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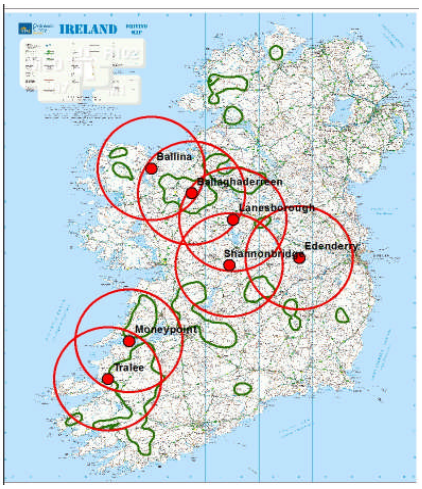
Supplychip - Facilitating the Supply of Energy Wood from Forest to Major Heat User



Key external stakeholders:

Commercial Energy Users
COFORD & Forest Service, Department of Agriculture, Food and the Marine
Teagasc Producer Groups
Forestry Companies
Forest Growers

Practical implications for stakeholders:

- A methodology has been developed to generate local supply forecasts for wood energy for local producer groups or for a potential end user or group of end users.
- Wood energy supply from farm forests show large potential to supply local scale and medium scale end users.
- The use of pulpwood material and other biomass residues from forestry can significantly increase supply to meet the energy requirements of a major heat user in the north west of Ireland who require c. 30,000 tonnes of biomass annually (e.g. Arivo milk processing plant in Ballaghaderreen).
- The results are capable of being replicated in each of the other 15 identified clusters and as such have all Ireland application.

Main results:

The potential supply of wood energy from 11,500 hectares of private forest plantations in the northwest was evaluated. When the supply is limited to 40% of the pulpwood fraction of roundwood, supply varies between 11,000 m^3 to 18,000 m^3 per annum enough material to supply local wood markets. Estimated supply increases to 25,000 m^3 by 2017 with the inclusion of tree tops enough to supply approximately 50% of the demand for a 12 MW boiler up to 2022. If all pulpwood is directed to energy wood then there is a significant increase in supply increasing to 32,000 m^3 in 2012 to reach a peak of 45,000m^3 in 2019. This is more than sufficient volume to meet the demand associated with a 12 MW steam boiler.

Opportunity / Benefit:

This research goes someway to identifying the potential of farm forests to meeting the Renewable Energy Directive (2009/28/EC) which has set ambitious targets for Ireland – that by 2020 at least 16% of all energy consumed is from renewables. The Supplychip project provides forecast estimates of energy wood assortment based on realistic output from farm forest representing 5% of the private forest resource nationally. It provides the likely breakdown by volume of wood energy assortments within an identified cluster area i.e. Ballaghaderreen, County Roscommon, that could be used by a range of potential end users as a source of raw material from which to utilise for heat production. Considering the range of competing markets for roundwood it is not unreasonable to assume that there may be enough material to a 15 MW boiler and CHP plant in Ballaghadereen in the(i.e. Arivo milk processing plant).

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External collaborators: Henry Phillips, Forestry Consultant

1. Project background:

The private sector now accounts for 47% of the total forest area with the majority of plantations being established within the past twenty years.

The Renewable Energy Directive (2009/28/EC) has set ambitious targets for Ireland – that by 2020 at least 16% of all energy consumed is from renewables. The All-Ireland Roundwood Demand Forecast 2011 - 2020 (COFORD Roundwood Demand Group 2011) estimates that the annual demand for roundwood will increase to 6.04 million m^3 by 2020, including an estimated demand of 3.08 million m^3 for wood biomass for energy purposes leaving a shortfall in supply of circa 1 million m^3 by 2020 and almost all of this in the forest-based biomass category.

Against this background of increasingly demanding national targets for renewable energy, increasing demand for wood fibre and a relatively flat roundwood forecast from state owned forests, any increase in future supply is dependent on privately owned forests. Future forecasts if they are to meet the needs of industry must provide detailed estimates of wood energy and catchment based potential supply volumes bearing in mind the issues of accessibility and site productivity.

