American Hardwoods Around the Globe
遍布全球的美国阔叶木

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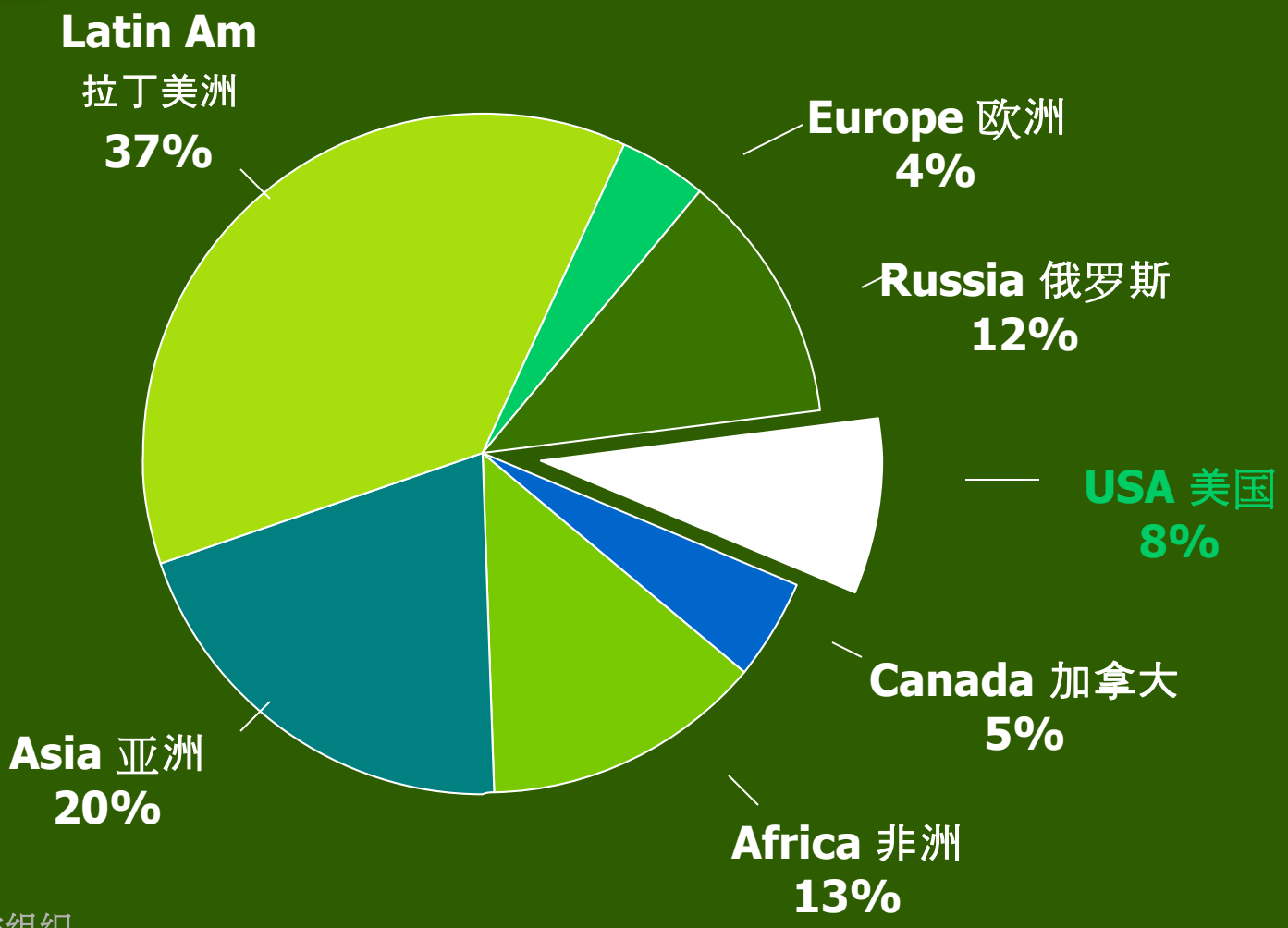
American Hardwood Export Council 美国阔叶木外销委员会(AHEC)
June 2014 **2014年6月**

AHEC's Global Reach
美国阔叶木外销委员会全球办公室

AMERICAN HARDWOOD EXPORT COUNCIL

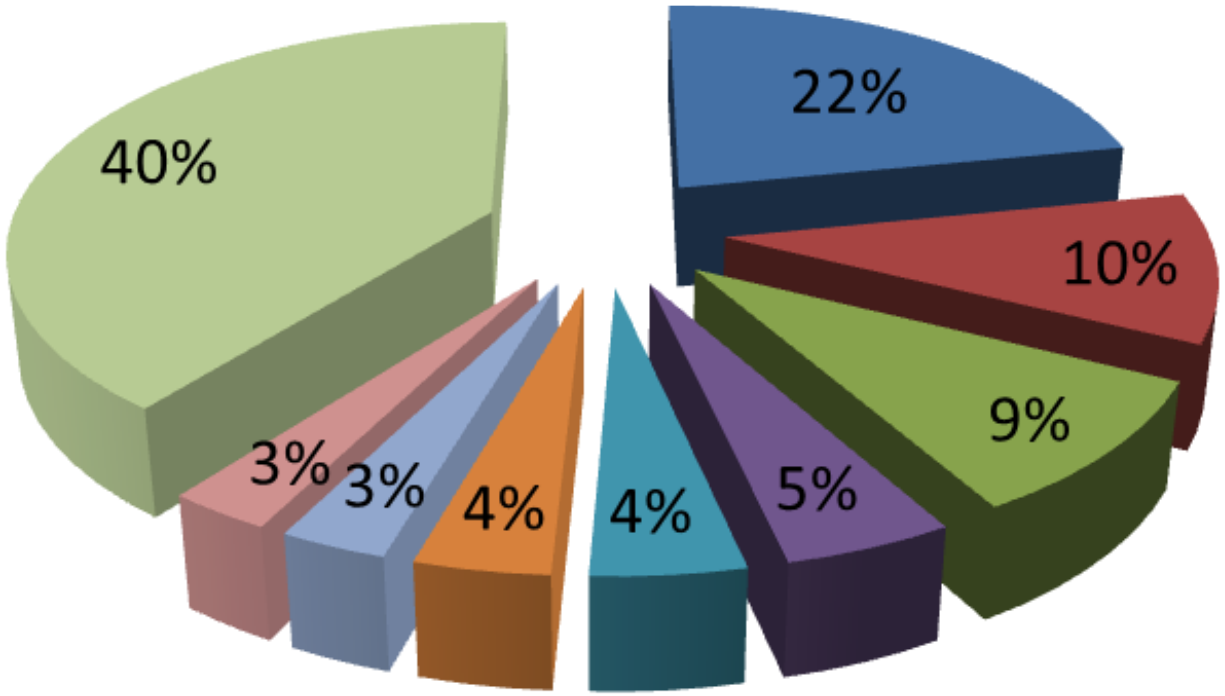
Global Hardwood Forests
全球阔叶林



Source: FAO
资料来源：联合国粮农组织

Share of global hardwood lumber trade in 2013 ($ value)

