3.4 Social housing in Curitiba, Paraná State, Brazil

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Introduction
Worldwide, the construction sector makes a huge contribution to greenhouse gas (GHG) emissions. The Brazilian government recently launched the *Minha Casa, Minha Vida* (My Home, My Life) program to support one million low-income families in buying their first house. All the houses will be built using iron and cement, which significantly increases this sector's contribution to a negative balance in national emissions.

This article argues that social housing built of wood is well suited and as safe, or safer, as houses built of other materials. In fact, using wood helps in the fight against global warming. The use of sustainably harvested wood in construction results in several benefits to society, economy and environment.

Deforestation and land-use change from forests to pasture, agriculture or human settlement release large amounts of stocked carbon. Using wood from sustainable sources helps to avoid these modifications of rural activities and to support market incentives for cultivating forestry carbon. Furthermore, increasing society's consumption of wood products results in larger stocks of carbon being transferred, which allows new trees to sequester even more carbon. Consumption of wood products is the fuel that enables the forest industry to keep cleaning the air.

Wood and mitigation
Global climate change is a natural phenomenon that is accelerated by human actions that generate GHGs. Levels of GHGs, especially CO₂, are increasing. Because of this human influence, the United Nations Framework Convention on Climate Change (UNFCCC) has created mechanisms for emissions compensation around the globe, resulting in today's Kyoto Protocol and voluntary markets. The construction and forestry sectors have signifi-

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carent advantages in contributing to reducing emissions by 2030: the construction sector creates 30–40 percent of all global emissions, and the forest sector could respond quickly to an increase in Certified Emissions Reductions (CERs) prices. Together they can be a major part of reducing the acceleration in global climate change.

Building wood-frame houses instead of traditional cement/iron structures creates several positive impacts:

- Trees sequester carbon while they are growing and harbour it for a period of time, depending on the end use. Used in construction, the carbon may remain stored in wood for hundreds of years.
- Increased afforestation may result in even greater benefits through absorption of CO$_2$. Areas planted with trees can take even more CO$_2$ out of the atmosphere.
- Using wood to replace emission-intensive raw materials, such as cement and iron, could increase the mitigation potential of wood products.
- Using leftover wood for energy and increasing the yields of forest stands further enhances the social, environmental and social benefits of using wood in construction.

Efforts are being made to include harvested wood products in the next negotiations for the post-Kyoto regime (beyond 2012), in recognition of wood's ability to mitigate global climate change. For Brazil, which has a large naturally grown stock of hardwoods — hardwood trees live the longest of all wood species — this signals a major opportunity. By adopting SFM practices it is possible to maintain, or even increase, the volume of carbon stored within living biomass while increasing the level of carbon stored within wood products. The use of industrial wood is connected with an increase in forest cover. All major consumer regions portrayed increments in tree vegetation over the last 25 years, while minor consumption often results in higher deforestation rates (FAO 2007).

German forests have tripled their standing-stock volume, from an average of 100 m$^3$/ha in 1750 (at the beginning of scientific SFM) to an average of 300 m$^3$/ha in 1950. From 1950 to the present, western and eastern European forests also increased their average yields, from 3 m$^3$/ha/year to 4.5 m$^3$/ha/year (Nilsson 2007). Brazil's natural forests are being harvested with the same natural regeneration silviculture systems used by Germany in the sixteenth century, driving them to a similarly degraded state. Using forest products intensively and extensively practicing SFM with artificial regeneration increases the average volume of a forest stand as well as annual yields. An intensification of production may have adverse effects on biodiversity and other forest environmental and social services, however.

Although the IPCC has coordinated discussions on potential accounting approaches and methods for estimating carbon in forest products, no agreement has yet been reached so far. This delayed the inclusion of forest products as legitimate carbon offsets under the Kyoto Protocol. Currently, the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (agenda item 5(b)) is working on definitions, rules and modalities based on decision 16/CMP.1; these will eventually determine procedures for using harvested wood products to generate carbon credits under the Kyoto Protocol.
The Chicago Climate Exchange (CCX) establishes basic specifications for carbon accounting for long-lived wood products, including the necessity of proving that those products will be in use or in landfills after 100 years and providing evidence that they came from sustainably managed forests, are certified and have their carbon rights retained through a sales contract (CCX 2009). In terms of the use of wood within construction as a strategy to fight global climate change, traceability and certification are as important as the need to improve technologies, enhance the application and increase the life span of such material. All these issues are addressed by this project.

Traceability has been addressed by several institutions around the world. The proposal from the Instituto Web Florestal (IWF) establishes an electronic system to support the legal accountability of forest resources and trace them along the production chain. It involves installing an electronic chip on each tree that allows it to be monitored within the chain of custody system and an overall monitoring centre, using software to follow the wood from the forest to final consumers. The wood can be audited at any point along the production chain and at any given moment, supplying technical, legal and tenure data and information.

