

Exploring market opportunities for Short Rotation Forestry in the current Irish wood processing and solid biofuel sectors

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Abstract

Short Rotation Forestry (SRF) is expected to increase in Ireland in response to the increasing demand for fibre products and fuel for renewable energy targets. A survey was carried out of 30 companies in the energy, fibre and sawmills sectors to assess their perceptions on the suitability of SRF species as a raw material. Also data was gathered on current company production, scale, material requirements, species used, price paid and source of supply. The objective was to identify market opportunities, if any, for growers of SRF.

The raw material intake for interviewed companies ranged from 400 to 650,000 tonnes per annum and the price they paid at the mill gate for softwood roundwood varied from €34 to €108 per tonne, with price aligned with piece size but not quality. Most of the interviewees (76%) were not familiar with SRF, however 30% of companies were favourable towards using SRF material for wood fuel and for pallet manufacture. A further 34% were negative about the suitability of SRF as a raw material, with the other 36% expressing no opinion. Information gaps were identified in wood and fuel properties, drying rate and particularly the scale of supply that would become available. Views were mixed regarding forecasted gap between roundwood supply and demand, with sawmills reporting a shortage of sawlog. Instead, the wood energy sector indicated plentiful supply but insufficient market development, which may indicate renewable energy policy targets, will be missed without support measures.

Keywords: *Fast-growing plantations, market survey, wood fibre, wood energy.*

Introduction

Demand for wood products is expected to increase internationally. Forecasts show that demand for wood based products such as fibre boards, wood fuel and paper, supplied from fast growing plantations, will increase even faster than other wood products (Elias and Boucher 2014). The silvicultural practice of producing woody biomass from sustainable fast-growing plantations on agricultural land or suitable forest land on a reduced rotation length is known as Short Rotation Forestry (Christersson and Verma 2006). SRF management (e.g. tree density, fertilization, harvesting cycles, etc.) is less intensive than conventional agricultural crops or Short Rotation Coppice (SRC) but more intensive than conventional forestry, which means that SRF occupies a niche between the highly productive systems and conventional forestry (O'Reilly et

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al. 2014). SRF rotation length is usually between 8-20 years, longer than the two to five year cycle of SRC (Crops for Energy Ltd. 2015). SRF has advantages as single stemmed trees can be planted in areas unsuitable for SRC and all operations are performed using conventional forestry equipment whereas SRC requires specialised machinery (Biomass Energy Centre 2016).

A wide range of products are manufactured worldwide from SRF, although these fast growing plantations are mainly used to produce cellulose, energy and fibre boards (Elias and Boucher 2014). In recent years wood production from SRF has increased due to increasing environmental constraints on harvesting native forest (Sánchez Acosta, et al. 2008). Globally, eucalyptus (*Eucalyptus* spp.) are the most common species used for fast growing plantations and have the potential to help to meet world demand for wood (Laclau et al. 2013). Eucalyptus plantations, grown in a short rotation (10-16 year rotation), have been mainly used by the cellulose industry in the past decades in the Iberian Peninsula (Ruiz and López 2010). Other uses for eucalyptus, such as furniture, flooring, veneers and fibre boards, increased from local use to international markets since 2000 (Sepliarsky 2007). Poplar plantations in Italy, also grown in a short rotation (10-18 year rotation), have been traditionally used for plywood, pallets, crates and paper pulp (Coalao and Nervo 2011).

The current area of SRF in Ireland is very limited. Keary (2003) estimated that there were 80 ha of hybrid poplar plantations in Ireland and it is unlikely that this area increased as poplar was not an approved species under the Afforestation Grant Scheme until 2014. Coillte have established plantations of Eucalyptus species since 2008 on reforestation sites, particularly in the south and east, expanding on field trials laid down in 1993/94 (Thompson, et al. 2012). An unpublished survey of the Coillte inventory carried out in November 2014 by WIT indicated that there were 333 ha of eucalyptus on 53 sites, established over the previous six years.

The main wood industry sectors in Ireland are the panel boards mills and sawmills, with the wood energy sector emerging recently (IFFPA 2015). The panel board mills used a total of 1.38 million cubic metres of wood fibre (pulpwood, woodchips, sawdust and used wood) in 2014 and this is forecast to increase to 1.6 Mm³ by 2020 (COFORD 2015). In 2014, a total of 1.95 Mm³ of roundwood was used by the sawmills, including large sawlog or sawlog, mainly used for construction sawn timber and small sawlog, used for pallets, fencing, packaging and small dimension construction timber. All Irish roundwood was used indigenously and due to a shortfall, additional logs were imported from Scotland (IFFPA 2015). Also demand for wood biomass for energy is forecast to increase from 0.99 Mm³ in 2014 to more than 1.87 Mm³ in 2020 (COFORD 2015). This is to help to meet Ireland's renewable energy targets which are set to increase to 16% of total energy supply by 2020 (European Directive 2009). The percentage of renewable energy contributing to the Irish Gross Final Energy Consumption in

2013 was 7.8%, almost half of the 2020 target (Howley, et al. 2014). Across all forest industry sectors, COFORD (2015) predicted a gap of 0.9 Mm³ between supply and demand by 2020.

Irish forest policy is promoting SRF afforestation through targeted support measures to contribute to meet this forecasted supply-demand gap for fibre, energy and other wood products (COFORD 2015). A new grant premium category for Forestry for Fibre was included in the Irish Forestry Programme 2014-2020 (DAFM 2014). The planting target for fibre and energy within the programme is 3,300 ha by 2020. The species selected under this scheme are specific eucalyptus species (*E. glaucescens* Maid. and Blakeley, *E. gunnii* Hook. f., *E. nitens* Dean and Maid., *E. rodwayi* A.T. Baker and H.G. Sm. and *E. subcrenulata* Maid. and Blakeley), Italian alder (*Alnus cordata* (Loisel) Desf.), hybrid aspen (*Populus tremula* × *tremuloides*) and a list of specific clones of hybrid poplar (× *Populus* spp.) (ibid.). All the proposed species covered by the Forestry for Fibre grants are broadleaved species, capable of high productivity over a short rotation.

