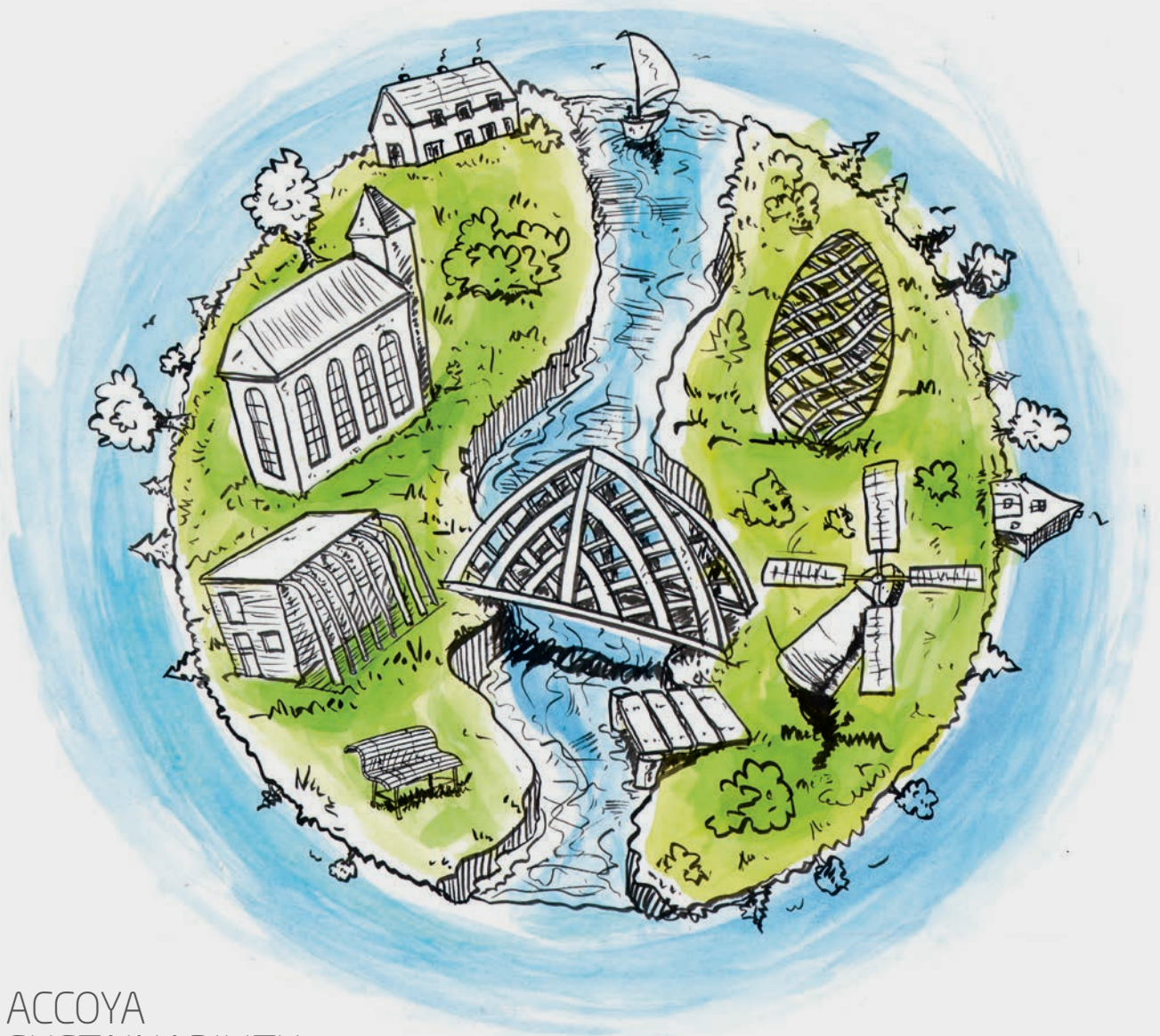


# ACCSYS TO A BETTER WORLD



ACCOYA  
SUSTAINABILITY  
GUIDE

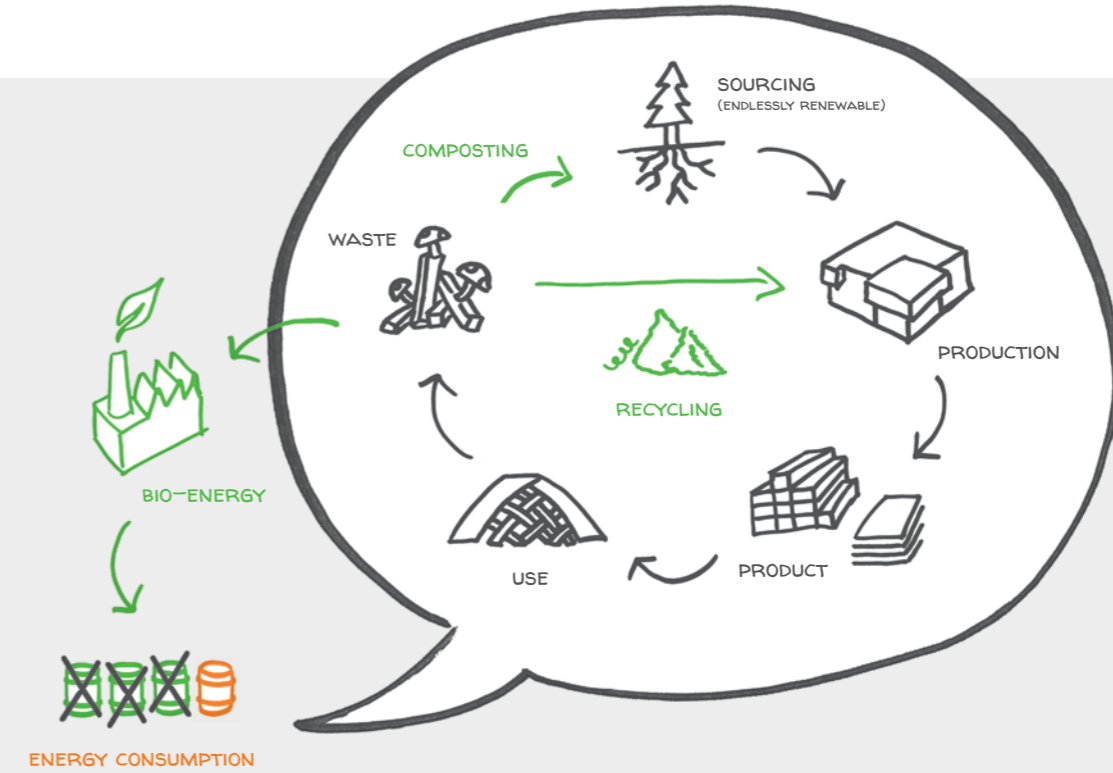
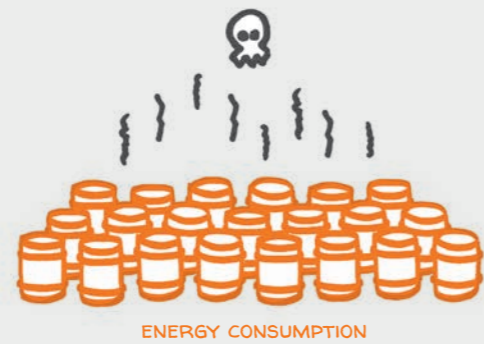
[WWW.ACCOYA.COM/SUSTAINABILITY](http://WWW.ACCOYA.COM/SUSTAINABILITY)

## PROBLEM: LINEAR ECONOMY BASED ON NON-RENEWABLE MATERIALS

As a result of increasing global population and consumption, and a make-take-waste mentality, our planet is overexploited resulting in depletion of resources, mass deforestation of tropical forests, a huge waste problem, toxic emissions and global warming.

Against this backdrop it seems unimaginable to keep mass consuming endangered materials like tropical hardwood and materials from non-renewable resources such as plastics, concrete and metals.

Although there are various initiatives within the concept of the circular economy that emphasize closing the loop of the so-called technical cycle for non renewable materials, in reality this is more an exception to the rule than current practice. When recycling of non renewable materials does occur, often a considerable amount of energy is needed to make this happen, resulting in additional greenhouse gas emissions.



## SOLUTION: BIOBASED CIRCULAR ECONOMY BASED ON RENEWABLE MATERIALS

A shift towards a biobased paradigm is urgently needed, based on abundantly available - and easily recyclable - renewable resources, with the same high level performance as the best man made materials from the technical cycle.

Wouldn't it be great if there could be a new natural building material that could combine all positive attributes from sustainable wood - renewability, strength, beauty, carbon sink ability - without the typical downsides -inconsistent quality and poor durability & stability?

