
*Review of the science relevant to the
sustainable use of native and plantation
forest-harvesting residues for energy
production in Tasmania*

Client: Forestry Tasmania, National Power,
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Executive Summary

This report reviews the science relevant to the sustainable use of residues from Tasmania's wet eucalypt forests for energy production. Extraction of fuelwood is a new activity in these forests, and as a consequence there are uncertainties associated with the economic supply of fuel, the nature and intensity of harvest on particular logging units, and the impacts of the operation on a range of environmental values. The fuelwood resource is highly spatially variable as a result of prior fire and logging history, and will vary over time because of changing cutting patterns and rates of conversion of native forest to plantations.

Existing planning procedures seem adequate for the broad assessment of the availability of fuelwood during the initial years of major new projects such as the Southwood power plant. However, there is a need to strengthen the planning system to provide better estimates of the nature of fuelwood on individual harvest units, and for predicting the distribution of coarse woody debris (CWD) habitat across the total forest estate.

Harvest of fuelwood has the potential to limit the successful regeneration and early growth of eucalypts because of increased soil physical disturbance, and lower fire intensities resulting from fuel removal. We believe that both of these potential risk factors can be adequately managed.

Provided that harvesting operations are carefully controlled to minimise topsoil disturbance, and that regeneration is achieved rapidly, then site productivity and the diversity of vascular plants can be maintained. Retention of undisturbed 'islands' to protect habitat within logging units, and return of ash to forest sites will help mitigate the impacts of fuelwood harvest.

The continuity of CWD habitat is interrupted by the clearfall, burn and sow (CBS) silvicultural system, and harvest of fuelwood may exacerbate the problem. An interim, 'precautionary', approach to management of CWD is proposed that involves:

- In the short-term, development of management guidelines for some CWD retention and its creation into the future. These should focus on the logging-unit scale, and the larger (>1m diameter) components of both existing CWD and defective green bolewood.
- In the medium-term, development of estimates of temporal and spatial change in CWD that can guide the management of CWD spatially in the landscape.

Consideration should be given to making the Forest Practices Board responsible for the review and approval of plans for CWD management at landscape scales.

The effect of fuelwood harvest on the greenhouse gas balance of all harvesting scenarios examined was highly positive, and was dominated by the offset of fossil fuel emissions during the generation of electricity. There is likely to be only a small difference in the C stock in the forest as a result of fuelwood harvest over a 80-100 year forest rotation. Harvesting of fuelwood may also lower emissions of non-CO₂ greenhouse gases.

Synthesis and Recommendations

This report reviews the science relevant to the sustainable use of residues from Tasmania's wet eucalypt forests for fuelwood. Eight key issues were identified, and these were analyzed in terms of:

- importance for sustainable forest management
- state of knowledge
- current approaches to managing the issue
- options for addressing perceived deficiencies, and
- recommendations for improved forest planning and management.

The review, whilst focusing on issues generic to the wet eucalypt forests, does also include a detailed greenhouse gas (GHG) analysis using the Southwood project as a case study. Temporal change in forest C stocks is modeled following harvest of 'mature' forest, 90 year-old regrowth, and eucalypt plantation forests.

Harvesting of fuelwood is a new activity in Tasmania's wet eucalypt forest, and as a consequence there are uncertainties associated with the economic supply of fuel, the nature and intensity of harvest on particular coupes, and the impacts of removal on environmental values. The fuelwood resource is highly variable spatially as a result of previous site history, and temporally because of changing cutting patterns and conversion of native forests to plantations. In particular, the impacts of residue removal on biodiversity at both the logging-unit (coupe) and landscape scale are poorly understood. The continuity of coarse woody debris (CWD) habitat is interrupted by the clearfall, burn and sow (CBS) silvicultural system, and harvest of fuelwood may exacerbate the problem. There are several options for mitigating the effects of fuelwood harvest on CWD habitat that are discussed in the report, and summarised in the set of recommendations that follow.

Whilst existing planning procedures seem adequate for broad assessment of the availability of fuelwood during the initial years of major new projects such as the Southwood power plant, the planning system needs to be strengthened to provide better estimates of the nature of fuelwood on individual harvest-units, and for modelling CWD habitat across the total forest estate (**Recommendations 1 and 2**).

Harvest of fuelwood has the potential to create two sets of conditions that could limit the successful regeneration and early growth of eucalypts: greater soil physical damage as a result of increased harvesting traffic, and lower fire intensities because of fuel removal. We believe that both of these potential risk factors can be adequately managed. Review of the success of eucalypt regeneration following very heavy pulpwood harvesting in the 1980s, and further development of visual techniques for monitoring soil disturbance, are suggested as ways of managing these risks (**Recommendations 3 and 4**).

Intensified harvest of biomass can lower soil fertility, and where topsoil is severely disturbed can prevent regeneration of understorey plants from rootstocks. We conclude that provided operations are carefully controlled to minimize topsoil disturbance, and that regeneration is achieved rapidly, then site productivity and the diversity of vascular plants can be maintained **(Recommendations 5, 8)**. Consideration should also be given to further evaluation of the value of undisturbed 'islands' for protecting habitat within logged areas, and of returning ash to forest sites to help maintain soil fertility **(Recommendations 6, 9, 7)**.

Since harvesting operations will regenerate much more (~30-70%) residue than is required to supply the Southwood power plant, there are options to vary both the nature (quantity and composition) of fuelwood harvest, and the location of harvested areas in the landscape. We propose a dual approach to the management of CWD over time:

1. In the short-term, development of management guidelines for CWD retention and for creation of CWD into the future, that are mainly applied at the logging-unit scale **(Recommendations 12 and 13)**.
2. In the medium-term, development of simple models that estimate temporal change in CWD habitat over the entire (production and conservation) wet forest estate. These should be used to help guide the management of CWD spatially in the landscape **(Recommendation 11)**.