2013年全球阔叶木木材贸易份额（百分比）



USA 美国 Thailand 泰国 Malaysia 马来西亚

Cameroon 喀麦隆 Germany 德国 Indonesia 印尼

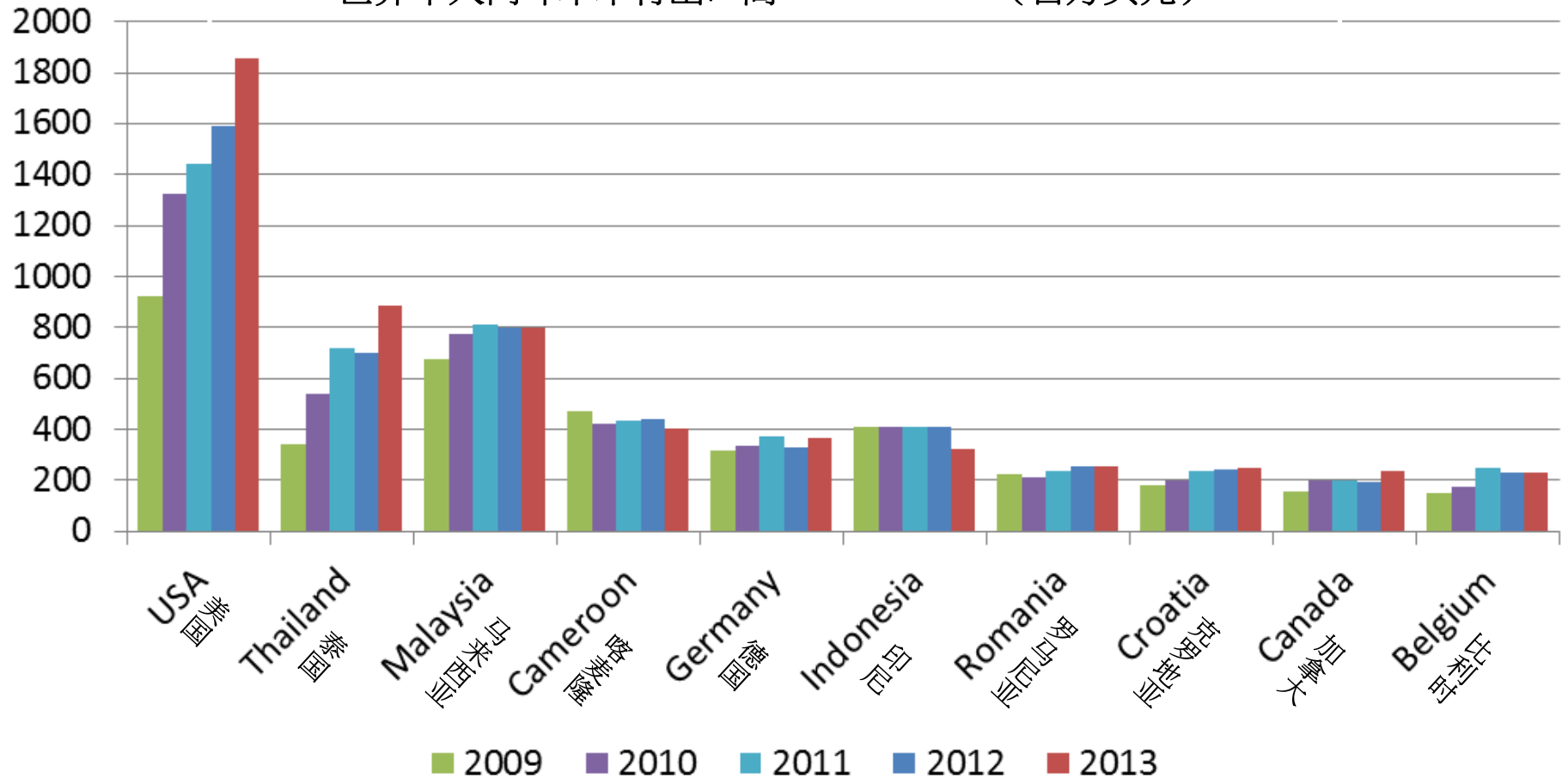
Romania 罗马尼亚 Croatia 克罗地亚 Other 其他

Source: Global Trade Atlas & FAO Forstat

资料来源： 全球贸易数据库

The world's 10 largest hardwood lumber exporters 2009-2013 ($ million)

世界十大阔叶木木材出口商 2009-2013（百万美元）

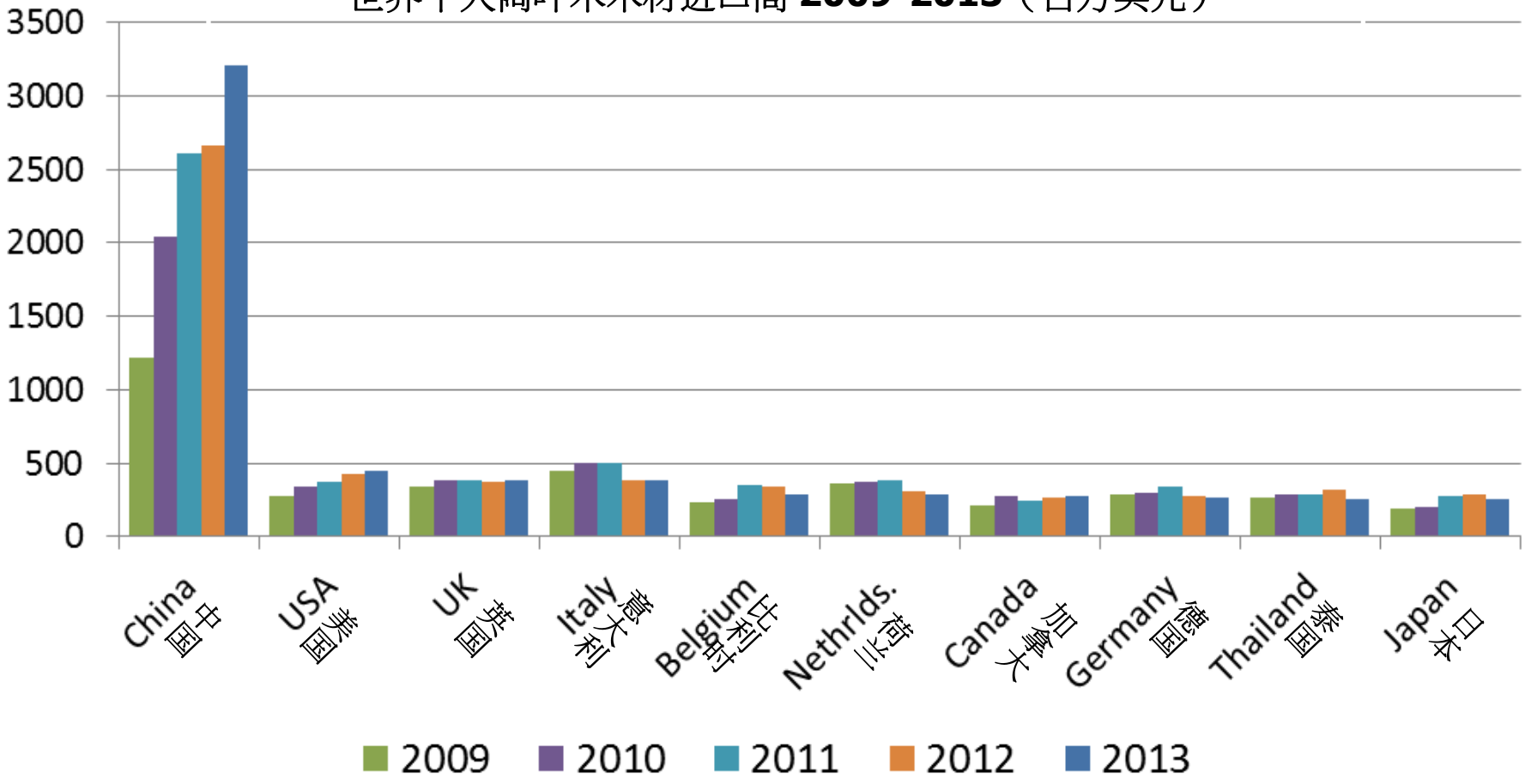


Source: Global Trade Atlas

资料来源： 全球贸易数据库

The world's 10 largest hardwood lumber importers 2009-2013 ($ million)