A market survey is “a research method for defining the market parameters of a business” (Entrepreneur 2016) and is used to investigate market development and marketing opportunities (Bryman and Bell 2003). The nature of market surveys is often qualitative and associated with emergent research design. Particularly when there is very little theory, structure or framework in the research area, an inductive qualitative approach is chosen (Burnard et al. 2008). Emergent research design uses the data collected to develop the structure of analysis. This means that the sample selection and size cannot be decided at the beginning as this will depend on the course of the research (Denscombe 2003).

Interviews are frequently used in qualitative research to secure a maximum number of responses, collect high quality information and to contextualise the responses and the relations between them. Interview studies usually involve thematic content analysis. This type of analysis is generally known as grounded theory (Denscombe 2003) and is based on identification of the main emergent themes from the qualitative data collected, by following these steps:

- a broad coding of the data into different categories or themes;
- identification of the main themes and relations, so categories are grouped or merged;
- these themes and groupings are then tested by further collected data;
- finally, more and less popular responses on various themes are identified and direct quotes from a wide range of participants are chosen to illustrate those themes (Burnard et al. 2008, Anderson 2010).

Market surveys have been carried out in the forestry sector to identify market development (Perkins et al. 2005, Mendell et al. 2007) and marketing of alternative

and not well-known timber species (Venn and Whittaker 2003, Nicholas and Garner 2007). Some studies have used NVivo (QSR International Pty Ltd., Australia), specialised software developed for qualitative data analysis and used in academia, government, business and social science research. In forestry, this tool has been used to analyse opinions of stakeholders and forest owners on emergent forest markets in recent years; for example in the forest biomass energy market (Silver et al. 2015) and the forest carbon market (Thompson and Hansen 2012).

Current Irish forest policy measures promote SRF as a means to bridge the predicted gap in wood biomass supply and demand. The success of this policy will depend in part on the readiness of the wood industry in Ireland to use SRF as a source of raw material. The objective of this study was to explore the Irish industry's perceptions and knowledge of SRF and identify if there are real market opportunities in Ireland for raw material that SRF growers could supply in the future.

The study, carried out in the form of a survey, aimed to investigate species suitability for particular market segments, price, material specifications (e.g. dimensions, certification, moisture content), market scale and infrastructure. This type of information is useful in order to study the economic sustainability of this land use, which is a key principle of sustainable forest management, as well as aid in determining return on investment to growers of SRF relative to other land uses.

Materials and methods

A survey was carried out on market opportunities for SRF of the Irish wood processing and solid biofuel sector between October and December 2015. The methodology used in this survey is summarised in Figure 1.

Approach

Qualitative analysis was used to collect the range of industry views concerning SRF as these perceptions could not be captured with an absolutely quantitative approach. Due to the novelty of SRF in Ireland an inductive qualitative approach was chosen. A thematic content analysis or grounded theory was used to analyse this qualitative data. In addition, some quantitative information was sought from the interviewed people (price, raw material amount and dimensions) and basic descriptive statistics were applied to the data.

Sampling frame: list of potential SRF users

The main sources used to develop the initial list of potential SRF users for energy were the catalogue of Irish wood fuel companies produced by the Irish Bioenergy Association (IrBEA 2013) and the SEAI List of Known Wood Fuel Suppliers (SEAI 2015), supplemented by work done by Mockler and Kent (2014).

Other potential users of SRF were identified by online search and in databases

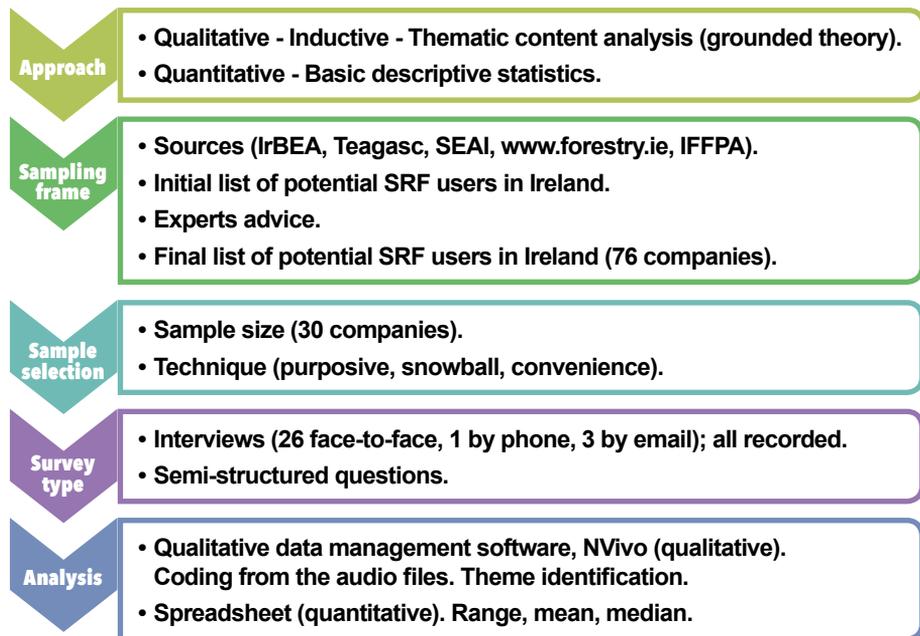


Figure 1: *Outline of the methodology used for the market survey.*

such as the contact list for timber buyers and contractors developed by Teagasc (2014) and the forestry directory (Forestry.ie). The annual overview of the Irish forestry and forest products sector produced by the Forestry and Forest Products Association (IFFPA 2013) was also used to identify companies.