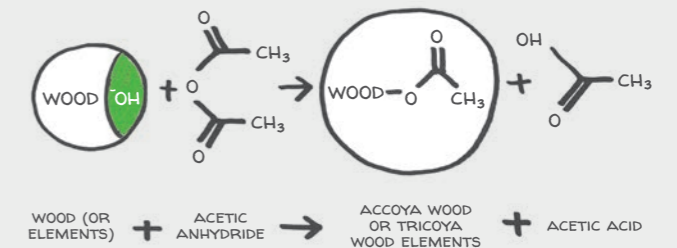
Imagine a revolutionary material that is CO<sub>2</sub> neutral over the full life cycle, which can be easily recycled to the highest quality exterior boards. Imagine a new material that even if just discarded is 100% biodegradable, fitting perfectly in the biological cycle of the circular economy and Cradle to Cradle (C2C) philosophy.

Therefore it comes as no surprise that Accoya is C2C Gold certified since 2010 and even C2C Platinum certified for Material Health. With the invention of Accoya® wood and Tricoya® wood elements the transition to a circular biobased economy can actually become a reality.

CRADLE TO CRADLE CERTIFIED PRODUCT SCORECARD	
MATERIAL HEALTH	PLATINUM
MATERIAL REUTILIZATION	GOLD
RENEWABLE ENERGY & CARBON MANAGEMENT	GOLD
WATER STEWARDSHIP	GOLD
SOCIAL FAIRNESS	GOLD
<b>OVERALL CERTIFICATION LEVEL</b>	<b>GOLD</b>

SEE FULL SCORECARD AND CERTIFICATE AT [WWW.C2CCERTIFIED.ORG](http://WWW.C2CCERTIFIED.ORG)

ACETYLATION IS A REVOLUTIONARY WOOD MODIFICATION PROCESS, WHICH HAS BEEN KNOWN AND STUDIED FOR OVER 80 YEARS, IT INVOLVES THE REACTION OF WOOD (OR WOOD PARTICLES) WITH ACETIC ANHYDRIDE, THROUGH WHICH THE FREE -OH (HYDROXYL) GROUPS - CAUSING THE SHRINK AND SWELL OF WOOD AND THE SUSCEPTIBILITY TO DECAY - WITHIN THE CELL WALL ARE REPLACED BY MORE STABLE AND HYDROPHOBIC NON-TOXIC ACETYL GROUPS, NATURALLY OCCURRING IN WOOD. AS A RESULT, THE STABILITY AND DURABILITY OF THE WOOD SIGNIFICANTLY INCREASES. THE CO-PRODUCT OF THIS PROCESS IS ACETIC ACID, OTHERWISE KNOWN AS VINEGAR IN ITS DILUTE FORM, WHICH IS REUSED IN A WIDE RANGE OF INDUSTRIES.