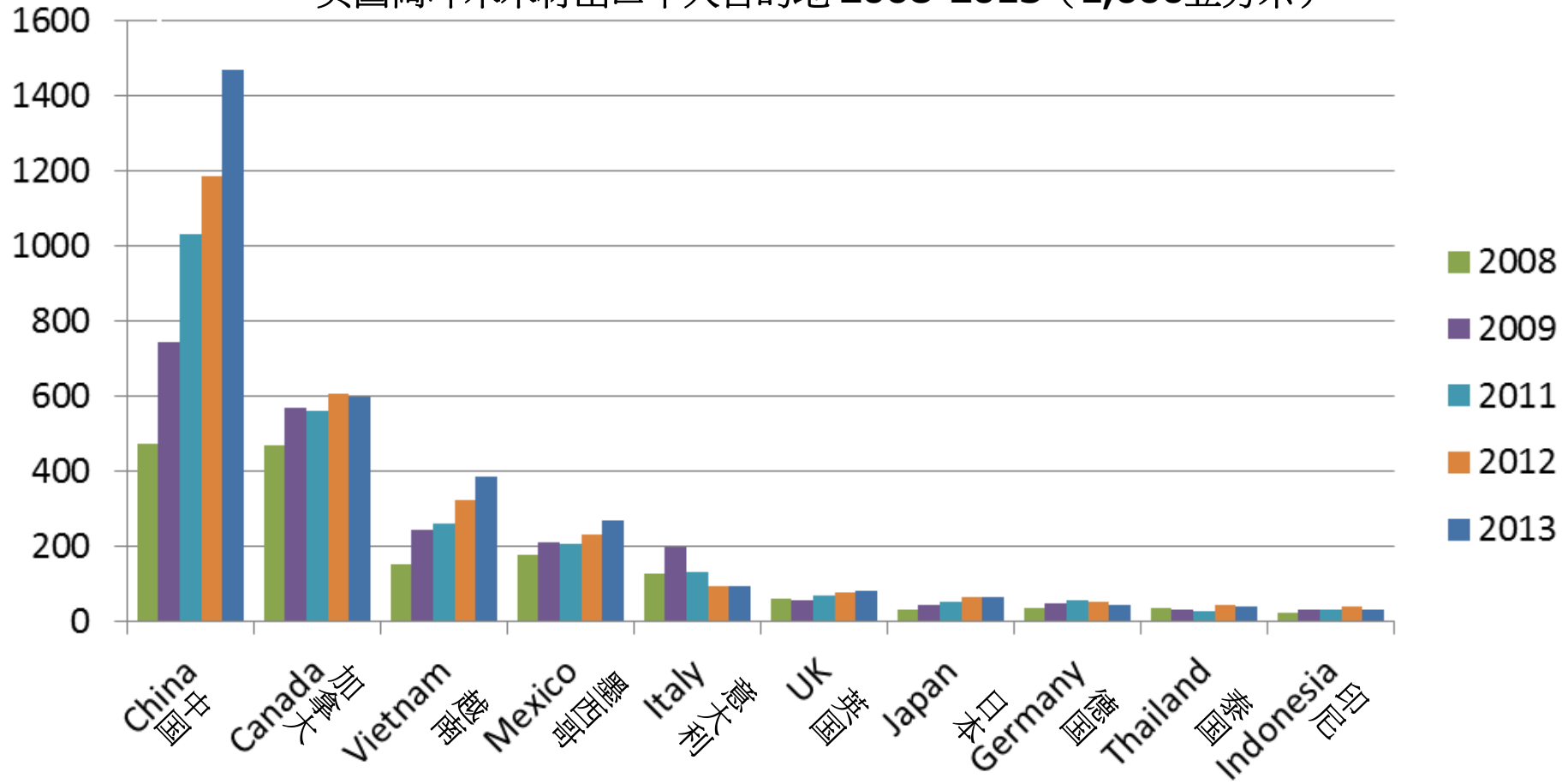
世界十大阔叶木木材进口商 2009-2013（百万美元）



Source: Global Trade Atlas

资料来源： 全球贸易数据库

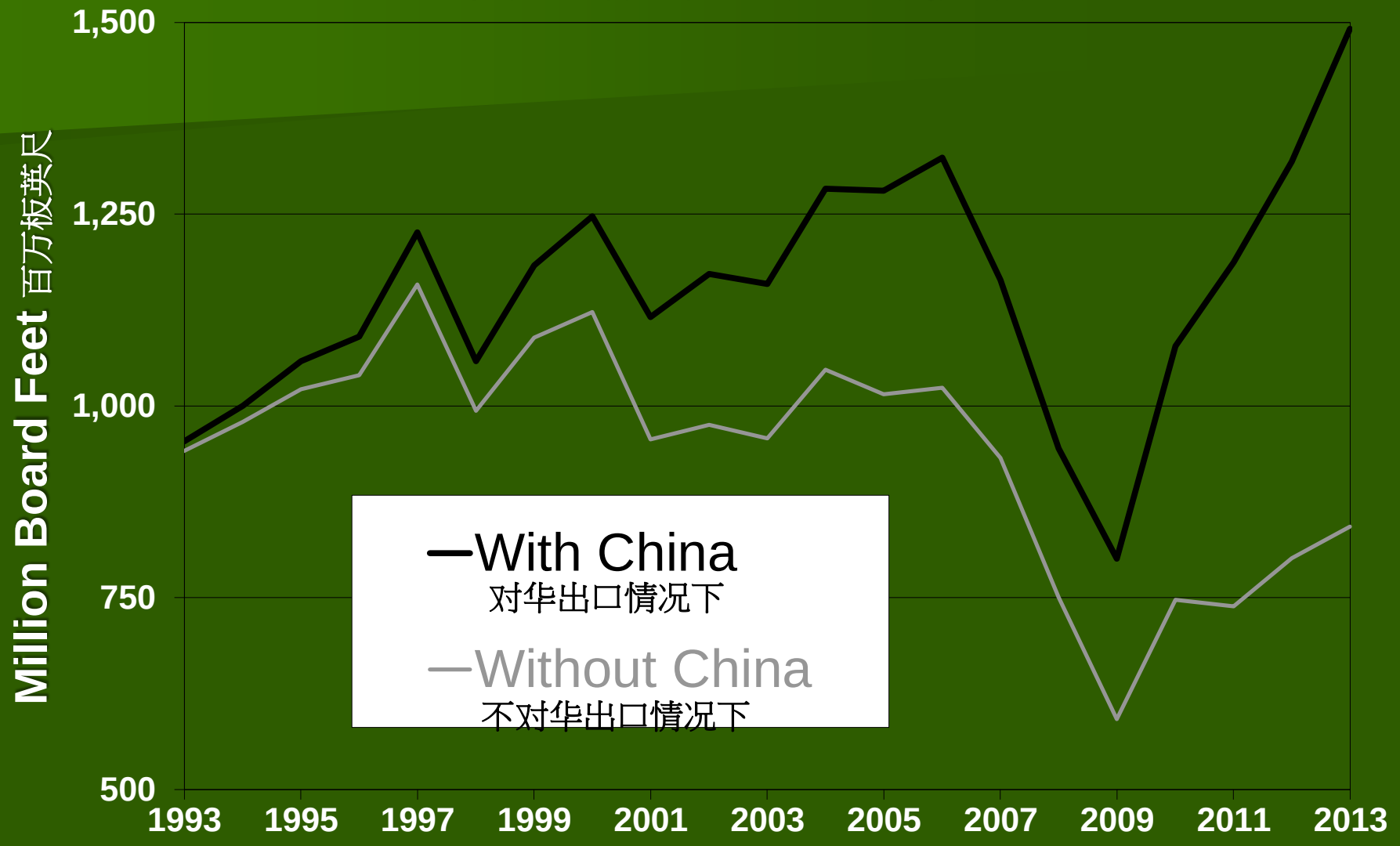
The 10 largest U.S. hardwood lumber export destinations
Years 2008-2013 (1000 m3)
美国阔叶木木材出口十大目的地 2008-2013（1,000立方米）