The main survey focused on companies that use raw material from the forest. However, a number of secondary users were also interviewed to get a better insight into woodflow in the Irish market. Furthermore, some of the interviewees were not only users of raw material from the forest but also forest owners or harvesting companies. This broadened the scope of the survey and helped to get a more comprehensive understanding of the market.

After an initial list was finalised, the following experts on the Irish timber and wood fuel markets and fast growing species were contacted for advice on the survey scope and company contact list: Noel Gavigan, Irish Bioenergy Association; Eoin O’Driscoll and Gordon Knaggs, authors of the annual Woodflow in Ireland COFORD report; and Kevin J. Hutchinson, expert on eucalyptus (Thompson et al. 2012). On advice from the experts, the sawmill sector was included in the survey, in order to consider the possibility of using SRF for pallet and fencing material. This idea of looking for higher value products was supported by literature. Other countries first introduced SRF with the target of producing pulpwood for the cellulose and energy sectors and higher value markets developed later once SRF became established.

Experts also helped to identify companies that were no longer in business and to add missing companies to the list.

This final list was revised and updated again throughout the interview process as new companies were nominated by the interviewees (see sample selection). The final list was composed of a total of 76 companies, representative of the Irish energy, fibre and sawmills sectors.

Sample selection: technique and sample size

Purposive sampling, snowball sampling and convenience sampling were the techniques used to select the interview sample. The sample size and selection was decided throughout the interview process due to the emergent research design nature of the survey. Purposive sampling was used because it was planned to interview people from the different sectors among those who showed interest in being interviewed in a first phone call contact. Snowball sampling refers to some of the interviewees providing new contacts interested in participating in the survey. Convenience sampling was required because interviews were scheduled in order to meet several companies in the same region on the same day due to time and cost constraints.

From the total of 76 companies that were identified, 30 were successfully surveyed. More companies were first contacted (53) but some were excluded for different reasons:

- did not answer the phone after several calls in several days;
- were not interested in participating in the survey;
- were too busy and could not commit to an interview.

The 30 surveyed companies were selected to represent all the target sectors and different regions of Ireland (Figure 2). Through the survey process the main potential users of SRF were identified as the firewood, woodchip, panel boards, pallet and fencing sectors. Other potential users of SRF were also explored and interviewed: construction timber, specialised sawmills, bark and woodchip for landscaping, animal bedding, pellet producers and power plants.

The identified and interviewed companies were mapped, so a spatial distribution of the identified and sampled potential users is shown in Figure 2.

Survey type

Companies were surveyed by interview. Questions focused on perceptions and current knowledge on SRF as a potential raw material (e.g. What can you say about SRF? and about the new grants for forestry for fibre? Do you know of any SRF plantations? Would you consider using SRF material?), availability now and into the future of forest resource (e.g. do you think there is balance between supply and demand?), the

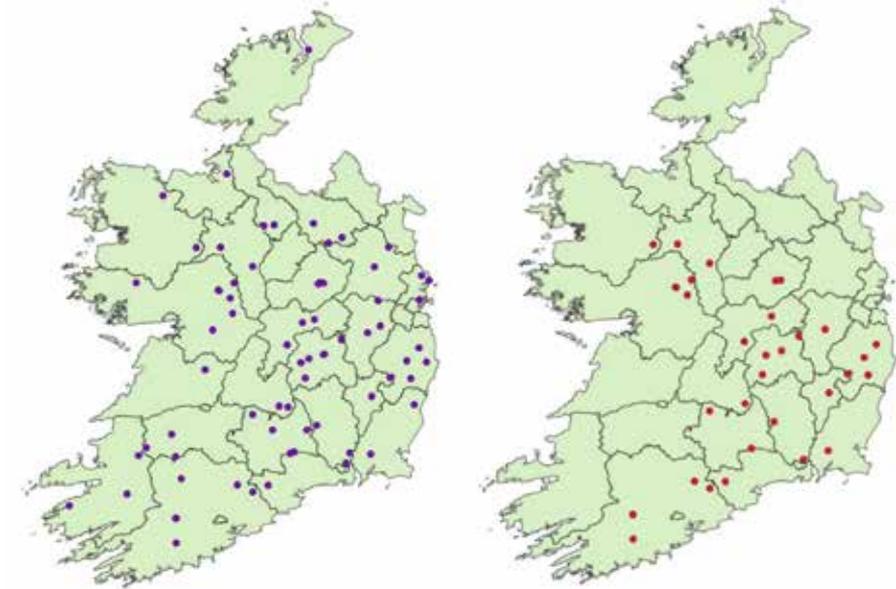


Figure 2: Left: Potential SRF user companies in Ireland. Right: Companies that were sampled (interviewed).

raw material used by the company (e.g. where do you source your raw material? How much do you pay for it? What are the maximum and minimum diameters and lengths you can use? Any other requirements?).

The interview was semi structured, in that, a clear list of questions was generated but there was flexibility to allow the interviewee to come up with related ideas and speak more broadly about the topic.

Most of the interviews, a total of 26, were face to face in order to get better quality information. However, three companies preferred to be interviewed by email and one by phone. The face to face interviews and interview by phone were recorded using the free, open source, cross-platform audio recorder software Audacity (found at: audacityteam.org). All the participants were asked for consent of recording before the interview and all accepted it. A unique identifier (company ID) was allocated to each company in order to keep the data anonymous. The average duration of the interviews was 40 minutes, ranging from 16 to 78 minutes.