The Brazilian Program of Forest Certification (CERFLOR) was developed within the framework of the Brazilian System of Conformity Analysis. CERFLOR aims to certify effective forest management practices in both native and exotic stands. In 2001 the Brazilian Association of Technical Regulation accepted the Principles, Criteria and Indicators for SFM of plantation forests and natural forests and the guidelines for auditors. CERFLOR is managed by the National Institute of Measuring and Industrial Quality and received international recognition, being associated with the Program for Endorsement of Forest Certification schemes.

Life Cycle Assessment (LCA) is an important part of the project's framework. LCA is the investigation and evaluation of the environmental impacts of a given product or service. The proportion of carbon in the logs that ends up in finished products and residues depends on various factors, such as species, site conditions, harvesting technique, log grading and efficiency of conversion in wood-processing plants (Ximenes 2006). It is important to understand the flows of carbon from harvested logs into different residues (bark, sawdust, off-cuts, shavings) and product streams. Different products have different service lives; domestic house framing typically has a long service life.

Disposal is a critical stage in the life cycle of forest products in terms of their ultimate impact on emissions. The methods of estimating parameters for accounting for carbon along the production chain may include factors such as national industry averages of volume of forest products manufactured and fate of the products after disposal. These are critical factors in determining the level of long-term storage in forest products.

The construction sector

The construction sector worldwide employs 111 million people, 90 percent of them in small firms (less than ten persons) and 75 percent in developing countries (UNEP 2009).
By around 2025, the world will need another 11.5 billion m² of space for residences, six billion m² for industries and 5.4 billion m² for commerce. On the planet, 70 to 75 percent of the population — approximately four billion people — live on less than US$3,000 per year, moving US$5 trillion.

In the UNECE region, covering 56 states in Europe, the Commonwealth of Independent States and North America, buildings (by and large in the residential sector) are responsible for more than a third of total energy consumption. Demographic, economic and cultural changes will only increase the pressure of housing on energy consumption and will be accompanied by even higher levels of GHG emissions. On the other hand, evidence suggests that it is the building sector, particularly the residential subsector, which could generate some of the greatest energy savings. Using wood is an essential part of this savings, especially for low-income populations. In Brazil there is a deficit of close to eight million homes — 84 percent of which are required by low-income families — and demand for another 27 million new units by 2025. The sector’s investments will increase from today’s US$97 billion to more than US$263 billion in 2030.

Wood is a feasible alternative for construction. It is a renewable raw material, well adapted to the framing process (its dryness and ease in assembling reduce the time required by approximately 30 percent), with a good ratio of weight-to-mechanical resistance. It can be immediately placed at structures and is a lightweight and environmental friendly option when compared to other building items. In addition, Brazil has a large forest resource base of both natural and exotic species and excellent conditions for implementing a sustainable supply of harvested wood products.

Despite these comparative advantages, however, wood is still rarely used in construction. The main reasons for this include lack of tradition of this kind of construction, lack of knowledge on the part of professionals involved in construction about the material and its qualities, and lack of research and development in technologies capable of meeting the needs of the population. There is a noticeable lack of good projects for wood-building systems that can offer functional and technological quality. Research has covered, among other topics, monitoring the quality of the construction process and evaluation of thermal and acoustic comfort. Modular construction can increase the versatility and feasibility of this alternative for the whole population. In addition, wood produces residues along the production chain can be further used or used for energy production.

Worldwide, forest sector products contributed an estimated US$207 billion to international trade in 2007. In Brazil the sector is robust. It generates around US$20 billion per year in revenues, with US$9.3 billion exports in 2008, close to six million ha of plantations and 1.6 million jobs (Rochadelli et al. 2008). In Paraná state, in southern Brazil, the sector produces almost 35 million m³/year (57 percent used for energy, 43 percent for industry), which corresponds to eight percent of GDP; it also creates as many as 750,000 direct and indirect jobs (Krugger 2008). The state government initiated a program for the timber-producing sector that is responsible for planning the next 100 years of developments.
within the sector. The main goal of the program is to overcome barriers to the production and use of industrial wood within the state and to support implementing strategic policies to this end.

Case study: social housing
In Parana there is a deficit of 314,200 homes; Curitiba, the state’s capital, has a deficit of 50,000 homes. In order to estimate the contribution of increasing the use of wood in house construction, a comparative study was conducted. It involving a 52-m² model built using traditional methods by the Parana State Housing Company and an alternative model from the Wood Products Laboratory of the Brazilian Forest Service (LPF/SFB).