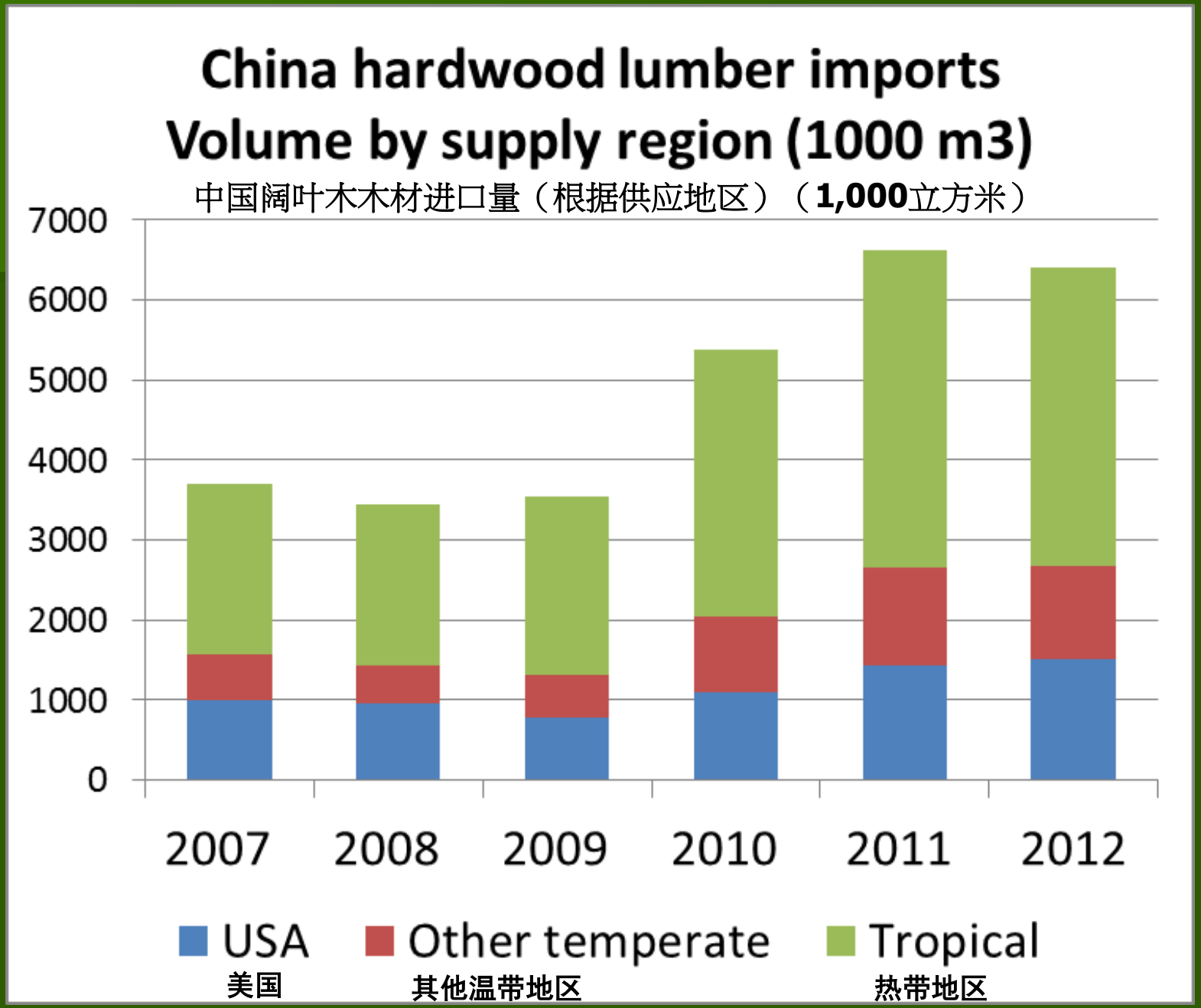
Source: USDA GATS

资料来源： 美国农业部 服务贸易总协定

China's Impact on US Exports
中国对美国出口的影响



Source: ***Hardwood Review***

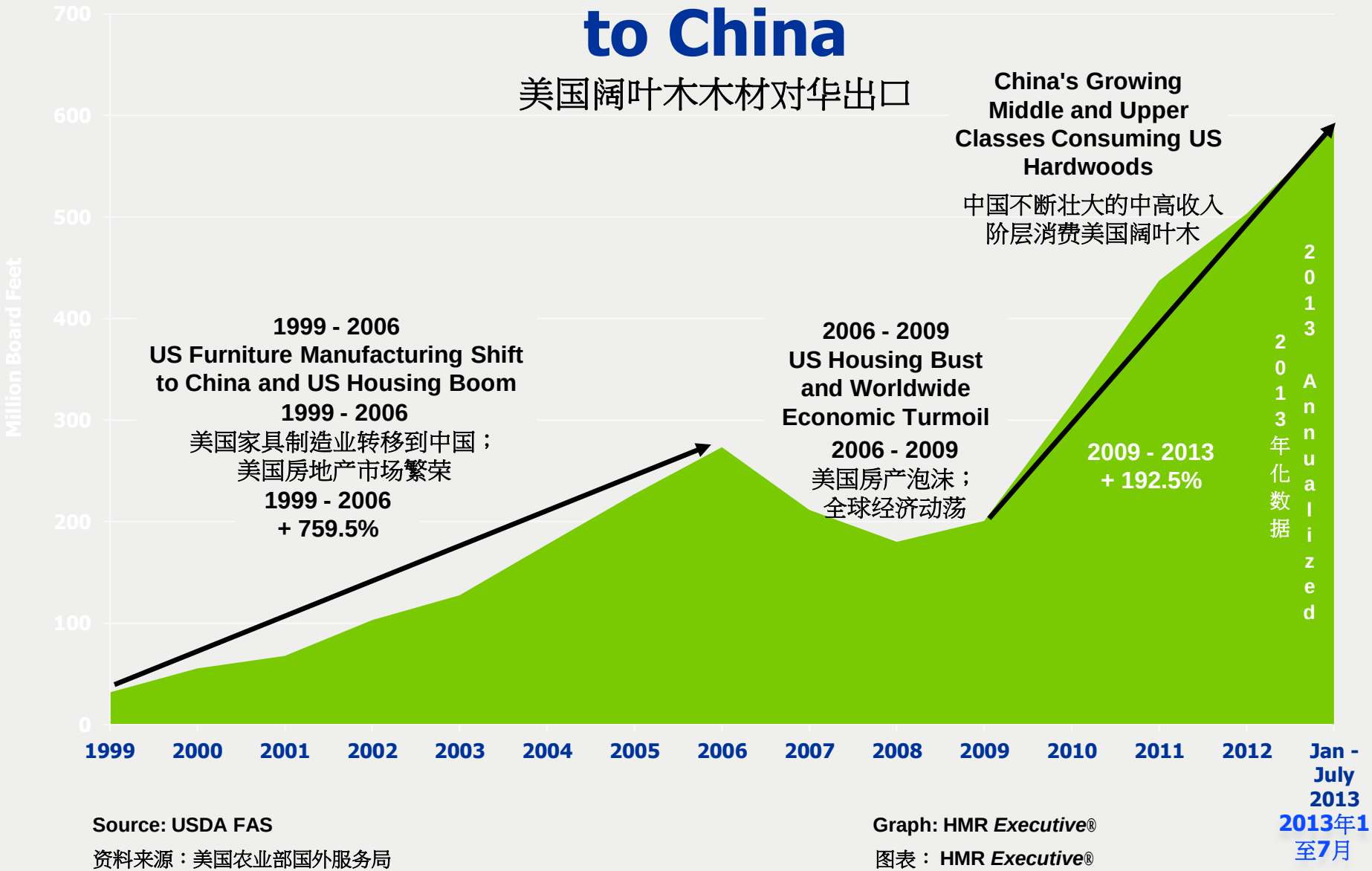


Source: Global Trade Atlas

资料来源: 全球贸易数据库

US Exports of Hardwood Lumber to China

美国阔叶木木材对华出口



Source: USDA FAS

资料来源：美国农业部国外服务局

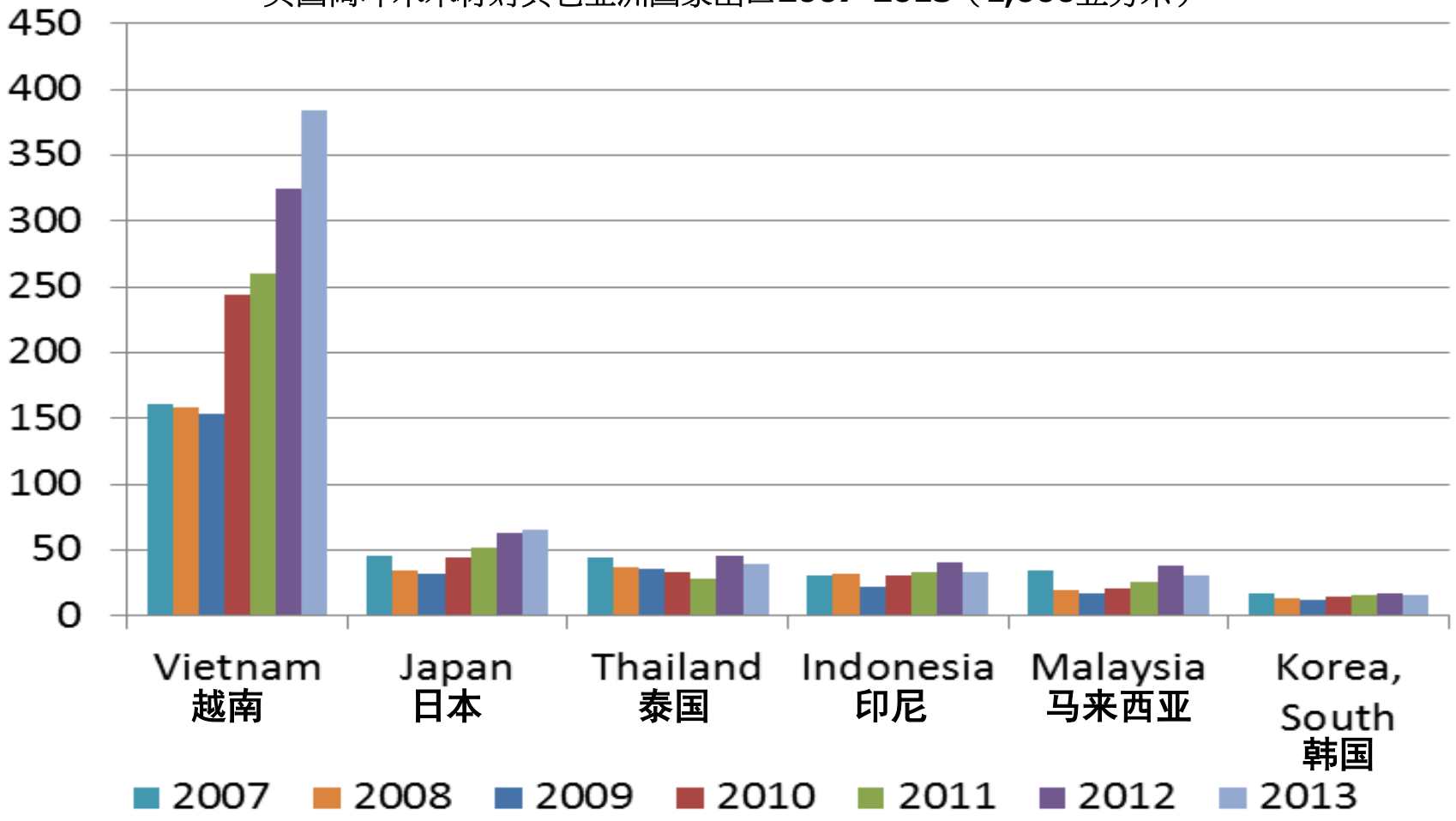
Graph: HMR *Executive*®

图表： HMR *Executive*®

2013年1至7月

US hardwood lumber exports to other Asian countries 2007-2013 (1000 m3)

美国阔叶木木材对其它亚洲国家出口**2007-2013**（**1,000**立方米）



Source: USDA GATS

资料来源： 美国农业部 服务贸易总协定

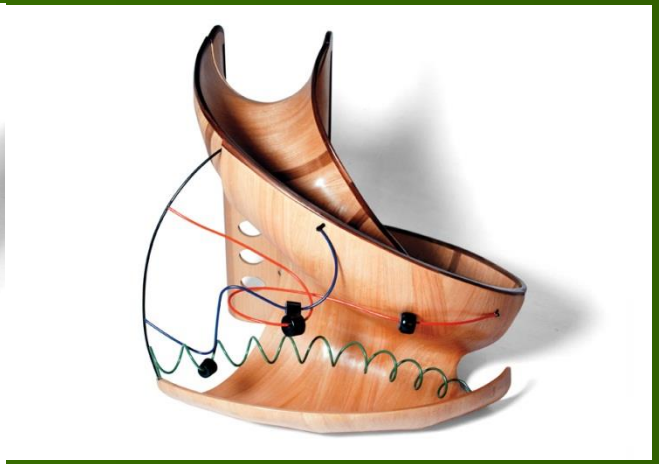
Furniture Design Competitions
家具设计竞赛