Analysis

Survey responses were evaluated with NVivo, while a spreadsheet was used to compile the quantitative data. The method used for analysis of the qualitative data was grounded theory. This involved identifying themes and detailed examples of those themes, emerging from the data collected.

Results

The results from the interview analysis were described, including direct quotes from the interviews to illustrate the qualitative analysis and tables to report the quantitative analysis.

Business products

There was a tendency for some companies to be involved in more than one product or even sector. Table 1 shows that nine companies were involved in two products and four in three products. Some products were very seasonal so a complementary product was needed: “The main reason we went into the firewood was because the fencing was very quiet into the winter”. Also, companies sought to make the most of the material they bought, for instance sawmills often sold or used their own residues as wood fuel.

Perceptions of Short Rotation Forestry

Most of the participants (76%) were not familiar with SRF defined as single stem plantations, on 8-20 year rotations. Seven of the interviewees thought of short rotation coppice willow instead. “My vision of SRF is willow and for those crops to be successful you need good fertilizer”.

Just six out of the 30 interviewees were aware of the Forestry for Fibre afforestation grant scheme. In spite of the majority not being familiar with SRF terminology, 37% had experience using eucalyptus or poplar wood and a further 27% had heard of these species (total 64%). However, these participants confirmed that their current knowledge was limited. Forty percent of the participants were able to say something

Table 1: *Companies interviewed by sector and sub-sector.*

Market sector	Sub-sector	No. of companies interviewed	Company ID
Wood energy	Firewood	10	A, D, E, F,G, H, I, J, K, L,M
Wood energy	Woodchip	8	D, E, F, L, W, X, Y,Z
Wood energy	Power plant	2	S, AA
Wood energy	Pellet	2	B, DD
Fibre	Panel boards	2	BB, CC
Sawmill	Pallet	9	Saw: B, K, R, S, V Pre-cut ^a : M, N, O, P
Sawmill	Fencing	5	Saw: B, C, R, V Pre-cut: I
Sawmill	General	3	S, U, V
Sawmill	Cut to order	2	Q, T
Other fibre users	Horticultural landscape	2	A, Y
Other fibre users	Bark	1	A
Other fibre users	Animal bedding	1	N

^a Pre-cut: did not purchase roundwood.

about the wood properties of these species: “eucalyptus looks like softwood, it’s very pale...burns ok...poplar is too hard to dry”; “eucalyptus cracks...it is very difficult timber to deal with, very difficult to dry...but when you saw is beautiful, great pattern”; “poplar, eucalyptus...I wouldn’t say is very strong...”; “poplar doesn’t burn very well it gets black and people think firewood isn’t dry”.

Almost a third (30%) of the participants, all of whom knew or had experienced using SRF wood, would consider using this material. Most of them were from the wood energy sector (86% of that), while two small-medium size sawmills expressed interest in using SRF to produce pallet material. These two sawmills had less advanced technology so they stated that they could adapt easily to different species and volumes. However, all the larger sawmills were not favourable toward SRF. The main reasons appeared to be the large volume required in order to change the manufacturing process and make the production effective:

We just don’t have the volume in this country...if we were setting up the sawmill for hardwoods...it’s a completely different plant, it’s a completely different market and we don’t have the species on the ground, we don’t have the hectares planted...we could change the plant and there would not be material to run one day.

Within the wood energy sector, the firewood sub-sector and the power plants were the most positive. The woodchip sub-sector was less enthusiastic. It might be because they consider the purchase price would be too high as SRF species are hardwoods and the current prices for hardwoods are prohibitive for the woodchip suppliers: “...[we take] any softwood, preferably hardwoods, but you can’t buy hardwoods, it is too expensive...you can’t compete with the firewood.”

The fibre board mills were negative toward using SRF. There was a general perception among all sectors that SRF was just a crop for fuel: “These are crops for biomass production; they will not be suitable for sawn products.”

A set of concerns towards SRF were revealed in the interviews, around the perceived risk due to past experiences of unsuccessful new crops: “...be careful because miscanthus [*Miscanthus x giganteus*] was fantastic 10 years ago, now nobody wants it.”

Another concern of using alternative species was that customers complain about species different to Sitka spruce: “If I took in Douglas, it’s a better timber but the customer would complain, they just don’t know it’s a better timber, they just see a piece of timber of a different colour and they’ll say, oh, an issue, problem.”; “...because our customer’s requirements...we can’t afford to take the chance, we have to keep our quality up and to keep the quality up, we need spruce.”

Seven of the interviewees expressed the view that it would be better to plant more Sitka spruce (*Picea sitchensis* (Bong.) Carr.) in traditional rotations instead of SRF.

Although they admitted species diversification was needed, their point of view was that Sitka spruce was the best species to grow in Ireland:

Rather than growing short rotation crops for fibre or biomass, this land could be used for growing Sitka spruce on a 35-year rotation...the benefit is a strong saleable product, which has high demand, that can be put into years of service, as construction products, locking up carbon for potentially hundreds of years, before finally being available for fibre or biomass. We have a massive natural advantage to growing Sitka spruce in Ireland, the problem is, we are not growing enough of it!

There was also a repeated opinion of planting more Sitka spruce and using harvesting residues for energy instead of establishing energy crops as there was a perception of plenty of forest waste material available for energy:

I don't see the sense in SRF, I think we should be pushing forestry, planting trees and using the branches of the trees, and we are doing two jobs: we are supplying logs to sawmills and we are supplying energy rather than the energy crop just being energy...we grow very good Sitka spruce...

The perceived difficulty to convince land owners and industry to change species was another concern: "The industry that is in the country at the moment is based on Sitka spruce...if somebody is thinking of changing species they should put a lot of consideration into it."