# PRODUCTION PHASE



## PROBLEM

Current consumption in human society shows a strong addiction to non renewable materials and fossil fuels while deforestation of tropical rainforests still continues at a high rate, which not only results in resource depletion but also means extra releases of greenhouse gases further enhancing the global warming problem.

For the world as a whole, carbon stocks in forest biomass decreased by an estimated 0.5 Gigatons due to deforestation in tropical regions worldwide between 2005 and 2010, where a region of over 8 million hectares was deforested (Source: FAO Global Forest Resources Assessment 2010).

### CARBON SEQUESTRATION IN WOOD

THROUGH THE PHOTOSYNTHESIS PROCESS TREES ABSORB CO<sub>2</sub> AND SOLAR ENERGY IN THEIR CREATION OF WOOD, WHILE RELEASING OXYGEN IN RETURN. DEPENDING ON THE DENSITY OF THE WOOD (THE DENSER, THE MORE CARBON IS STORED), 1 M<sup>3</sup> OF WOOD MAY STORE OVER 1 TON OF CO<sub>2</sub> FOR ITS USEFUL LIFE!

SOURCE: BUILDING WITH WOOD = THE ACTIVE FORM OF CLIMATE PROTECTION (2011) CENTER OF LIFE AND FOOD SCIENCES WEIHENSTEPHAN TECHNISCHE UNIVERSITÄT MÜNCHEN

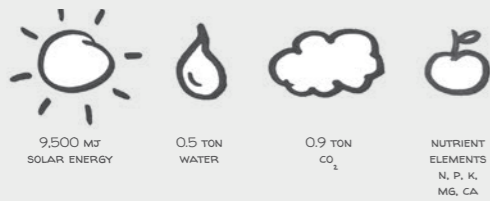
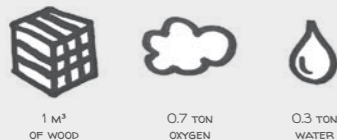


PHOTO-SYNTHESIS



## SOLUTION

A natural solution for the problem of ecosystem deterioration and global warming is actually already available but often overlooked: wood from well managed sources.

Forests are an important carbon sink by filtering CO<sub>2</sub> out of the air and absorbing this in the biomass of the tree. For the sake of climate protection, it is actually best to harvest as much wood as sustainable for production of durable products - acting as temporary carbon sinks - while managing the forest well for new biomass production. As wood is a renewable resource, this is a very effective way to continuously absorb carbon in the forest as well as in durable products. As a result of sustainable management in Europe and North America, the their net forest area has been increasing steadily for several decades. To produce Accoya® and Tricoya®, only abundantly available, typically fast growing wood species, such as Radiata pine, are being used from certified sustainably managed sources including FSC® and PEFC™.

### SUSTAINABLE SOURCING

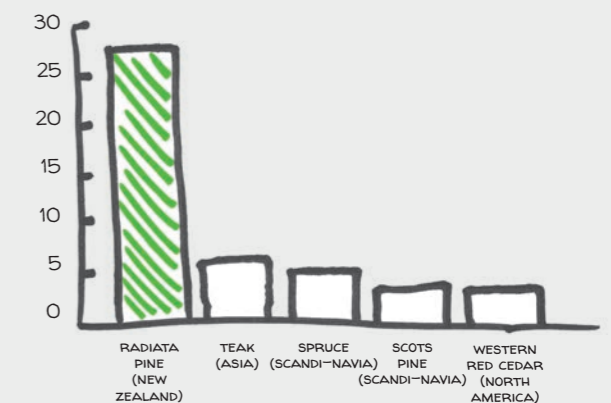
- SUSTAINABLY SOURCED WOOD
- MADE FROM ABUNDANTLY AVAILABLE, FAST GROWING SPECIES
- NON-TOXIC; NOTHING IS ADDED TO THE WOOD THAT DOES NOT NATURALLY OCCUR IN IT