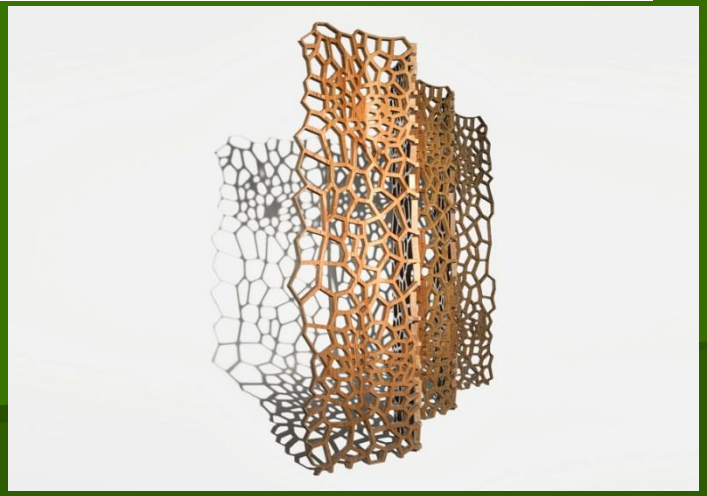
2011美国阔叶木外销委员会大中华区家具设计大赛
创无限
2011
AMERICAN HARDWOOD EXPORT COUNCIL
greater china furniture design competition

THE 3rd INDONESIA FURNITURE DESIGN COMPETITION
AMERICAN HARDWOOD EXPORT COUNCIL
Category: CREDENZA (IFDC)

AHEC Furniture Design Awards-Mexico

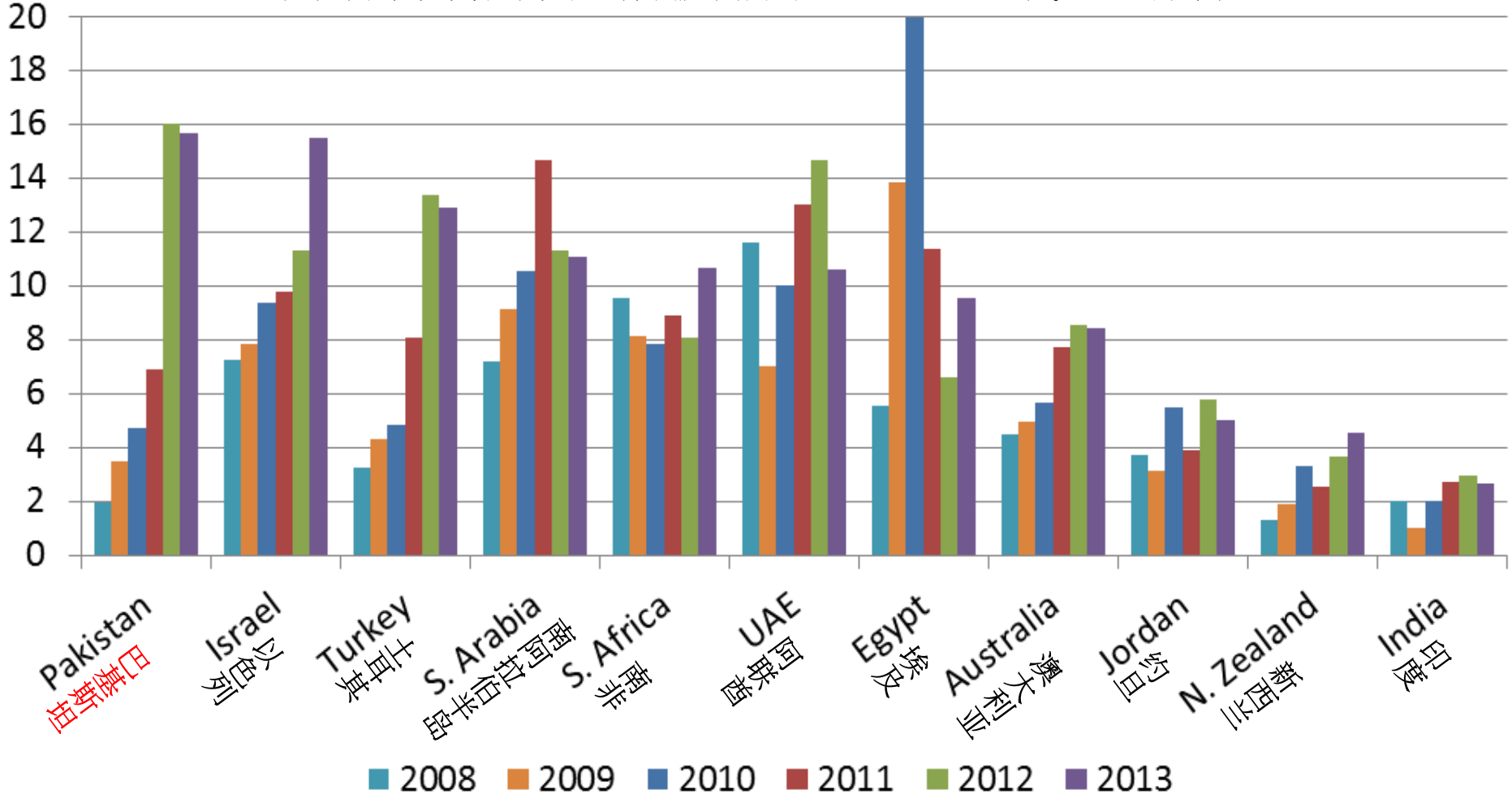
AHEC家具设计奖-墨西哥





US hardwood lumber exports to Middle East, Africa & Australia 2008-2013 (1000 m3)

美国阔叶木木材对中东、非洲及澳洲出口 **2008-2013**（**1,000**立方米）



Source: USDA GATS

资料来源： 美国农业部 服务贸易总协定

New Markets: Middle East (Dubai 1990)
新市场：中东（**1990**年的迪拜）

New Markets: Dubai (2007)
新市场：迪拜（**2007**年）

Dubai 2014
迪拜 **2014**

The Hub, Dubai by LW Design.