Users who had experience using eucalyptus and poplar were mainly negative about their use due to problems with drying and sawing processes. Regarding eucalyptus, concerns about the bark were also identified:

Although the quick yield was great and the timber quality was good, we had huge problems with the bark of the tree. This created a lot of problems in our production process as it blocked chutes and conveyors and wrapped itself around pulleys which stopped conveyors.

In spite of this, they agreed SRF had potential once the appropriate management, drying and sawing techniques are clear.

Participants affirmed they would need more information about SRF in order to consider using it and highlighted the importance of clarifying uncertainties about SRF for market development to proceed. Interest was expressed in having more information on:

- financial return and market for SRF -13 interviewees.
- combustion properties such as calorific value, chemical composition and boiler reaction -nine interviewees.
- moisture content and how long it takes to dry -four interviewees.
- wood properties e.g. straightness -four interviewees.
- availability -four interviewees.

Raw material: quantity, suppliers, distance

The range of raw material intake by company was from 400 to 650,000 tonnes per annum with a median of 5,000 tonnes (Table 2).

Interviewed companies purchased raw material from a variety of sources: Coillte, forest management companies, sawmills and private forest owners. Just 20% of companies relied on one source only. Half of interviewed companies purchased material from two sources and 30% purchased from three sources. Coillte (the Irish semi-state forestry company) supplied raw material to 18 of the 30 companies, but only two companies relied solely on Coillte. Four companies purchased from sawmills only, but a further four companies bought from sawmills in addition to Coillte, forest management companies or private forest owners. Forest management companies entirely supplied six companies and partially supplied a further 14 companies. Only one company purchased all raw materials from private forest owners but another nine companies were partly supplied by private forest owners.

However, the amount of raw material sourced directly from private forest owners was very limited. Interviewees reported that they preferred dealing with forestry companies than directly with forest owners:

...it's hard to deal with farmers and get a good rate and then in

Table 2: Annual raw material intake and price paid relative to specification.

Sub-sector	Annual raw material intake (tonnes ^a)			Price paid relative to specification (€ per tonne softwood at mill gate)		
	Min	Max	Median	Min	Max	Mean
Firewood	170	5,500	1,852	34 (55 ^b)	42 (85 ^b)	40 (52 ^b)
Woodchip	600	50,000	9,012	34	42	39
Pallet and fencing	35,000	150,000	114,167	40	65	52
General sawmill	100,000	350,000	216,667	70	96	84
Bark	20,000	20,000	20,000	23	23	23
Cut to order	3,000	5,500	4,250	100	130 ^b	108
Power plant	500,000	500,000	500,000	-	-	-
Panel boards	500,000	650,000	575,000	-	-	-

^a Assumed conversion between cubic metres and tonnes was 1 m³ = 1 t.

^b Hardwood price.

the long run it nearly costs you more by the time you have the guys in and the licence got, it just takes too long so it's easier for someone else than for ourselves.

Furthermore, if interviewees dealt directly with forest owners, they had to organise the transport. They were also negative about buying from private forest owners due to the small properties, observing that a lot of work was required for a small amount of raw material.

They [private landowners] are very nervous and demanding... it's more work for me and if I am dealing with the landowner I might have 10 ha, and then that's a lot of work for 10 ha, if I am dealing with a forestry company is the same amount of work for maybe 200 ha.

Most of the interviewees sourced their raw material from anywhere in Ireland. Mainly sawmills imported some of the material because of the short supply in Ireland (Table 3). Some of the woodchip and firewood suppliers tried to only buy locally (50 km maximum) to save transport costs, but they were finding this difficult:

Normally within an hour of the yard, 40-50 km of where it has to be processed, it should be the maximum, it should be moving biomass, but the way it is happening at the moment, there is very few outlets for the product... the market at the moment for pulp is small, it is big for board mills but take the price...they use a lot of pulp from the South of the country going to the North at the moment, you talking about 150 miles...

Requirements of raw material: dimensions, species and others

The roundwood dimensions required by each sub-sector are summarised by Table 4, where the specifications include the minimum, maximum and median allowed dimensions. The most common assortments in Ireland are: saw log from the lower section of a stem, usually with a small end diameter down to 20 cm; small sawlog, from the stem mid-section, usually 20 cm large end diameter and down to 14 cm; pulp,

Table 3: *Source of raw material by distance and by sector.*

Sector	Anywhere in Ireland	Anywhere in Ireland and import	Locally (<50 km)
Wood energy	10	2	5
Sawmill	5	7	1
Fibre	2	0	0

Table 4: Roundwood assortment dimension requirements by sub-sector; values include the minimum and maximum allowed, with the median in brackets.

Sub-sector	Length (m)	Top diameter (cm)	Bottom diameter (cm)	Assortment
Firewood	1.8-6.7 (3.0)	5-25 (8)	20-100 (45.5)	Pulp
Woodchip	3.0-4.9 (3.0)	7-14 (9)	40-100 (62.5)	Residues & Pulp
Panel board	3.0-3.0 (3.0)	7-7 (7)	35-50 (42.5)	Pulp
Pallet	2.4-7.7 (3.1)	13-18 (14)	30-120 (40.0)	Small sawlog
Fencing	1.6-3.8 (3.0)	7-16 (13)	16-40 (23.0)	Pulp & small sawlog
General sawmill	2.5-7.3 (4.9)	14-16 (15)	35-150 (57.5)	Sawlog & small sawlog

from the stem top section, usually with a minimum diameter of 7 cm; and residues are the top, below 7 cm diameter and the branches.

