until viable alternatives have been identified”
- “Adequate lead in time must be provided to communicate alternatives to farmers, so they can alter management practices in light of new requirements”
- “Members are very concerned about what to do with this material if they cannot burn it”
- “It is a significant issue as many contractors who work for farmers often stack this green waste for burning after removal from hedgerows or areas of overgrown vegetation and the option of chipping this waste can be too expensive as an option for many of their farmer clients”

3. Have you ideas / suggestions and approaches to prevent the generation of this agricultural green waste?

- “The generation of some agricultural green waste is unavoidable”
- “The accumulation of large volumes of agricultural green waste could be reduced, through changes in management practices such as more regular maintenance of hedgerows and landscape management to avoid creating large volumes of waste”
- “Changes in the CAP 2023 to 2027 rules mean that farmers will be paid for areas designated as landscape features such as hedgerows, scrub etc. on their farm”
- “Under previous CAP programmes areas designated as landscape features were disallowed for core payment”

- “This change to CAP will change management practices on some farms and will reduce the volume of green waste produced”
 - “Burning is part of normal farming practice in the course of trimming and tidying up green woody waste around farms”
 - “Coppicing under the ACRES Scheme will give rise to more of this material”
 - “Nitrates Derogation only allows hedges to be cut in a 3 year rotation which results in greater volumes of material and now won't be able to be burn”
 - “Solve one problem to create another from air emissions to general emissions”
 - “We would suggest that where hedges are maintained annually in a timely way, the clippings are recycled directly into the hedgerow, and this reduces the amount of green waste produced on farms for more significant disposal after a lapse of a number of years between hedge management cycles”
 - “Across Europe, hedge growth is significantly lower in volume terms than in Ireland due to climate growth conditions”
 - “Green waste management contractors and their operators should be provided with training and certification to ensure that they provide the best hedge management practices incorporating biodiversity to create a management approach that minimises the annual growth patterns to reduce the scope for the production of large amounts of green waste in unmanaged hedgerows”
 - “Green waste management contractors should be supported for the purchase of specialist machines to allow for the recovery of green waste”
 - “Local Authorities who tender for this work, should enter discussions with Farm & Forestry Contractors to agree minimum work standards and payment rates for such work. Current tender rates are not viable or sustainable and are not supportive of improving standards of work, equipment or training”
- 4. Can you identify any alternative uses for this green waste?**
- “Alternative uses for green waste will very much depend on the volume of waste produced, the location, access to the area and end user markets (energy companies, composting etc.)”
 - “Most alternative options may only be viable for larger volumes of green waste”
 - “The cost and the additional environmental impact of transportation, chipping etc. for smaller volumes may make alternatives less viable and negate environmental benefits”
 - “An option is to have green waste mulched, chipped or processed into wood shavings for use in landscaping or animal bedding but this option would require

funding to support the establishment of necessary infrastructure including chipping equipment, drying areas, storage etc”

- “The number of farmers who would require chipping equipment on a regular basis and the volumes produced are unknown making it difficult to determine the viability for farmers or contractors to invest, as well as the financial viability of such a venture”
- “Any alternative to burning adds cost”
- “Land location, dry or wet fields, scale of equipment are all variables impacting the alternatives”
- “Biomass value low”
- “Cost of transport”
- “Mulching of the material is a cost”
- “Some farms are not accessible for large chipping machines”
- “Cost of chipping, who gathers it up, cost of hauling, compare it with the value”
- “Letting it decay to create a habitat might attract badgers”
- “Contractors doing the work need to be properly training in techniques and timings”
- “Alternative for bedding for animals”
- “Health and safety are a concern with chippers”
- “Tractor operated wood chipping machines can increase the bulk density of the load if a need to transport and reduce transport costs”
- “Contractors, who can provide seasonal machinery services to chip the green waste and transport it from field to a central point in an economical way during a seasonal period when much of their other farm related work has ceased”
- “Contractors can also provide green waste recovery services from green biomass waste that can be part of the biomass resource”
- “The support for the development of this type of green waste recovery service to be provided contractors will allow them to recover some seasonal winter working time for their expensive machines and skilled operators and support the maintenance of skilled employment in contractor businesses all of which are based in rural communities”
- “No issue with creating biodiversity habitat with chips – small animals and mammals welcome but badgers not”
- “Central collection – cost of diesel, lack of availability of labour and the volume of the material”
- “Cost and emissions factor”
- “Access and soil suitability and trafficability”