迪拜中心，LW Design作品。

American white oak

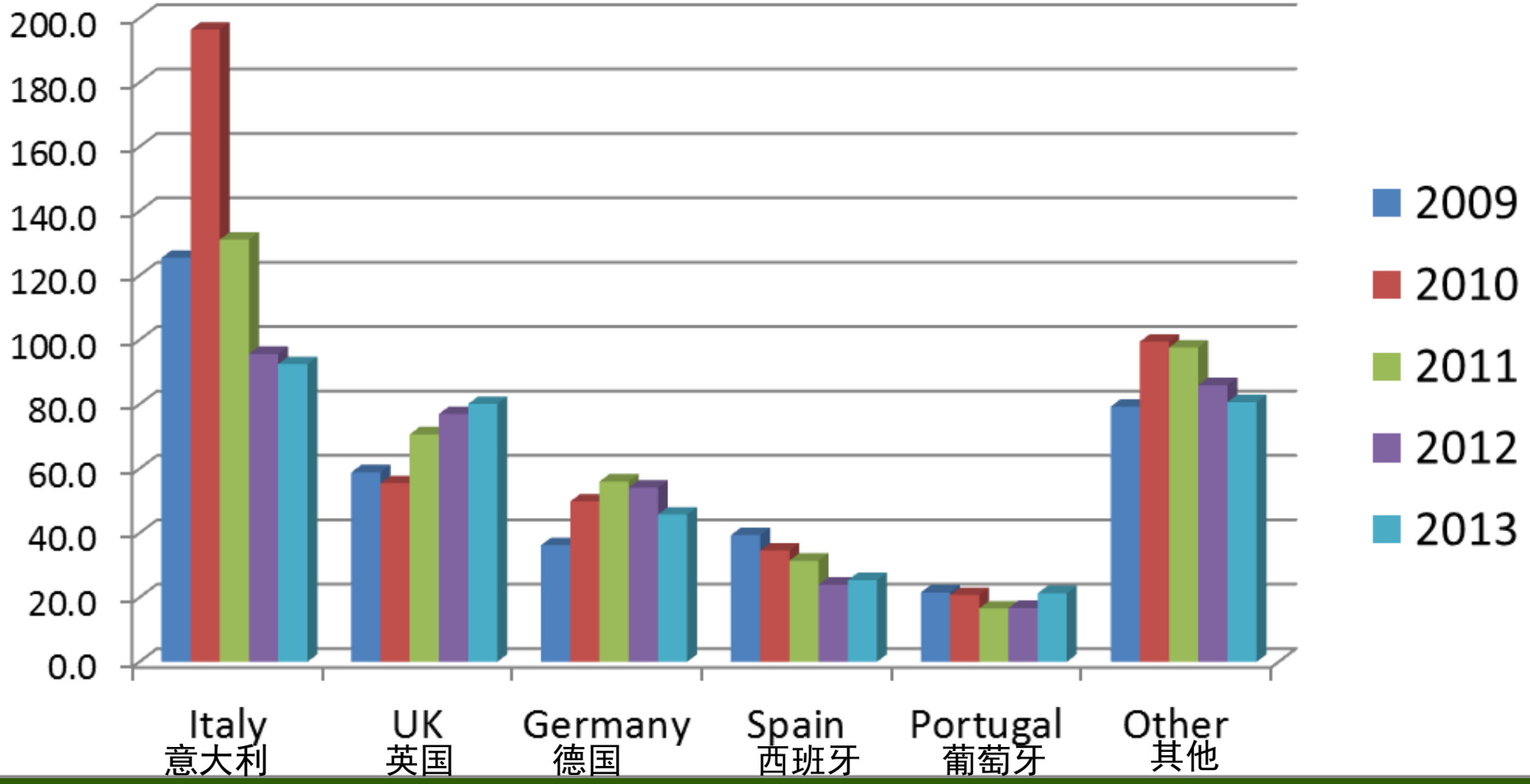
美国白橡木

Winner of the AHEC-sponsored Middle East Commercial Interior Design Awards 2013

获得AHEC赞助的2013年中东商业室内设计大奖

US hardwood lumber exports to European destinations
Years 2009-2013 (1000 m3)

美国阔叶木木材对欧洲出口 **2009-2013（1,000立方米）**



Source: USDA GATS

资料来源： 美国农业部 服务贸易总协定

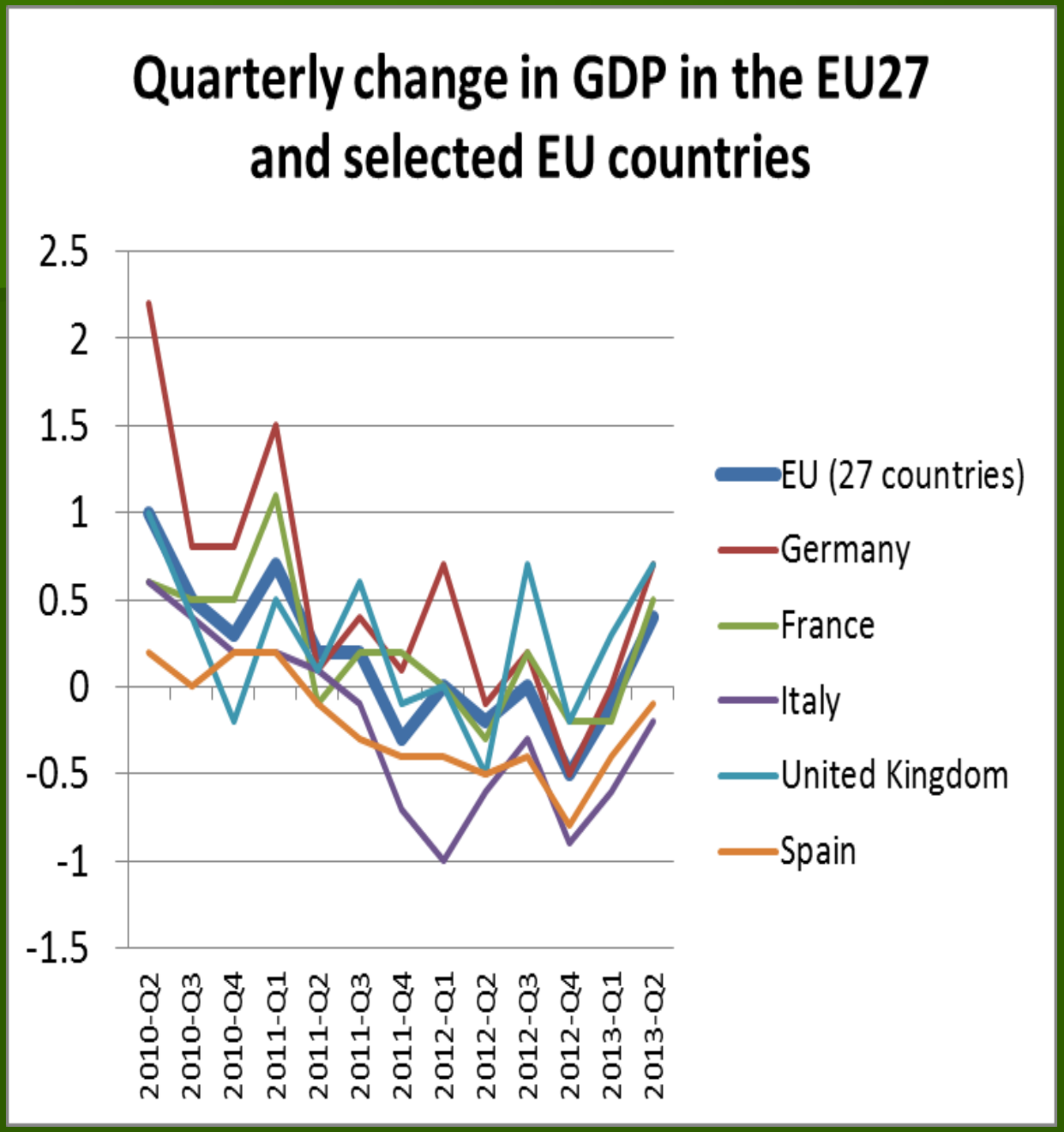
Long term decline in EU construction

欧盟建筑业长期下滑

Total value of construction across the EU in August 2013 was 10% lower than in 2010 and 25% down on 2008.