2. Questions addressed by the project:

The Supplychip project is timely in that it not only provides forecast estimates of energy wood assortment but also addresses the deficiencies associated with previous private sector forecasts as for example access and the basis for estimation productive capacity (yield class). The project addresses the following:

- **a)** It quantifies the likely breakdown by volume of wood energy assortments within an identified cluster area i.e. Ballaghaderreen, County Roscommon;
- **b)** It examines the roading infrastructure - national, county and within forest networks that will facilitate harvesting; and
- **c)** It provides a wood energy flow to potential users (co-fired power plants, CHP plants and industry) through the ranking of plantations based on roading infrastructure, wood energy potential and haulage distance to end users.

The SupplyChip project utilises the Ballaghaderreen cluster (3,276 private plantations with circa 11,500 ha) and expands on the data already collected but in particular on accessibility and the basis for determining the future management regime of the forest areas.

3. The experimental studies:

Extensive spatial analysis and quality control procedures were used to develop a spatial forecast dataset including aerial photography analysis to visually assess the forest and its attributes in the Geographic Information System (GIS). For each of the 3,276 stands mapped these were assessed for accessibility using aerial photos and road maps and classified as being either (a) not adjacent, (b) adjacent, (c) within 50m of a third class road or (d) within 50m of a fourth class road. Based on this, 88% of the study area was classified as being reasonably accessible to the public road network i.e. within 50m of a third or fourth class road, with the remaining 12% were classed as inaccessible. Yield class for Sitka spruce was calculated using the *Forecast Model* described by Farrelly *et al*., (2011) (soil, parent material, fertility class and wind speed).

In order to evaluate the potential of each forest stand as a source of thinnings for wood energy, a decision tree based on area, public road access and ground conditions was developed and the suitability of each site for thinning was evaluated using specific criteria under these headings and a thinning and rotation regime

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classification then applied to each stand (Figure 1).

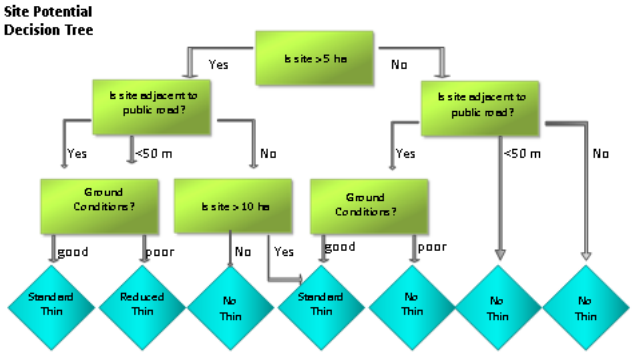

Figure 1: Forest Management Regime Decision Tree

The classifications used were (a) standard thin, (b) reduced thin and (c) no thin. Standard rotation lengths were determined based on the findings from a previous economic analysis (Phillips, 2008) with the price data updated. A series of forecasting rules and assumptions based on the appended spatial data, the aerial photography analysis and the Forest Management Regime, together with volume assortments were used to derive a forecast of production from forests. Four possible wood energy supply scenarios were assessed and recognise that energy wood has to compete with existing markets for raw material supply.

a) Scenario **S1**: 40% of the 7-13cm assortment goes to wood energy;
b) Scenario **S2**: 40% of the 7-13cm and all tree tops (tip -6cm) go to wood energy;
c) Scenario **S3**: 100% of the 7-13cm and all tree tops go to wood energy; and
d) Scenario **S4**: 100% of all size assortments go to wood energy.