### ANNUAL YIELD COMPARISON

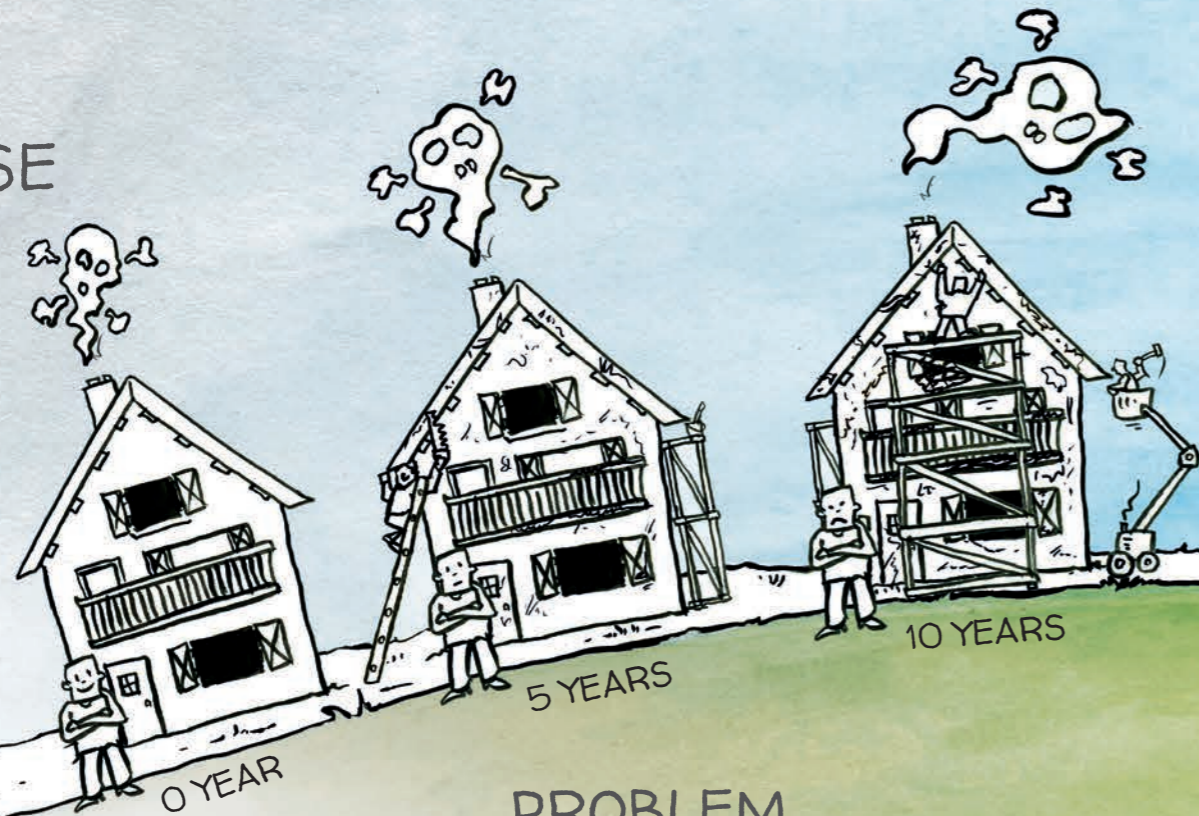
FAST GROWING SOFTWOOD SPECIES SUCH AS RADIATA PINE ARE PRIMARILY USED TO PRODUCE ACCOYA®. THIS MEANS THAT THERE IS AN AMPLE SUPPLY OF TIMBER FROM CERTIFIED SOURCES FOR THE PRODUCTION OF ACCOYA® WOOD TO REPLACE SCARCELY AVAILABLE CERTIFIED TROPICAL HARDWOOD AND OTHER COMPROMISED NON RENEWABLE BUILDING MATERIALS FOR DEMANDING EXTERIOR APPLICATIONS.

SOURCE: FAO (2006), USDA FOREST SERVICE (2013), MAP (2013)

### MEAN ANNUAL INCREMENT FOR PLANTATION GROWN TIMBER (M<sup>3</sup>/HA/YR)



## USE PHASE



## PROBLEM

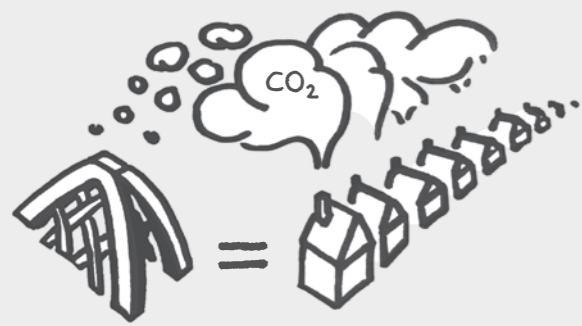
Although from a resource and carbon sequestration perspective wood seems like the ideal material, there is an important reason why it has not been adopted as the main building material in modern markets: mediocre performance in use - poor durability and dimensional stability leading to short life spans and frequent maintenance.

Whereas tropical hardwoods represent some of the best performing and most beautiful woods available, there is simply not enough to sustainably harvest anymore with depletion of tropical rainforest as a catastrophic consequence. Man-made materials based on metals, plastics and concrete, but also chemical wood preservation with toxic substances, solved some durability issues associated with the use of most woods, but the environmental damage in the production and waste phase are no longer tolerable (landscape deterioration, depletion, toxic waste).

## CARBON SEQUESTRATION POTENTIAL

LEADING INDEPENDENT CARBON FOOTPRINT AND LIFE CYCLE ASSESSMENT (LCA) STANDARDS SUCH AS ILCD AND PAS 2050:2011 ALLOW FOR THE CARBON SEQUESTERED IN THE WOOD DURING ITS USEFUL LIFE TO BE INCLUDED AS A NEGATIVE CO<sub>2</sub> VALUE, WHICH IS AN IMPORTANT CONSIDERATION FOR ACCOYA DUE TO ITS SUPERIOR DURABILITY AND THEREFORE LONGER LIFE SPAN. THIS CREDIT IS INCLUDED IN THE CRADLE TO GRAVE CARBON FOOTPRINT COMPARISON PERFORMED BY DELFT UNIVERSITY OF TECHNOLOGY IN 2013 (SEE RIGHT PAGE).