2013年8月，整个欧盟的建筑项目总额比2010年低10%，较2008年下降25%。

Source: Eurostat *资料来源：欧盟统计局*



Source: Eurostat *资料来源：欧盟统计局*

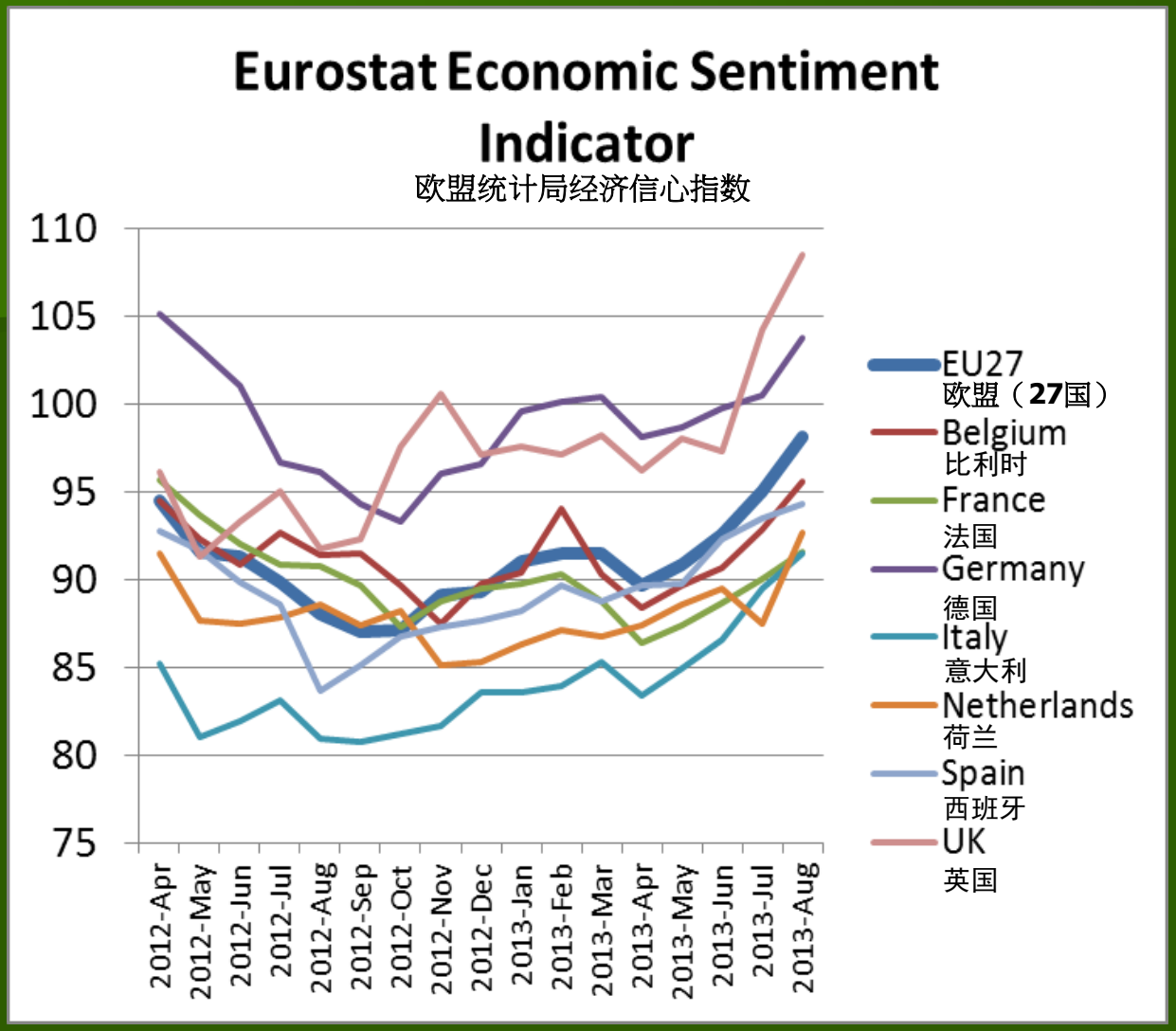
Early signs of economic recovery
经济复苏的早期迹象

GDP in 2nd Qtr of 2013 compared to 1st Qtr
2013年第二季度GDP与第一季度比较

EU as whole: +0.4%
欧盟整体：+ 0.4%

Gains in Germany (+0.7%), the UK (+0.7%) & France (+0.5%)
德国增长(+ 0.7%)，英国(+ 0.7%)，法国(+ 0.5%)

GDP fell but at a slower pace in Italy (-0.2%) and Spain (-0.1%)
意大利GDP下降但幅度较小(-0.2%)，西班牙同样(-0.1%)



Eurostat index based on monthly survey of expectations in five surveyed sectors (industry, services, retail trade, construction and consumers). Index > 100 above average sentiment, index < 100 below average sentiment

欧盟统计局指数采用月度调查形式了解人们对五个被调查行业的预期(工业、服务业、零售贸易、建筑和消费者行业)。指数> 100表示高于平均信心水平，指数< 100表示低于平均信心水平

Improvement in economic sentiment
经济信心改善

Index rising strongly and above average in Germany and the UK
德国和英国信心指数增长强劲，高于平均水平

Rising, but still below average in Belgium, France, Germany, Italy, Netherlands and Spain
比利时、法国、德国、意大利、荷兰和西班牙信心指数上升，但仍低于平均水平

EUTR requirements for due diligence system
欧盟木材法规(EUTR)尽职调查系统要求

- Operators must have "access to information" on species, product type, quantity and “place of harvest”
- “Place of harvest” = country of harvest if risk profile does not vary between regions or forest management units
- Satisfied for US hardwoods through:
  - Shippers invoice - describes goods, value and identifies exporter.
  - Phytosanitary certificates for most shipments - exporter's name, statement of U.S. origin, species scientific name, shipment quantity.
- Operators must have access to “documents or other information indicating [legal] compliance“
  - Satisfied for US hardwoods by Seneca Creek study - independent peer reviewed risk assessment demonstrating negligible risk of any US hardwood being illegally sourced

- 运营商必须“获取”有关物种、产品类型、数量和“伐木地点”的“信息”
- 如果风险状况不随地区或森林管理单位变化而变化，则“伐木地点”=木材被伐所在国家
- 美国阔叶木需要符合如下要求
  - 托运人发票——描述货物、价值并标识出口商
  - 适用大多数运输的植物检疫证书——出口商名称、美国原产地声明、物种学名、运输数量。
- “ 运营商必须能够获取“表明（法律）合规的文档或其他信息”
  - 美国阔叶木通过Seneca Creek 研究符合规定——独立的同行审查风险评估，用以证明任何美国阔叶木拥有非法来源的风险可忽略不计

Consignment-based *American Hardwood Environmental Profile* (AHEP)

基于运输货物的美国阔叶木环境总则

American Hardwood Environmental Profile

Data is provided on the environmental impact to deliver a defined consignment of lumber of a specified U.S. hardwood species to an overseas customer (1). Data is derived from the PE LCA study of U.S. hardwoods (2), the U.S. Forest Service Forest Inventory and Analysis (FIA) program (3), the Seneca Creek Risk Assessment of Legality and Sustainability in U.S. Hardwood Exports (4), and the FSC Risk Register (5). The issuing organisation should identify the consignment and species and enter the quantity and thickness(es) of lumber. The issuing organisation may choose to use standard statements on the legality and sustainability of individual U.S. species prepared by AHEC drawn from the above referenced sources, or amend these to include specific data on their own U.S. hardwood operations. The issuing organisation may also choose to use default U.S. average values for energy consumption of the kiln and for transport distance and mode or may enter values specific to their own hardwood operations or the supply chain to the customer.