The LPF/SFB model resulted in an emissions reduction of 12.1 tCO$_2$eq/unit. Just by replacing raw materials associated with high emissions, it elevated demand of forest biomass by approximately 60 percent and generated another 8 tCO$_2$eq/unit for energy production with the use of solid residues. In addition, the use of residues avoided methane emissions at landfills. In terms of CERs, the cumulative effect of increasing SFM production or reforestation, replacing raw materials, producing energy from residues and avoiding methane emissions from landfills resulted in an estimated 83 tCO$_2$eq/unit. This amounts to US$830 per house in terms of carbon credits.

The Parana State government’s Ouro Verde reforestation project aims to establish 400,000 ha of forest plantations. A list of regionally occurring species was drawn up and was compared to the raw materials needed for the LPF/MMA wood-frame house model, to determine which tree species could be used in construction. Based on that study, a list of 25 species$^1$ was produced for Parana state’s regions 1 and 2. These regions are located in the central-southern part of the country and are home to 99 municipalities with the lowest incomes in the state. For Curitiba and the metropolitan region, 16 species$^2$ were recommended. Most of them are grown in agroforestry and silvipasture systems; this project aims to increase their plantation area within the region, taking advantage of pasture and degraded areas surrounding municipalities.

By implementing a diversified forest resource base and using those trees as industrial raw materials in the construction of social housing, the proposal links forest plantations with biodiversity, emissions reduction, economic development and social integration. This requires a massive inclusion of local and global actors.

The issue of fire was also addressed. Rio Sagrado, a private company that produces a substance used in fighting forest fires, has joined the initiative and will supply fire combat planning for each house unit and condominium, according to governmental and bank regulations. This will increase assurance and secure people’s investments.

Governance and wood promotion
The Ouro Verde reforestation project proposes a new governance model for establishing the 400,000 ha of forest plantations. The Unidade Gerencial do Programa (Managerial Program Unit), composed of members from several federal, state and local institutions, will support
the state government in developing the program. As part of the program, over the next 100 years, the state will organize seminars and training and offer technical assistance to increase municipalities’ awareness of the necessity of planting forests for industrial wood production. The state will also provide services to municipalities, cooperatives, associations, industry, schools, universities and others, to facilitate the process of informing the public, talking with investors and submitting documents to finance institutions.

By using a larger number of species in social housing construction, and linking the silviculture program with the state’s and municipalities’ demand for these houses, the strategy supports a positive cycle involving forest plantations and industrial wood consumption and the state increases its ecological footprint (which is in general considered to be negative). The state government is already planning the construction of the first social housing project with wood-frame construction; 300 houses will be built within the Curitiba metropolitan region.

The Standardization of Solid Wood Industrial Residues on Commercial Volumes project creates a new technological alternative for managing residues in order to increase their aggregate value. This technology also involves using larger volumes of wood from the same tree, reducing the generation of solid wastes and enriching product assortment. With the use of residues to add value, new jobs are created and artistically crafted works can be made. Social inclusion is essential to assure sustainability.

Under the UNFCCC, parties report the carbon sequestered by forests in their national GHG inventories if they have the necessary data. It is essential to obtain public recognition for the long-term storage of carbon in forest products in Brazil, and to involve traceability, certification and life cycle assessment in the approach to the process. Adopting these practices will recognize the role of forest products in mitigating GHG emissions, and consequently further promote the use of forest products in the country and the overall image of the sector globally.

The Sustainable Originated Wood Utilization Network, or RUMOS (Rumos means “directions” in Portuguese), is a newly formed institution involving several Brazilian organizations. It was established to inform the public about the social, economical and environmental benefits of using wood. Its objectives are aligned with similar initiatives all over the world. RUMOS is initially focused on Brazil and its integration with BRIC (Brazil, Russia, India and China), but its members look forward to meeting with the other networks, and would participate in a global network for promotion of wood, if one were formed.

Integrating wood promotion networks provides a forum for discussions and coordination of a global system for accounting and certifying forestry carbon. This could bring the sector to a new level of participation at international agreements, increasing the strength and influence of its common proposals.

The architectural models and wood-frame houses already exist, the carbon estimates are accurate and being validated and the state is implementing the first social housing
projects constructed of wood. Network statutes are under review, with headquarters located at the Escritório Verde (Green Office) of the Technical Federal University of Paraná.

**Conclusions**

Building high-quality houses with wood can both mitigate the construction sector’s contribution to global warming and increase forest sequestration of CO₂. Furthermore, increasing the number of wood species used in house construction can contribute to tree diversity.

There is work to be done on transforming public and professionals’ understanding of the role of wood and forests in global climate change, and on promoting a cultural rehabilitation of wooden houses within society.

An accounting system is needed that traces forestry carbon from stands to finished products, and allows participants to estimate wood products’ contribution to reducing emissions from land-use change and increasing carbon sequestration at forest sites. Such a system could be used to promote the role of wood and its use in fighting global climate change.

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**Endnotes**


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