Regarding species, the Irish wood industry is softwood based (58% of the participants use softwood only). The predominant, Sitka spruce, was the industries' preferred species (60 to 100% of the total raw material intake) because of availability, price and wood properties:

Alternative species are probably not there for us...now we get a bit lodgepole...is very bad timber species, it breaks when you are peeling...the product you are dealing with is still a low value product [round posts for fencing] so, if we are going to hardwood they [customers] wouldn't pay to do it.

Another 27% used mainly softwood but occasionally some hardwood. They also confirmed using mainly Sitka spruce. Other softwoods used were Norway spruce (*Picea abies* (L.) H. Karst.), larch (*Larix* spp.), Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) and lodgepole pine (*Pinus contorta* Dougl. ex Loud).

Just 15% of the companies, all from the firewood sector, use mainly hardwood: "The hardwood is much better: it burns twice as long but you pay more".

Hardwood species used were quoted as being: ash (*Fraxinus excelsior* L.), beech (*Fagus sylvatica* L.), oak (*Quercus robur* L. and *Q. petraea* (Mattuschka) Lieblein), alder (*Alnus glutinosa* (L.) Gaertn.) and birch (*Betula* spp.).

Another set of requirements emphasised were:

- straightness -10 interviewees;
- appearance (e.g. colour, smell) -six interviewees;
- moisture content and the time wood required for seasoning -five interviewees;
- cleanliness from branches -five interviewees;
- sufficient supply volume -four interviewees;
- combustion characteristics (calorific value, chemical composition, dry matter and ash) -three interviewees.

Purchase: price, point of purchase, units

The prices paid by the surveyed companies varied from €20 to €80 m⁻³ roadside (€34 to €96 m⁻³ at mill gate), with prices aligned with roundwood piece size but not quality. Companies reported prices in tonnes and cubic metres interchangeably. The cheapest raw material was bark (€23 m⁻³ “delivered-in”, i.e. at mill gate) and the most expensive was timber from old and large-sized hardwoods used in specialist mills that saw to order (€130 m⁻³ delivered). There was no data collected from power plants and panel boards due to confidentiality (Table 2).

Most prices were given as delivered-in (17 out of 23 responses). Some interviewees gave a haulage rate, averaging €15 t⁻¹ and ranging from €5 t⁻¹ to €30 t⁻¹, with prices aligned with distance (€30 per approximately 250 km). It was also common to buy roadside (six out of 23 responses), but standing sales were unusual (no responses).

Prices were mostly given in weight units (tonnes) by the private sector and in volume (cubic metres) by the state company. Furthermore, 30% of the interviewees did not use the metric system when describing dimensions. It was very common for lengths and diameters to be reported in feet and inches.

Balance of supply and demand: currently and in the future

Interviewees, by market sub-sector, had different perceptions on availability of and demand for raw material. Demand for woodchip and bark for horticulture was reported to be increasing, so more material was requested by this sector. The woodchip for energy sub-sector has the opposite opinion: demand for woodfuel had not developed in recent years, but the raw material supply is readily available and increasing:

Getting timber is fine, there is no problem with it, getting rid of it is the problem. It is fine for us because we have our customers already,...there is no order, there is no more development going on, the grants are gone which is a killer, ...we are waiting for, there is talks about bringing the tariff from England over to here.

The latter companies pointed out the necessity of grants, such as the Renewable Heat Incentive in the UK, to develop the woodfuel sector and they highlighted the price of oil as the key determinant for this sector’s future. Firewood participants viewed the supply-demand as being in balance at the moment. However, some of the sawmills expressed strongly that there was lack of timber in the country at the moment: “...now every sawmill in Ireland is fighting over the raw material. There is more capacity in this country than there are logs...”, while others thought there is balance between supply and demand at the moment.

There were different opinions between and within sectors regarding the availability of raw material in the coming years. Some of those surveyed thought there would be

enough wood resources: "...there will be, there was a lot planted 20 years ago...It's flying in, it's coming on." Others opined that there would be lack of supply as demand was going to increase: "If the business happens the way it is supposed to happen there will not be enough timber, there isn't enough planted".

Potential market for SRF in Ireland

A basic analysis of the survey results indicated that the thirty companies had a combined annual raw material requirement of 3,126,120 m³, or 98 % of the Irish total annual demand of 3.2 Mm³.

Of the surveyed wood energy companies and sawmills that confirmed that SRF material could potentially be used, the sawmills required 52,500 m³ of small sawlog, 3.1 m in length and 13-120 cm diameter, purchased at mill-gate on average at €52 m⁻³. The wood energy companies had a total annual requirement of 512,120 m³. However, this value was dominated by a single large power station and included approximately 50% imported non-woody biomass and an amount of indigenous biomass, such as miscanthus and forest residues, amounting to an estimated 300,000 m³. The remaining 212,120 m³ could be characterised as pulp logs, typically 3 m in length, 5-100 cm diameter, with an average mill-gate price of €40 m⁻³. In all cases except the large power station, these companies sourced material only within Ireland and two companies preferred exclusively local supply.

Discussion

Currently, the cellulose and veneer industries that use SRF wood internationally are absent from the forestry sector in Ireland. However, the current wood industry in Ireland (panel board mills, wood energy sector and perhaps the sawmills), have the potential to use SRF as these same sectors use short rotation species such as poplar and eucalyptus internationally. This survey confirms that SRF is considered an acceptable raw material by the majority of the wood energy sector and some sawmills. The international experience (Sepliarsky 2007) suggests that additional wood industry sectors will include SRF in their raw material mix as it becomes increasingly available.

While the negative views expressed towards SRF by some industry sectors may be partially attributed to an attachment to Sitka spruce, there were valid technical issues raised on the difficulties of sawing, drying and debarking of SRF species. The reason participants were not familiar with SRF might be partly due to a lack of awareness of this terminology (Silver et al. 2015). Within published literature, there are various definitions for SRF (Christersson and Verma 2006, McKay 2011) and such plantations are often treated simply as fast growing species harvested every 8-20 years. Confusingly, SRF is often applied by authors to short rotation coppice systems.