5. **What's required to assist farmers/landowners following removal of the burning exemption?**

- "Any alternative route(s) need to be practical and cost effectiveness is essential"
- "Any alternatives must be local and require short transportation distances"
- "Any alternative must be cost neutral to the farm business"
- "Until alternatives have been established the burning exemption of green agricultural waste must be extended"
- "When alternative routes have been identified, it is vital that a phased in approach to the exemption is adopted, to allow time to communicate with farmers on the new options to be developed, for farmers to change management practices to satisfy the requirements of these new alternatives and supports in place to cover any additional costs"
- "It is vital that an extension to the exemption is granted up until the 1st of January 2024 at a minimum"
- "This would provide time for the findings of this report to be analysed, practical and viable alternatives identified and supports put in place to cover any additional management costs associated with alternatives"
- "Subsidised scheme required to implement alternatives"
- "If left it in the corner of the field farmer cannot be penalised, not impact eligible land from the point of view nitrates regulations"
- "TAMS support for small chippers for farmers"
- "Burning not sustain long-term but need the alternatives to be cost neutral"
- "Short-term – no cost neutral alternative and not widely available so burning needs to continue temporarily"
- "Contractor's quality of service varies, some good and some bad, no common approach, different land types – training programme required"
- "Farmers will not be able to afford the additional costs associated with wood chipping, so some additional payments must be provided to the farmer, and these must be ring-fenced to support the additional costs for the Contractor providing this chipping and transport service, which is a power and fuel demanding service for the contractor as well as capital intensive in terms of purchase price and repairs and maintenance costs. Any payments to the farmers must be linked to invoices received for the service from approved and certified Contractors"

6. **What additional considerations or general feedback on this topic should be included in the report?**

- “It would appear that the main driver for the removal of the burning exemption is air quality”
- “The study should look at the costs associated with the development of alternative disposal method(s), processing and transporting waste to facilities, as well as the impact of these activities on air quality versus the potential benefits”
- “Based on the number of farmers applying to the Local Authority to notify them of burning it would appear that a relatively small number of farmers burn green waste on an annual basis”
- “It would be appreciated by farmers that in advance any changes to the exemption, that the Department of Environment, Climate and Communication (DECC) would show farmers the results of their monitoring programmes that show the link between the burning of green agricultural waste and air quality issues”
- “The data would be important to show that farmers are not being unfairly targeted”
- “Any proposed alternatives must be cost neutral to farmers”
- “If there are costs associated with the disposal of the green waste, supports must be available to farmers to cover these costs”
- “Dealing with an air emissions problem will mean that results in another emission in the use of diesel”
- “The important role of the Contractor must be included in this report, as they will provide the skilled machinery services for implementation of any of green waste alternatives”
- “Green waste must be collected, chipped and transported in the most cost-effective way, using tractors and trailers that are already available in contractors' fleets, reducing the need for additional financial support other than support for the purchase of wood chipping machines. There are over 20,000 tractors in contractor fleets and at least 10,000 modern silage trailers that can be used for green waste transport”
- “Using these machines during the off-season can result in greater efficiency and support additional full-time rural-based employment opportunities”
- “Where wood chipping machines are used by Farm & Forestry Contractors and are based on a truck body, and where these trucks by their function are single purpose machines, their owners should be entitled to use Marked Gas Oil as their propulsion fuel on the public road between jobs, in the same way that single purpose concrete pumping”
- “machines and vacuum excavator machines, all of which are truck-mounted are eligible to use this rebated fuel”