These interim approaches suggested for the management of CWD could be seen as 'precautionary' until a more solid scientific base is established. Emphasis should be given to retention of the larger (> 1m diameter) components of both existing CWD and defective green bolewood, because these will be more long-lived and will be in short supply under CBS silviculture and 100-year forest harvest cycles.

Consideration should be given to making the Forest Practices Board responsible for the review and approval of plans for CWD management at landscape scales. **(Recommendation 14)**.

Several high priority research topics relating to CWD have been identified; the most important relate to the rates of decay of existing CWD and large components of logging slash, and to the dispersal capacities of representative log-dependent biota.

The overall GHG balance of the several managed forest systems examined is highly positive and is dominated by the saving due to the offset of fossil fuel emissions during generation of electricity. There is likely to be only a small difference in the carbon stock in the forest as a result of fuelwood harvest using a framework of a 80-100 year forest rotation. This is due to a slight reduction in the C stock in coarse woody residues and soil C. However, conversion of mature forest to regrowth forest managed on a 100-year rotation, results in significant loss of the forest C stock (~200t C/ha), mainly because trees in regrowth forests are prevented from reaching the size of trees in mature forests.

Harvesting of fuelwood may also result in reduced emissions of non-CO₂ GHGs, because combustion in the power plant is often cleaner than the incomplete combustion in forest fires that can lead to release of significant amounts of methane. Further research is proposed to clarify this issue **(Recommendation 15)**.

Some other important R&D needs are summarised at the end of the Report.

Recommendations

Planning

Recommendation 1. *Procedures should be developed within 3 years of the commencement of fuelwood harvesting to provide adequate estimates of the availability and characteristics of energy-wood at the coupe level to support resource planning and management of CWD stocks.*

Recommendation 2. *Procedures should be developed within 3 years of the commencement of fuelwood harvesting for modelling the CWD resources in both harvested and reserved forests for time periods exceeding at least one rotation. These findings must be incorporated in assessments of harvest schedules to establish that required long-term CWD habitat is recruited and maintained. (See also Recommendations 11 and 14).*

Protecting Soil Physical Properties and Water Values

Recommendation 3. *Further development of the visual assessment methods proposed by Pennington and Laffan (2001) for monitoring the effects of harvesting intensity on soil disturbance should be undertaken. The method requires calibration of visual ratings to important soil physical change for major soil types and harvesting systems.*

Regeneration of Eucalypts

Recommendation 4. *Regeneration success on areas subjected to very high pulpwood removals in the 1980s be reviewed and used as a guide to the possible effects of proposed harvest of fuelwood on regeneration. Further, regeneration success be carefully monitored or areas subjected to harvest of fuelwood, especially those areas where harvest is most intensive, so that measures can be quickly taken to remedy any problems that may arise.*

Nutrient Cycling and Forest Growth

Recommendation 5. *Existing guidelines should be further developed to ensure that, in general, and particularly on the most intensively-harvested coupes:*

Wood extraction continues to be planned so that soil disturbance is limited and soil organic matter is maintained over most of the coupe;

Regeneration is rapid and optimal so that nutrient cycling processes are rapidly re-established;

Nitrogen-fixing species (e.g. wattles) are established early in the regenerating forest.

Recommendation 6. *Research at the Warra LTER site should be continued so as to provide an assessment of the value, through the maintenance of organic matter, of leaving undisturbed patches in coupes harvested for energy-wood. This recommendation is in consort with Recommendations 9 and 14.*

Recommendation 7. *Practical and safe procedures be explored and developed for returning ash to forest sites.*

Biodiversity of Vascular Plants

Recommendation 8. *Extraction techniques should continue to be planned so that topsoil is maintained intact wherever possible, thereby ensuring that regeneration of understorey species both from seed and from root-stocks is maximized.*

Recommendation 9. *The value of undisturbed patches that maintain some proportion of a coupe in a relatively undisturbed state, for maintaining plant diversity should continue to be evaluated. This Recommendation is in consort with Recommendations 6 and 14.*

Recommendation 10. *Studies of change in plant species composition and frequency after current and proposed logging regimes should continue.*

Role of CWD in the Conservation of Biodiversity

Recommendation 11. *The dynamics of CWD be modelled at the landscape level to establish how the stock and size structure vary over time across forest types, productivity classes and geographical locations. This information should be used to reduce or avoid fuelwood*

harvest, and/or increase rotation length beyond 80-100 years, in selected areas so as to create zones (nodes) of forest rich in large diameter CWD that are linked throughout the harvested forest.

Recommendation 12. *Guidelines for retention of CWD be developed that give priority to large (> 1m diameter) decayed logs (existing habitat) and defective green sections of harvested trees (which during decay will create a new suite of habitat). The guidelines should specify a minimum quantity (volume/ha) for retention that could be varied according to characteristics (e.g. landscape position) of the harvest unit. Where sufficient material of >1m diameter exists, the harvest of other fuelwood could be high. Coupes to be converted to plantations should be subjected to intensive fuelwood harvest.*

Recommendation 13. *Silvicultural techniques be further developed for aggregated habitat retention on logging coupes.*

Recommendation 14. *The Forest Practices Board consider developing guidelines for planning the management of CWD at landscape scales, and a role in the review and approval of such plans.*

Greenhouse Gas Balances

Recommendation 15. *The use of fuelwood is likely to have considerable greenhouse benefits. However, because of the large contribution of non-CO₂ greenhouse gases to total greenhouse gas balances, further research to better quantify non-CO₂ emissions under a range of field burning conditions is warranted.*