Although potential SRF users prefer local supply to reduce transport cost, most took material from anywhere in Ireland, so the location of SRF plantations should not

be limited to areas adjacent to particular end users. On the other hand, the transport cost and value of SRF will determine maximum viable distance to market. The SRF products identified as suitable by this survey are pulp and small sawlog, which are lower in value compared to large sawlog, so shorter haulage distances may be more economic.

These assortments are also smaller in average dimensions, indicating a smaller mean tree volume compared to current/traditional norms. This suggests short rotation length, higher tree stocking rates or a mix of both could be used to affect target tree volume. However, the tendency of wood-using companies to be involved in more than one sector will require SRF growers to ensure production suitability for diverse markets, rather than targeting a single end use. Furthermore, wood property requirements indicated by sawmills, such as straightness and small knot size, would need to be investigated in SRF wood.

A further point of concern for SRF growers was the clear preference potential SRF users expressed for purchasing raw material from Coillte and private forestry companies rather than small forest owners. This suggests that growers should organise themselves and join a producer group co-operative or sell through a forest management company.

There were diverse opinions about availability and demand of wood resources. While the sawmills agree with the forecast of a shortfall of resources (COFORD 2015), the wood energy sector and particularly the woodchip suppliers have the opposite opinion and state that demand would only increase with grant support. Ultimately, this represents industry feedback to policy makers that current energy policy has defined renewable energy targets for wood biomass, but has not put in place the supports to ensure that these targets are met.

As a shortfall of wood in Ireland was the main reason given by sawmills of importing sawlog, *even if* native material was preferred, SRF could be a real option if supply, quality and processing concerns were addressed. As also found in similar studies, availability of SRF and information on properties are prerequisites for market development (Nicholas and Garner 2007).

Regarding quantity of raw material intake, market expansion will depend on the larger potential users (Venn and Whittaker 2003). However this expansion is difficult as it incurs a significant risk (Perkins et al. 2005) and smaller wood energy companies may first establish the market. In that case, development of SRF may depend on grants for the establishment of firewood and woodchip boilers or fixed rate tariffs on energy prices.

This study had several limitations including the relatively small sample due to the qualitative approach and the heterogeneous data responses from market sectors, scale of production, measurement units for payment and species used. Results should be

interpreted with caution and more research in this field would be beneficial.

Companies interchangeably used prices in tonnes and cubic metres and these two different measurement units were perceived as being equivalent. This equivalence is only rarely accurate due to variations in basic density and in particular, moisture content. Currently, these companies pay depending on the raw material source: weight for the private forest sector and volume for Coillte. This interchangeable use of volume and weight units, in addition to using non-metric units to describe dimensions, promotes ambiguity and a lack of transparency in trade. Particularly, as raw material is being supplied increasingly from sources other than Coillte, there may be a need in the wood processing industry to articulate more precisely and consistently (as well as transparently) their raw material needs.

The survey captured a point sample of roundwood prices for the surveyed market sectors. These prices are indicative only, as there is no SRF material supply yet and wood prices vary throughout the year. However, these data do provide a reference of how much potential users of SRF are willing to pay, so set a ceiling on the price SRF material should meet to compete in the market. Knowledge of this price paying potential is a necessary input to evaluate the economic sustainability of SRF in Ireland.

Conclusions

Nine of the companies (30%) indicated that SRF material would be a suitable raw material and they had an annual roundwood requirement of 264,620 m³ each year. The wood energy sector was the most favourably disposed towards SRF and the other sectors agreed the main use of SRF would be for energy production. Two sawmills indicated that SRF could also be suitable for pallet manufacture.

Other companies had reservations against SRF, including preference for conventionally produced Sitka spruce, poor drying characteristics and other doubts about the wood properties of SRF species and the large volume required for the biggest companies in order to make the production effective. The technical capacity of these wood market sectors to use SRF in production should also be investigated.

Seventy percent of the interviewed companies identified a need for SRF research and education. Evidence of the potential production scale of SRF species in Ireland, in addition to information on wood properties and fuel parameters and suitability to different markets, is needed to inform potential users on the suitability of SRF for their market sector. Current research, under the SHORTFOR project, may provide some of the required information but further research, development and dissemination actions will be required.

As evidence of this, only 20% of the companies were aware of the Forestry for Fibre grant premium category described in the Afforestation Grant Scheme, supporting SRF afforestation. However, this study confirms there is a potential market

for SRF material grown under the scheme. The mixed views on a wood biomass supply and demand gap represent a challenge to policy makers. In particular, wood energy producers' insistence that there was raw material oversupply and insufficient market development for renewable energy from biomass suggests that policy targets on renewables may not be met without support measures to stimulate the investment in wood energy.

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References

- Anderson, C. 2010. Presenting and evaluating qualitative Research. *American Journal of Pharmaceutical Education* 74: 141–152.
- BiomassEnergyCentre. 2016 Short rotation energy crops. Available at http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,17369&_dad=portal&_schema=PORTAL [Accessed March 2016].
- Bryman, A. and Bell, E. 2003. *Business Research Methods*. Oxford University Press, USA.
- Burnard, P., Gill, P., Stewart, K., Treasure, E. and Chadwick, B. 2008. Analysing and presenting qualitative data. *British Dental Journal* 204: 429–432.
- Christersson, L. and Verma, K. 2006. Short-rotation forestry – a complement to “conventional” forestry. *Unasylva* 223: 24–39.
- Coaloe, D. and Nervo, G. 2011. Poplar wood production in Europe on account of market criticalities and agricultural, forestry and energy policy. In *Proceedings Tercer Congreso Internacional de Salicáceas en Argentina*, Neuquén, Argentina.
- COFORD. 2015. *Mobilising Ireland's Forest Resource*. Wood Mobilisation Group, COFORD. Dublin.
- Crops for Energy Ltd. 2015. *Crops for Energy*. Available at <http://www.crops4energy.co.uk/> [Accessed October, 2014].
- DAFM. 2014. *Forestry Programme 2014–2020: Ireland*. Forest Service, Department of Agriculture Food and the Marine. Dublin, Ireland.
- Denscombe, M. 2003. *The Good Research Guide: for Small Scale Social Projects*. Open University Press, p. 310.
- Elias, P. and Boucher, D. 2014. *Planting for the Future. How Demand for Wood Products Could Be Friendly to Tropical Forests*. Union of Concerned Scientists, Cambridge, MA, USA.