- “Irish Farm & Forestry Contractor are already providing hedge management services to many of these farms to a high standard. In order to ensure that standards are improved Farm & Forestry Contractors should be provided with training and certification to carry out this work to a standard that meets the highest bio-diversity objectives”

7. Please provide any other comment you may have?

- “Given the volume of green waste involved burning may be the best and most suitable management of green waste. This option – to keep the status quo - must be fully considered within the report”
- “The exemption should be maintained until suitable alternatives have been identified and developed at scale that provide practical and cost-neutral disposal alternatives for farmers”
- “Any changes must be introduced on a phased basis and dependent on alternatives disposals options being developed”
- “Banning burning is total madness without having any alternatives in place and is not dealing with reality”
- “Life cycle analysis needs to be completed”
- “Amount of effort and diesel – to get it loaded”
- “Transport net emissions from one process to the other”
- “Environmentalists want hedges to grow, thicker and higher and then wont us allow us to dispose of material arising for maintenance”
- “A Farm & Forestry Contractors training programme should be developed to certify hedge and green waste contractors”

13.6 Local Authority Director of Service for Environment collated feedback

1. Can you give us some insights and feedback regarding the notification process for the burning of agricultural green waste?

- “We receive 60 to 70 agricultural burning applications per year. Process here is that they fill out an application form with details including herd number requesting permission at least 72 hrs before they intend to burn”
- “It generally seems to work well, particularly by reducing unnecessary callouts of the Fire Service to such incident type”
- “Prior to a notification process to the 999 System, Fire Brigades would be mobilised to signs of smoke from controlled burning of agriculture green waste, thereby reducing levels of Fire cover while such false alarms had to be checked out”

- “There appears to be better safety management in place when a person goes through the notification process, resulting in very few calls for fire service assistance by the owners”
- “Overall, the process is streamlined. The Environment Section receives notification by e-mail or post, a copy is forwarded to the regional fire control centre and an acknowledgement is received from same. The applicant is advised that the go ahead has been given and is advised to follow the code of practice”
- “The administration of the notification system works well in the sense that it is not over onerous on both us and the public. However, we always feel that the process is only followed by the diligent and organised farmers (herd no required for permit). Many farmers and non-farmers ignore the system and we do not have the enforcement capability to follow up with them”
- “We always request a minimum of 2 days' notice prior to burning and the farmers are given a window of 3 days to burn. The process is-the farmer fills in the appropriate form specifying the dates and return it to the Environment Section. We call the farmer by phone to confirm permission to burn. We email the fire brigade with the appropriate information; the farmer must notify the regional fire brigade 30 minutes prior to burning”

2. Can you highlight any issue(s) or challenges that the burning of agricultural green waste has created?

- “We are not aware of any, however I doubt we would issue permission if they were concerns about forest fires, i.e. heatwave condition”
- “This practice leads to the burning of other waste (treated timber products) and non-organic material in conjunction with burning cut green waste”
- “Applicants may incorrectly use a single permit to burn on multiple occasions in lieu of applying for a new permit each time”
- “Air Pollution results from the burning of permitted material and from unauthorised burning”
- “No major issues, however, there is a high degree of trust involved”
- “It is not possible to carry out a physical inspection on each application, so you are trusting that the applicant is only burning agricultural wastes”
- “Resourcing and training issues have prevented us for carrying out site inspections”
- “We only take action if it was causing excessive smoke, risked getting out of control or was in a SAC/SPA”
- “We processed 212 Burn permits in 2022 as more and more farmers are using the system”