FOR EXAMPLE, ONE OF THE TWO ROAD BRIDGES IN SNEEK, THE NETHERLANDS COMPRISES 1200 CUBIC METERS OF ACCOYA WOOD. AS A RESULT, 1080 TONS OF CO<sub>2</sub> (0.9 TON CO<sub>2</sub> / M<sup>3</sup> x 1200 M<sup>3</sup>) ARE LOCKED IN THE BRIDGE FOR NEARLY A CENTURY (ANTICIPATED LIFESPAN OF THE BRIDGE IS 80 YEARS). THIS IS EQUIVALENT TO ELIMINATING THE ANNUAL CO<sub>2</sub> EMISSIONS OF 432 TYPICAL WESTERN EUROPEAN HOUSEHOLDS FOR THEIR ENERGY NEEDS!



1 BRIDGE

432 HOMES

## SOLUTION

Through acetylation the downsides of wood are overcome, providing Accoya® wood and Tricoya® wood elements several environmental gains during use.

First, Accoya® and Tricoya® have achieved the highest durability class possible (Class 1 - EN 350), are guaranteed up to 50 years and have received several quality certifications (KOMO, RAL, BBA, WDMA, etc.). Therefore the proven longer lifespan enables lower material consumption (less replacement!) over the same period compared to most other materials, while having larger carbon sequestration benefits.

Secondly, the superior dimensional stability of Accoya® and Tricoya® means less coatings need to be used not only relating to a lower environmental impact but to lower costs as well.

Finally, compared to other durable wood species, Accoya® offers superior thermal insulation, which yields energy conservation advantages in applications such as window frames.

### LONG LIFE

- ENHANCED DURABILITY
- WARRANTED 50 YEARS ABOVE AND 25 YEARS IN THE GROUND
- IMPROVED STABILITY FOR LONGER COATING LIFE
- SUPERIOR THERMAL INSULATION