- Entrepreneur. 2016 Small Business Encyclopedia. Available at <https://www.entrepreneur.com/encyclopedia/market-surveys> [Accessed March 2016].
- European Directive 2009/28/EC. Council Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. OJ L 140/16. Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=en> [Accessed November 2016].
- Forestry.ie. *Forestry Directory and Portal*. Available at <http://www.forestry.ie/directory> [Accessed September, 2015].
- Howley, M., Holland, M. and Dineen, D. 2014. *Energy in Ireland. Key Statistics 2014*. Sustainable Energy Authority of Ireland.
- IFFPA. 2013. *An Overview of the Irish Forestry and Forest Products Sector 2013*. Irish Forestry and Forest Products Association. Dublin, Ireland.
- IFFPA. 2015. *An Overview of the Irish Forestry and Forest Products Sector 2015*. Irish Forestry and Forest Products Association. Dublin, Ireland.
- Irbea. 2013 *Catalogue of Irish Wood Fuel Companies*. Available at <http://www.irbea.ie/index.php/bmtc/147-2013-catalogue-of-wood-fuel-suppliers> [Accessed February 2016].
- Keary, K. 2003. Country report for Ireland. *First international Conference on the Future of Poplar Culture*. 13-15th September 2003, FAO Headquarters, Roma, Italy.
- Laclau, J.P., de Moraes Gonçalves, J.L. and Stape, J.L. 2013. Perspectives for the management of eucalypt plantations under biotic and abiotic stresses. *Forest Ecology and Management* 301: 1–5.
- McKay, H. 2011. Short rotation forestry: review of growth and environmental impacts. *Forest Research Monograph* 2: 1–211.
- Mendell, B., Morales, V., Bennadji, Z., Moreno, A. and Siry, J. 2007. Financing Uruguay's forestry sector: Survey and case study. *Journal of Forestry* 105: 125–130.
- Mockler, N. and Kent, T. 2014. Participation in a wood-fuel quality assurance scheme in Ireland. *Irish Forestry* 71: 63–75.
- Nicholas, I. and Garner, S. 2007. A survey of alternative species markets. *New Zealand Journal of Forestry* 52: 10.
- The reference should read:
- O'Reilly, C., Tobin, B. and Farrelly, N. 2014. Can short rotation forestry play a role in renewable energy demands? *Forestry and Energy Review* 4: 32-34. Available at <https://www.teagasc.ie/media/website/crops/forestry/research/Teagasc-shortfor-article-july-14.pdf> [Retrieved January 2016].
- Perkins, B., Smith, B. and Jackson, G. 2005. *Evaluating Markets for Small Diameter Timber: a Case Analysis in Northern Mississippi*. Center for Forest Products

- Marketing and Management. Department of Wood Science and Forest Products. Virginia Polytechnic Institute and State University.
- Phillips, H. 2011. *All-Ireland Roundwood Production Forecast 2011–2028*. COFORD, Dublin.
- Ruiz, F. and López, G. 2010. History of Eucalyptus, present situation and utilization. In *Proceedings Eucalyptus Species Management, History, Status and Trends in Ethiopia.*, Proceedings from the Congress held in Addis Ababa, Ethiopia, 15–17th September 2010.
- Sánchez Acosta, M., Mastrandrea, C. and Lima, J.T. 2008. Wood technologies and uses of Eucalyptus wood from fast grown plantations for solid products. In *Proceedings 51st International Convention of Society of Wood Science and Technology*, Concepción, Chile, 10–12th November 2008.
- SEAI. 2015. *SEAI -Wood Pellet Fuel Information*. Available at http://www.seai.ie/Grants/GreenerHomes/Wood_Pellet_Fuel_Information/ [Accessed February 2016].
- Sepliarsky, F. 2007. Desarrollo de nuevos mercados de madera sólida para Eucalyptus globulus. *Boletín del CIDEU* 3: 109–117.
- Silver, E.J., Leahy, J.E., Noblet, C.L. and Weiskittel, A.R. 2015. Maine woodland owner perceptions of long rotation woody biomass harvesting and bioenergy. *Biomass and Bioenergy* 76: 69–78.
- Teagasc. 2014. *Contact List for Timber Buyers and Contractors*. Available at <http://www.ifa.ie/wp-content/uploads/2013/10/Timber-Buyers-Contractors.pdf> [Retrieved September, 2015].
- Thompson, D., Hutchinson, K. and Berkery, B. 2012. Recent results of growing Eucalyptus in Ireland. *Irish Forestry* 69: 167–183.
- Thompson, D.W. and Hansen, E.N. 2012. Institutional pressures and an evolving forest carbon market. *Business Strategy and the Environment* 21: 351–369.
- Venn, T.J. and Whittaker, K. 2003. Potential specialty timber markets for hardwoods of western Queensland, Australia. *Small-scale Forest Economics, Management and Policy* 2: 377–395.