- “We do not charge for this service which we feel is very important”
 - “The risk of the burning of green waste getting out of control is now the real risk”
 - “We condition all applicants to contact the fire service on the day they are going to carry out the burning, and give some advice (place green waste/ wood in the middle of the field etc.)”
 - “If the Burning permit system was discontinued, the practice would persist but neither Env. or the fire service would be kept in the loop”
 - “We allow the burning to occur during the full 12 months. This should be re-considered, and we could prohibit the burning of wet wood or burning green waste during periods of high summer temperatures”
- 3. Have you ideas / suggestions and approaches to prevent the generation of this agricultural green waste?**
- “Maybe the new DAFM ACRES scheme which rewards farmers for biodiversity will encourage non forage areas to rewild”
 - “Burning of such wastes arising from agricultural activities may only be undertaken as a final measure following the application of the following waste hierarchy: Waste arisings are reduced in accordance with best agricultural practice. Waste is reused where practicable. Waste is recycled through shredding and used as compost or wood chippings”
 - “The local authority is cognisant of the fact that land management practices will always result in the production of a certain amounts of green wastes, however the little and often approach should be adopted i.e. regular annual maintenance as opposed to leaving it for a significant period”
 - “This green waste will always be generated. The question is how you deal with it. Annual maintenance of hedgerows. DAFM not to penalise farmers basic payments for areas of scrub or encroaching hedgerows this would help biodiversity”
- 4. Can you identify any alternative uses for this green waste?**
- “For large quantities maybe mulching on site – return to the soil. Biomass pellet facilities should they exist in the locality. Make ditches / hedges from some of the material in traditional hedge laying styles”
 - “Every county should have a full time operational, medium – large scale, composting facility where this agri material can be brought to and processed / mulched / composted, reused locally instead of being burned. Funding should be made available to LAs for this and the material could be directed here instead of whole scale burning”

- “Applicants of a permit could use the material as riverbank stabilisers, use as fences, Shredding/composting – reuse the compost to naturally fertilise poor soils, use as animal bedding, store for a period to reduce bulk, form natural biodiversity habitats for animal. This material could potentially be used to generate energy from the waste”
- “The local authority owns a Green Waste Facility which can accept green waste from farmers. Alternatively, the material could be shredded/chipped and used as an alternative bedding to straw/peat etc”
- “It could be possible for individual farmers to purchase shredder if included under the TAMS grant scheme”
- “Farmers are very sensitive to incurring additional costs. Any scheme or alternative solution must be cost neutral at worst”
- “Waste to energy facilities after being dried. Composting facilities, anaerobic digestion. Collection and transport of this needs to be considered”

5. Are there any opportunity regarding central collection points or days and processing options for this waste?

- “Don’t think the volume of green waste produced will justify collection, possible more emissions generated in the transportation than in the burning”
- “Our civic amenity sites are not for commercial use, if we looked at this, we would need to increase capacity of our Central Waste Management Facility to take green waste and convert to compost, then look at end uses for compost”
- “Individual collection days may not be suitable due to it requiring farmers having all works completed by the same day. It may not be suitable to have this material lying around fields or farmyards for extended periods of time. Also works would potentially be weather dependent so organising a suitable individual collection day may not be feasible”
- “Some Local Authorities operate their own Green Waste Facility which is opened year-round and accepts this type of material”
- “There is also scope for Local Authority operated Civic Amenity Sites to accept this material at skips which can then be transported onwards for further processing and recovery”
- “Many LA civic amenity sites already accept this material but additional advertising & education around this is needed”
- “The environmental impacts of transporting this material are likely to out-weigh the carbon neutral burning practises, an alternative would be a mobile shredding service – whereby green waste is shredded on site and remains with the landowner”

6. What's required to assist farmers/landowners following removal of the burning exemption?

- "Viable cost neutral alternative is required"
- "An alternative place to dispose of it – an incentive to do things differently and an FPN if burning continues"
- "Alternative processing of Agri waste will have to be looked at by the Agricultural Sector e.g. mobile mulchers/composting"
- "Composting may provide an alternative to chemical fertilisers as well as an environmentally friendly disposal method for green Agri waster. An incentive scheme for farmers to keep native hedgerows etc rather than having to remove them"
- "Clear concise information - farmers need to be informed of what the changes mean, what the consequences of non-compliance are and what are the alternatives, with the latter being the most important. Farmers must be provided with an alternative convenient outlet for this material"
- "Shredding and composting facilities to be supported on site"