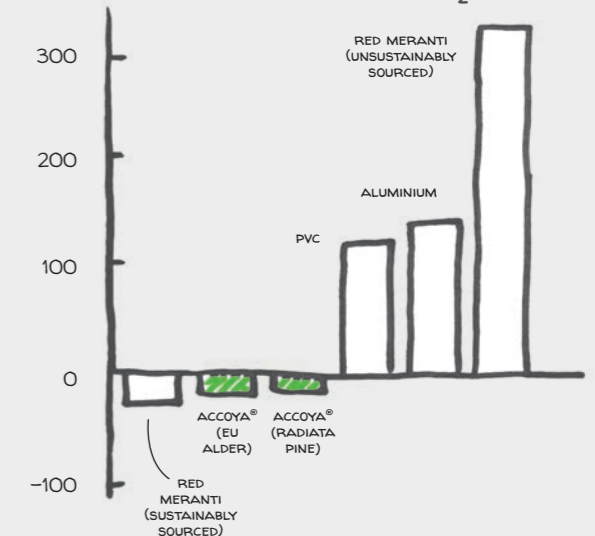


## CARBON NEGATIVE WINDOW FRAMES

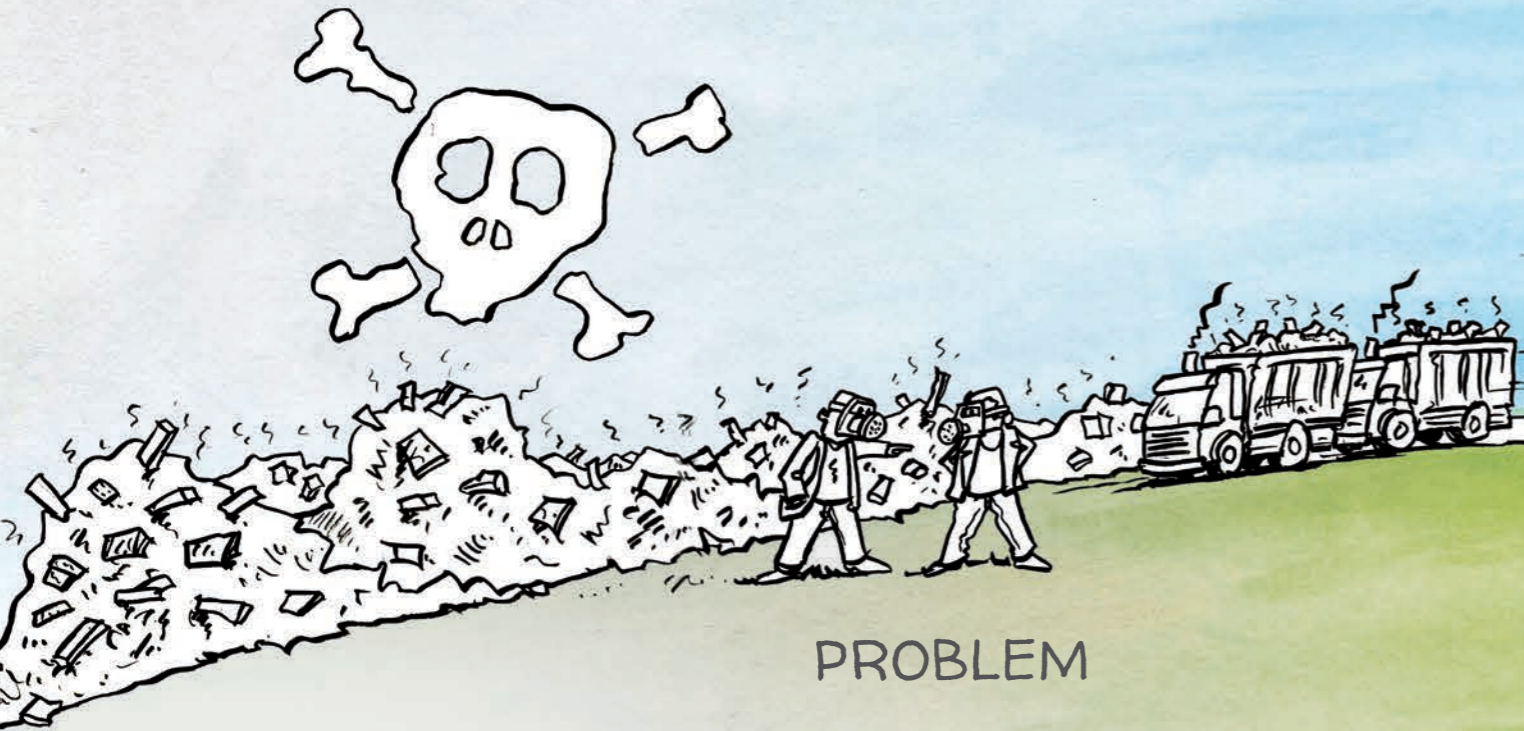
- IN A CRADLE TO GRAVE CARBON FOOTPRINT ASSESSMENT, GREENHOUSE GAS EMISSIONS (IN CO<sub>2</sub> EQUIVALENT) DURING THE LIFE CYCLE OF A PRODUCT CAN BE MEASURED.
- INCLUDES END OF LIFE SCENARIO (RECYCLING, DUMP OR INCINERATION FOR ENERGY) AND CARBON SEQUESTRATION OF WOOD (PAS 2050:2011) OVER A 100 YEAR TIME FRAME.
- EXCLUDES ANNUAL YIELD, WHICH IS AN EXTRA GREEN BENEFIT FOR RENEWABLE MATERIALS, BUT ESPECIALLY FOR ACCOYA® BASED ON FAST GROWING CERTIFIED SOURCES.\*

SOURCE: VOSTLÄNDER, Z.B. (2013). CRADLE TO GRAVE CARBON FOOTPRINT ASSESSMENT FOR ACCOYA® WOOD AND ITS APPLICATIONS PART 1: WINDOW FRAME. DELFT UNIVERSITY OF TECHNOLOGY. PUBLICLY AVAILABLE THROUGH WWW.ACCOYA.COM/DOWNLOADS

## GREENHOUSE GAS EMISSIONS PER WINDOW FRAME (IN KG CO<sub>2</sub>)



## END OF LIFE PHASE



### PROBLEM

#### RECYCLING STRATEGY – THE LADDER OF LANSINK

WE RECOMMEND THAT USERS OF ACCOYA® WOOD AND TRICOYA® ADOPT THE RECYCLING STRATEGIES KNOWN AS THE "LADDER OF LANSINK". THIS MODEL LARGELY FOLLOWS THE GUIDELINES OF THE CRADLE TO CRADLE PHILOSOPHY TO CLOSE BIOLOGICAL AND TECHNOLOGICAL CYCLES AS MUCH AS POSSIBLE AND RE-USE MATERIALS IN APPLICATIONS WITH THE SAME OR EVEN HIGHER ADDED VALUE (UP-CYCLING). THE MODEL CONSISTS OF THE FOLLOWING POSSIBLE WASTE MANAGEMENT SCENARIOS IN WHICH PREVENTION IS THE PREFERRED OPTION AND DUMPING THE LEAST:



- 1 PREVENTION – AVOID WASTE
- 2 PREVENTION – DEVELOP PRODUCTS THAT CREATE NO HARMFUL WASTE (E.G. 100% BIODEGRADABLE)
- 3 USEFUL APPLICATION THROUGH PRODUCT RE-USE
- 4 USEFUL APPLICATION THROUGH MATERIAL RE-USE
- 5 USEFUL APPLICATION THROUGH ENERGY PRODUCTION (INCINERATION)
- 6 REMOVE: BURN
- 7 REMOVE: DUMPING / COMPOSTING

Non renewable man made materials as well as wood treated with toxic chemicals pose serious problems in the end of life phase. Whereas natural wood is biodegradable, these materials often end up in landfills and pollute the soil and surroundings. In the sporadic cases that non renewable materials such as plastics and various metals are recycled this often comes at the expense of the quality while large amounts of energy are required throughout this process.

Furthermore, due to overconsumption of fossil fuels such as coal, oil, gas - causing global warming - global resource reserves are quickly depleting, showing the urgent need to focus on energy based on renewable sources such as sun, hydro, wind and biomass.