4. Main results:

Under scenario S1, wood energy potential is forecast to increase from 11,000 m^3 in the first year of the forecast to reach a maximum of 18,000 m^3 per annum in 2017, then decline gradually to 14,200 m^3 in 2021 and thereafter to decline more rapidly to 5,100 m^3 in 2030. Under scenario S2, the inclusion of additional material from the tree top assortment increases the estimated forecast wood energy supply to 25,000 m^3 by 2017. Thereafter the forecast supply follows a similar pattern to scenario S1, decreasing gradually to 15,000 m^3 in 2023 followed by a more rapid decrease to 8,000 m^3 by 2030.

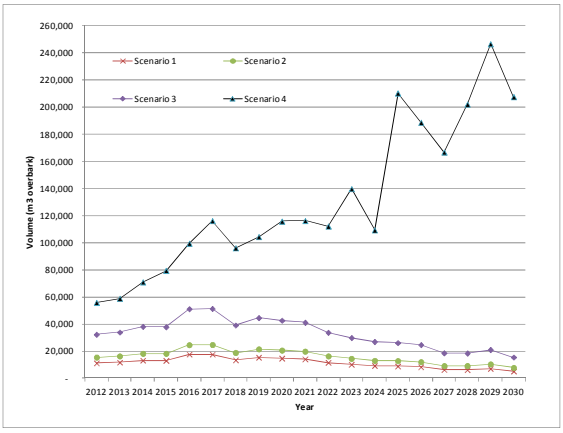

Figure 2: Wood Energy Supply Scenarios

Under scenario S3 which assumes that 100% of the small roundwood and tree tip assortments will go to energy wood, there is a significant increase in the forecast energy wood volumes over the period of the forecast. The forecast supply increases from a starting value of 32,000 m^3 in 2012 to reach a peak of 45,000m^3 in 2019. Thereafter forecast supply decreases gradually to 30,000 m^3 by 2023 and then more rapidly to 16,500m^3 by 2030.

Under scenario S4, which assumes that all harvested wood volumes goes to energy wood, the forecast

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supply increases steadily with some fluctuations from an initial volume of 56,000 m^3 in 2012 to reach a peak of 247,000 m^3 in 2029 followed by a decline to 208,000 m^3 in the final year of the forecast. There are a number of peaks and troughs in the forecast supply, reflecting significant clearfell areas and the age class distribution of plantations within the cluster area.

5. Opportunity/Benefit:

Table 1 show the potential end users and demand levels. Under scenario S1, local wood markets, have the most potential. Under scenario S2, approximately 50% of the demand for a 12 MW boiler could be met up to 2022. Under scenario S3, there is more than sufficient volume to meet the demand associated with a 12 MW steam boiler. In terms of wood flows/potential supply to larger co-firing facilities (e.g., Lanesborough), then the only scenario that offers any sort of scale of supply is S4 where all of the harvested material goes to energy wood. This is perhaps somewhat unrealistic

Table 1: Scenario Analysis - Potential End Users and Demand Levels

User	Potential Users	Demand	Likely Scenario	Comments
Local Level	Town based facilities (nursing homes, etc.)	<20,000 m^3	S1	Sufficient available wood energy under scenario for 10 -20 local facilities
Medium scale	Ballaghaderreen (12 MW steam boiler)	35,000-40,000 m^3	S3	Only scenario 3 offers a realistic supply, likely will have to rely on additional sawmill residues with scenario 2
Industrial scale	Lanesborough (co-firing)	100,000 m^3	S4 S1-3 with increase of catchment area to 40,000 ha	Only scenario 4 offers a realistic supply, would have to rely on additional volume assortments or increase catchment area.

6. Dissemination:

Main publications:

Farrelly, N., Fitzgearld, J., and Phillips, H. 2013. Supplychip: Facilitating the supply of Energy Wood from Forest to major heat user. Teagasc, Crops, Environment and landuse programme, Athenry, Co. Galway. ISBN 978-1-84170-602-3. 21 pp.

Popular publications:

Farrelly, N., Fitzgearld, J. 2012. Wood Energy potential from farm forestry. TResearch Vol. 7. No. 3. Autum 2012. 24-25.

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