7. What additional considerations or general feedback on this topic should be included in the report?

- "The emission generated in the collection and decomposition of the green waste needs to be less than the emission generated if the green waste was burnt. A cost benefit analysis in terms of emission generation needs to be undertaken"
- "93 applications for the burning of waste under the Agri Exemption were received in 2022 so this volume of waste will have to be disposed of by alternative means"
- "The report should look at the expected quantity of material likely to be produced and compare to existing infrastructure to determine if additional management capacity is required"
- "Ash dieback is going to be a major issue in years to come for both farmers and Local Authorities (from a road safety perspective) so a clear management plan needs to be considered"
- "Alternative uses for green waste on site need to be considered"

8. Please provide any other comment or recommendations you may have as an implementing authority.

- "Early notification of the expiration of the exemption to be provided to LA's so that we can raise awareness in advance that no permits will issue"
- "In 2022 the exemption was to expire but was extended post deadline. This should not be repeated"

- “A clear communications programme from a national level is required”
- “Suitable alternatives must be identified prior to the removal of the exemption - they must be suitable for farmers across the country. It is important to keep Local Authorities informed in this process”
- “Ceasing this exemption in the absence of an alternative will result in significant amounts of ‘illegal’ burning, any system to divert green waste from burning will require planning and infrastructure to be put in place, it is premature to remove this exemption prior to completion of an alternative option”
- The green waste should be recognised as being a valuable resource for biodiversity and we would encourage its retention on-farm”
- “Standing and fallen deadwood is an important habitat for invertebrates and fungi and the birds and mammals that feed on them”
- “Green waste generated should be left in situ to create wildlife habitats. It would be good to see that approach reflected in the presentation”
- Best practice should minimise flailing and that a flail cutter should only be used on soft growth of thorny species, and never on heavy woody growth: the resulting ragged ends are unsightly and invite disease. Smooth wood species such as willow, hazel and cherry are not well suited to flail cutting.
- There would appear to be a need for clearer guidance on hedgerow maintenance for farmers, including setting restrictions/ limitations for flailing hedgerows.
- “The Burren Life project is promoting the concept of farmers retaining a ‘Hare’s Corner’ on their land – an area intentionally left over for wildlife”
- “We should certainly support Teagasc etc in their ongoing efforts to promote best practise in hedgerow management and maintenance which could thereby reduce the need to dispose of significant volumes green waste generated from more ad hoc management approaches”

13.7 About the Irish Bioenergy Association (IrBEA)

The Irish Bioenergy Association (IrBEA) was founded in 1999. Its role is to promote the bioenergy industry and to develop this important sector on the island of Ireland. The diverse membership includes farmers and foresters, fuel suppliers, energy development companies, equipment manufacturers and suppliers, engineers, financiers and tax advisers, legal firms, consultants, planners, research organisations, local authorities, education, and advisory bodies – anyone with an interest in the bioenergy industry. IrBEA is recognised by the Government and agencies as the voice of the bioenergy industry.

The association's main objectives are to influence policy makers to promote the development of bioenergy, and to promote the interests of members. Improving public awareness, networking, and information-sharing, and liaising with similar interest groups are other key areas of work in promoting bioenergy as an environmentally, economically, and socially sustainable energy. IrBEA is affiliated to Renewable Energy Ireland (REI), Bioenergy Europe and the European Biogas Association (EBA). The organisation's activities are managed by the CEO assisted by a small executive staff team and is governed by a board of Directors which includes an elected President and Vice-President. Policy direction is provided by a Management Executive Committee and specific sub-committees.

IrBEA is leading, managing, and administering the DAFM European Innovation Partnership (EIP) Small Scale Biogas Demonstration Programme (SBDP). Other projects in progress include the Interreg NWE Three C project: Creating and sustaining Charcoal value chains to promote a Circular Carbon economy in NWE Europe, and the National Just Transition Fund - supported Midlands Bioenergy Development Project. IrBEA manages and administers the Wood Fuel Quality Assurance (WFQA) scheme, on behalf of the state, which certifies wood fuel suppliers on the island of Ireland.