### SOLUTION

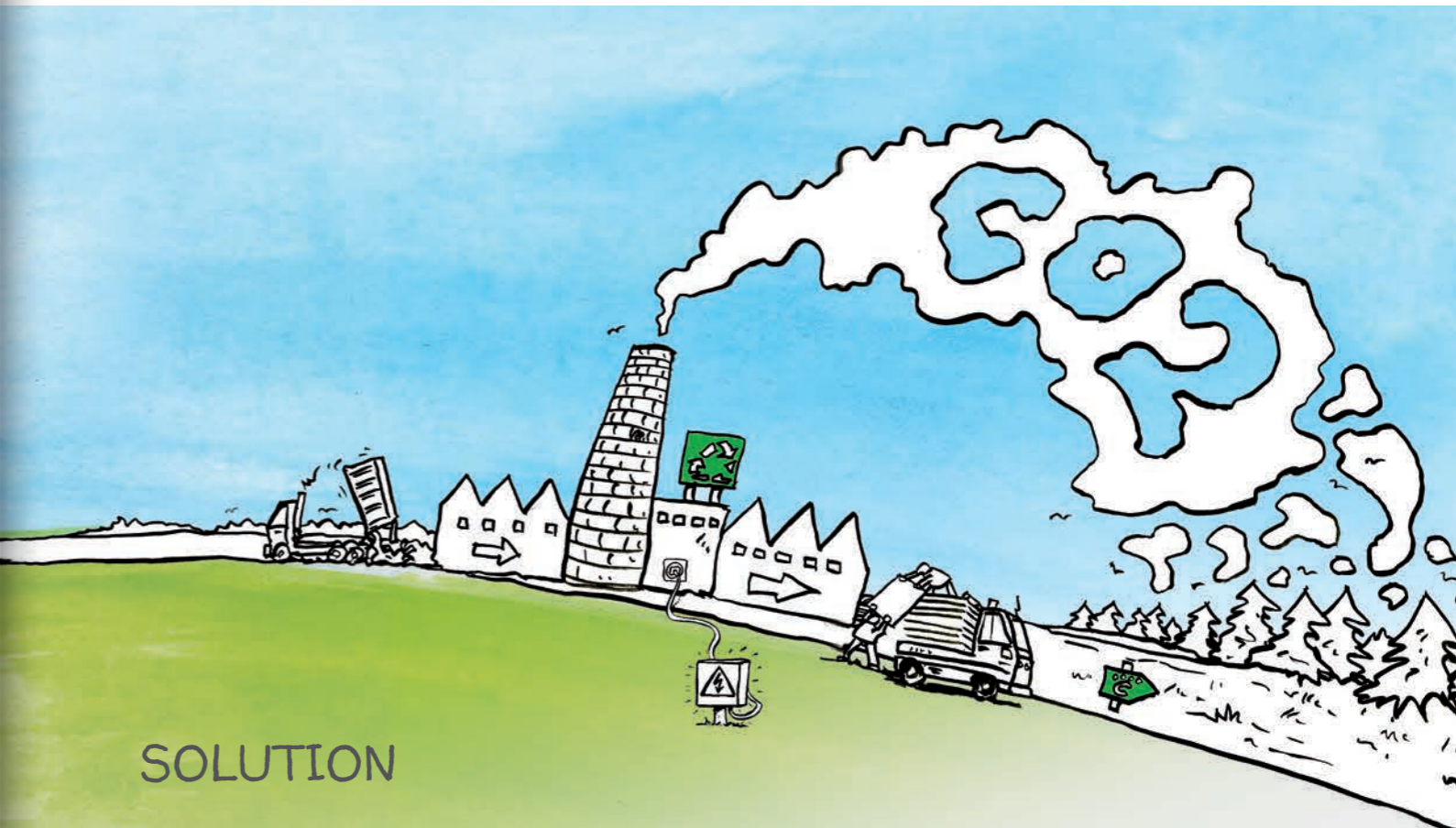
In the end of life phase Accoya® has no limits. Accoya® is a non toxic product and therefore fully biodegradable.

As a result, Accoya® can be handled in the same manner as untreated natural wood at the end of its life and therefore fits perfectly in the Cradle to Cradle design philosophy for which it has been awarded the Gold certification as one of few products worldwide.

Following the "Ladder of Lansink" recycling strategy (see left), we recommend that Accoya® is re-used in applications with the same or even higher added value (up-cycling). Another high added value end of life scenario for Accoya® is to use it to produce Tricoya, acetylated wood elements e.g. for the production of high grade panels. Even if this is not possible there are no limitations. As wood products are in essence stored solar energy they can always be used for green clean energy production (releasing only the CO<sub>2</sub> absorbed during growth) thus saving emissions caused by burning oil, gas or coal.

#### 100% RECYCLABLE

- ACCOYA WOOD IS FULLY REUSABLE AND RECYCLABLE
- NON-TOXIC AND 100% BIODEGRADABLE
- WASTE WOOD GETS HIGH QUALITY SECOND LIFE



#### TRICOYA, THE ULTIMATE SECOND LIFE FOR WOOD FIBRES AND ELEMENTS

TRICOYA® ACETYLATED WOOD ELEMENTS (INCLUDING CHIPS, FIBRES AND PARTICLES) IS A REVOLUTION IN MODIFIED WOOD FIBRE TECHNOLOGY PIONEERED BY ACCSYS TECHNOLOGIES. TRICOYA IS WIDELY RECOGNISED AS THE GOLD STANDARD FOR HIGH PERFORMANCE WOOD ELEMENTS WHICH CAN BE USED IN THE MANUFACTURING OF EXTERNAL USE PANEL PRODUCTS WHERE WOOD PANELS COULD NEVER BE USED BEFORE.