Further information on the association is available at www.irbea.org

13.8 IrBEA Editorial Team

A multi-disciplinary team within IrBEA has authored this report.

Seán Finan – B.E. C.Eng MIEI - IrBEA CEO

Seán Finan has a broad ranging experience in engineering, management and agriculture. As CEO of IrBEA, is responsible for the day to day running of the Irish Bioenergy Association and manages the multi-disciplinary IrBEA executive staff team. He works with the board of directors to deliver the IrBEA strategy and corporate governance and legal requirements. His main role is to represent the members and organisation at various meeting, events and conferences and to raise awareness and knowledge of the sector through lobbying, advocacy and knowledge transfer, and build a sustainable energy future with bioenergy.

Noel Gavigan B.Agr.Sc - IrBEA Technical Executive

Noel Gavigan is has a background in agriculture, energy and sustainability and has worked with the Irish Bioenergy Association since 2010. Over the past 17 years he has managed multiple projects dedicated to the promotion and development of the bioenergy industry in Ireland. Principally this work has been done with IrBEA and funded through Intelligent Energy Europe, Horizon 2020, RX3, Department of Agriculture Food and the Marine and the SEAI.

Since 2010, he has managed the Wood Fuel Quality Assurance scheme on behalf of IrBEA, this involves education of wood fuel suppliers, promotion of wood fuels to potential domestic and commercial consumers, certification of wood fuel supply, and providing technical assistance and guidance to stakeholders. In addition, he has managed the projects Biomass Trade Centre II, Biogas3, H2AD and Small Farm Biogas Demonstration projects, along with multiple smaller projects dedicated to the technical advancement and promotion of bioenergy.

Noel Gavigan has many years' experience in agriculture, having worked with the Farm Relief Services, agricultural merchants and as a REPS planner. He is well-versed in agricultural practice and regularly works with and within the agricultural community.

Stephen McCormack B.Env Sc, Pg.Dip Environmental Sustainability - IrBEA Project Executive

Stephen McCormack has a background in energy, sustainability and environmental science, as part of the executive team at the Irish Bioenergy Association, I am responsible for the day-to-day delivery and implementation of transnational Interreg Northwest Europe funded

projects as well as acting in a support role for the association and the other projects and programmes. Project work to date has been focused on the conversion and utilisation of low value and residual biomass streams, for the provision of energy and value-added carbon products such as biochar and activated carbon. Through these transnational project consortiums, knowledge exchange features heavily, where examples of integrated biomass and carbon management systems are well developed. The areas of resource efficiency, the circular economy and the bioeconomy have also featured throughout. I am also tasked with seeking new opportunities for the association and its members as well as liaising with external stakeholders, both nationally and internationally.

Pádraic Ó hUiginn BA (Economics), LLB, Dip. PR, MPRII, PGC Sustainable Development - Project Executive

Pádraic Ó hUiginn has fifteen years' plus experience of policy and regulatory analysis, innovation and advisory. His experience includes working on Dept. of Agriculture, Food and the Marine (DAFM), SEAI and EPA Ireland-funded research in environmental policy integration and implementation, bioeconomy and the broader circular economy. In Bio-Éire (DAFM-funded), he was co-author on a report that identified bioeconomy policy and market barriers, together with quantification of potential materials and value-chains. Bio-Éire informed Ireland's first National Policy Statement on the Bioeconomy 2018, published by An Taoiseach. From being a key steering board member on European Union co-funded sustainability, bioeconomy, and circular economy projects, he brings rich insights into sustainability problem-solving. Over the past decade in particular, he has been a central connector and facilitator for innovation and knowledge transfer within the quadruple helix of industry/enterprise, government, academic research, and citizens/end users. Pádraic has also been a government policy and communications adviser in four government departments, including Environment.