THE NEW DESIGN AND APPLICATION POSSIBILITIES OFFERED BY THE MARRIAGE OF ACETYLATED WOOD ELEMENTS WITH OTHER MATERIALS IS SET TO EXCITE AND STIMULATE COMPOSITE MANUFACTURERS, DESIGNERS, ARCHITECTS AND THE CONSTRUCTION INDUSTRY ALIKE, OPENING UP NEW POSSIBILITIES AND SOLUTIONS.

FOR MORE INFO CHECK [WWW.TRICOYA.COM](http://WWW.TRICOYA.COM)

## PROVEN GREEN PERFORMANCE

As outlined in the previous pages, in every stage of the life cycle Accoya provides compelling environmental advantages. As we value transparency at Accsys, all claims about sustainability are always referenced to recognised standards.

Therefore, the environmental performance of Accoya® is thoroughly tested and published following uncompromising leading independent international methodologies such as Life Cycle Analysis (LCA following ISO 14040/44) and Environmental Product Declarations (EPD following EN 15804 and ISO 14025). For example, official LCA / carbon footprint studies by Delft University of Technology and environmental consultancy Verco show that Accoya® wood is an environmentally compatible - and even carbon negative - substitute for many traditional carbon intensive materials such as plastics, metals and concrete, as well as for various wood species.

Furthermore, we actively seek to acquire the most respected ecolabels available and have been recognized by others as an exemplary product and company in the field of sustainability on many occasions.

As a result, more and more leading architects and builders are adopting Accoya® & Tricoya® as high performance substitutes for non-renewable materials in several challenging projects worldwide where application of wood before was never thought as being possible. This shows that our promise towards a fully biobased circular economy posed in the introduction is not just imagination, it is becoming a reality.



BREEAM® NL



DUBOKEUR

### Cradle to Cradle Gold

Accoya® wood is one of the very few building products to have acquired Cradle to Cradle Certification at the stringent Gold level. Cradle to Cradle (C2C) provides a means to tangibly and credibly measure achievement in environmentally-intelligent design including the use of environmentally safe and healthy materials and instituting strategies for social responsibility.

### FSC®

Of the various schemes for sustainable forestry available, the Forest Stewardship Council (FSC®) is regarded as the leading and most comprehensive certification program available. The program not only focusses on benign environmental performance but also safeguard social interests for all stakeholders involved. Accoya® and Tricoya® are available in FSC®.

### BREEAM and LEED

Of the many green building certification schemes available worldwide, BREEAM (mainly used in Europe) and LEED (mainly used in North America) are most widely adopted and recognised. Both are based on various building related environmental indicators including sustainable energy, -water and -material use. For the latter category the application of Accoya can contribute to several credits in both schemes (BREEAM: MAT 1, MAT 5; LEEDv4: MR1, MR2, MR3, MR4, I1). See the website for detailed memo's with more information.

### Nordic Ecolabel

The outstanding green credentials of Accoya®, have been officially recognised by Europe's Nordic nations with the award of the Svanen Ecolabel. The label, renowned for its rigor and transparency is the internationally recognised ecolabel for Norway, Sweden, Denmark, Iceland and Finland and was established in 1989 by the Nordic Council of Ministers. It was developed to help consumers and companies select products that are guaranteed to have met stringent environmental standards.

### The Future Build

The Future Build is a green building materials portal that helps architects, engineers and contractors confidently select and source environmentally sustainable, third party certified products. Only products that have been assessed and selected according to stringent standards and criteria set by the carbon neutral Masdar City, Abu Dhabi, are listed. Accoya® wood was rated as Excellent or A.

### Singapore Green Label

For the South East Asian market we have attained the highly regarded Green Label of the Singapore Environment Council (SEC), which was set up to promote environmental awareness in this region. The 'Green Label' can only be obtained by compliance with the strict eco standards specified by the SEC's scheme and rigorous testing of the product for possible harmful content.

### Dubokeur

As one of the leading green labels in the Netherlands, Dubokeur certificates are only granted to the most environmentally friendly products, based on LCA methodology.

## CERTIFIED GREEN BUILDING PROJECTS WORLDWIDE

WAITROSE  
CLADDING  
UNITED KINGDOM



SUSTAINABLE APARTMENTS  
CLADDING  
USA



C2C BUSINESS INNOVATION PARK 20/20  
CLADDING  
THE NETHERLANDS



GREEN FAMILY HOME  
STRUCTURAL APPLICATION & CLADDING  
USA



VENLO CITY HALL  
STRUCTURAL APPLICATIONS, DECKING AND CLADDING  
THE NETHERLANDS



GEELEN COUNTERFLOW  
WINDOWS AND CLADDING  
THE NETHERLANDS

99.94%  
HIGHEST BREEAM  
RATING EVER

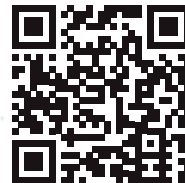


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#### UNITED KINGDOM

Brettenham House, 19 Lancaster  
Place, London WC2E 7EN  
T: +44 (0)207 421 4300

[info@accoya.com](mailto:info@accoya.com)

#### THE NETHERLANDS

Postbus 2147  
6802 CC Arnhem  
T: +31 (0)26 320 1400

#### USA

5000 Quorum Drive #620  
Dallas, Texas 75254  
T: +1 972 233 6565

[WWW.ACCOYA.COM](http://WWW.ACCOYA.COM)

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