Id. number(s) (6)		Cross-refs (7)	
Issued by (8)	American Hardwood Export Council, 3 St Michael's Alley, London EC3V 9DS, UK europe@americanhardwood.org	Issued to (9)	A.N. Other Hardwood Importer GmbH, Messeplatz 1 50679 Cologne, Germany T: +49 221 821-0
Description of product (10)	Sawn wood of yellow poplar HS 4407.99.01.72	Common name(s) (11)	American tulipwood/yellow poplar
Scientific name (12)	Liriodendron tulipifera	Country of harvest (13)	USA
Sub-national region of harvest (14)	Eastern United States with concentrations in Virginia, North Carolina, Georgia, Tennessee, Kentucky and West Virginia (Figure 1)	Concession of harvest (15)	Multiple private forest owners

List up to 3 thicknesses & quantity in consignment:		Thickness	Quantity		Thickness	Quantity
	1	1 inch	1	3	3 inch	1
	2	2 inch	1		Unit of quantity	cubic meters

Legal compliance (16)

- The Seneca Creek Risk Assessment concludes that: there is negligible risk of any U.S. hardwood containing wood from illegal sources; stolen timber represents much less than 1% of total U.S. hardwood production; and there can be high confidence regarding legal compliance in the U.S. hardwood sector. See http://www.americanhardwood.org/sustainability/sustainable-forestry/seneca-creek-study/
- The FSC Global Risk Register concludes that the United States is Low Risk against all 4 FSC Controlled Wood criteria for legality. See http://www.globalforestregistry.org/map.
- U.S. hardwood companies are regulated by the Lacey Act requiring declarations for all U.S. timber imports & imposing sanctions on U.S. companies found in possession of timber sourced contrary to the laws of any country.

Sustainable forestry (17)

- The PE LCA study concludes with respect to land-use change: "in the system under investigation the main material – wood – comes from naturally re-grown forests. The harvested areas had undergone several iterations of harvesting and re-growth. After harvesting, the land is returned to forest so there is no direct land use change to account for in the timeline of a few hundred years".
- On biodiversity impacts, the PE LCA study concludes that: "Conversion of any other commercial land into the hardwood forest would most probably be a positive impact on the land quality including biodiversity and associated ecosystem services".
- FIA data indicates that tulipwood makes up 7.5% of U.S. hardwood standing volume. The tulipwood resource is not only renewable, but is expanding. Tulipwood in the U.S. forest is growing at a rate of 35 million m3/per year while the harvest is 17 million m3 per year. The net volume (after harvest) is increasing by 18 million m3 each year. According to FIA data, annual forest growth exceeds harvest in all states with the exception of Delaware (Figure 2) where special controls have now been introduced to protect the species.
- The Seneca Creek Risk Assessment concludes that there is Low Risk of U.S. hardwoods being derived from any of the five categories of controversial forest source identified in the FSC Controlled Wood standard.

Figure 1: Distribution of tulipwood/yellow poplar

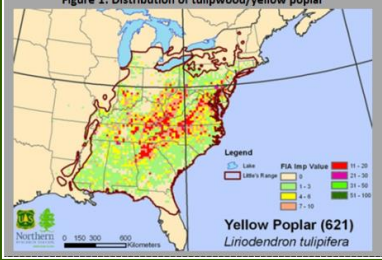
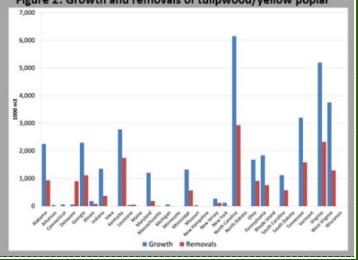


Figure 2: Growth and removals of tulipwood/yellow poplar

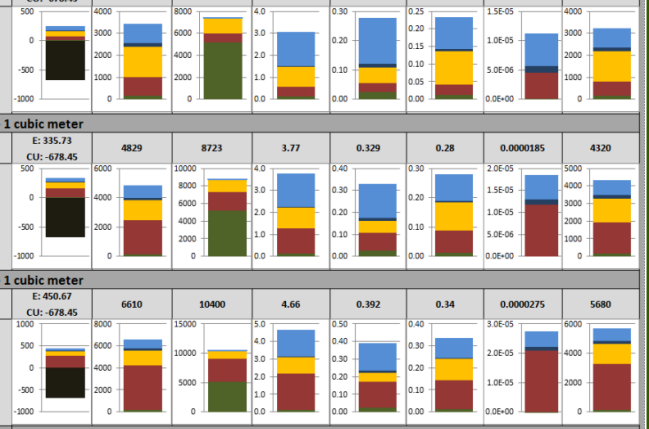


Life cycle assessment (cradle to gate plus transport) (18)

The following charts show the environmental impact of delivering this consignment to the overseas customer. The data is derived from the ISO-conformant LCA model prepared by PE. The Parameters table summarises all values entered by the issuing organisation. All other parameters required to calculate the environmental profile are derived and fixed in the model by PE. Results are categorised according to process steps (forestry, sawmill, kiln drying, transport forest to kiln, transport kiln to customer, and carbon uptake).

Impact category:	Global Warming Potential	Primary Energy Demand from Resources	Primary Energy Demand from Renewables	Acidification Potential	Eutrophication Potential	Photochemical Ozone Creation Potential	Abiotic Depletion Potential (Elements)	Abiotic Depletion Potential (Fossil)
Unit	kg CO2-equiv.	MJ	MJ	kg SO2-equiv.	kg PO42-equiv	kg Ethene-equiv.	kg Sb-equiv.	MJ
1" lumber - 1 cubic meter								
Total	E: 242.60 CU: -678.45	3420	7370	3.04	0.277	0.233	0.0000112	3210
2" lumber - 1 cubic meter								
Total	E: 335.73 CU: -678.45	4829	8723	3.77	0.329	0.28	0.0000185	4320
3" lumber - 1 cubic meter								
Total	E: 450.67 CU: -678.45	6610	10400	4.66	0.392	0.34	0.0000275	5680

Data by process steps



Key: Carbon uptake ■ Forestry ■ Kiln drying ■ Sawmill ■ Transport forest-kiln ■ Transport kiln-customer

Description of impact categories

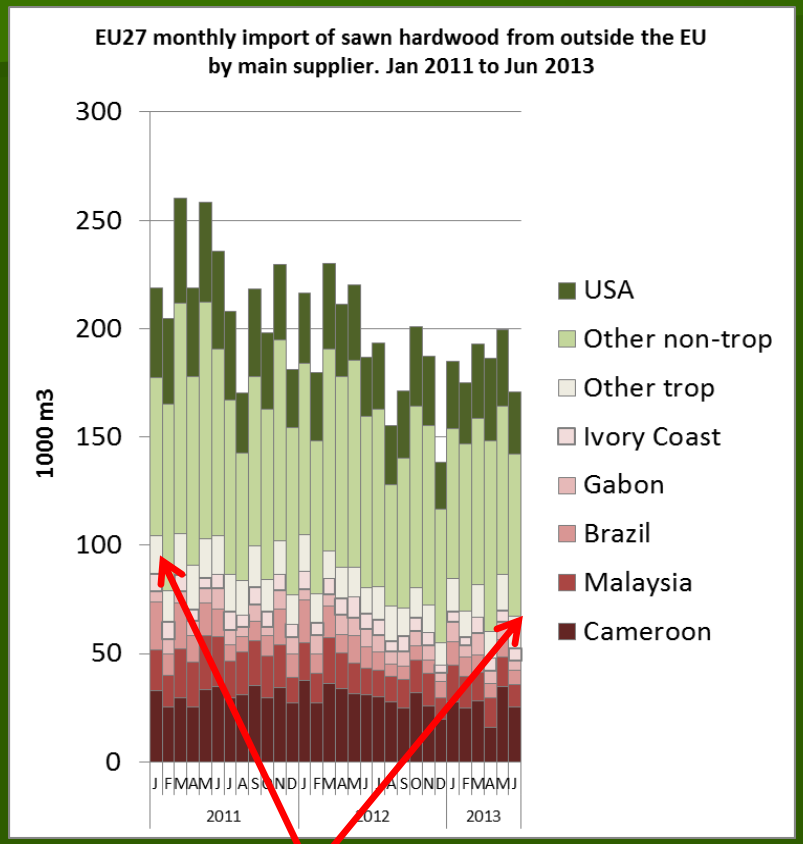
Global Warming Potential	Often termed "carbon footprint". Expressed in kg of carbon dioxide equivalent. The sum of the warming potential of all gases emitted (including carbon dioxide, methane and water vapour) which influence the energy balance of the atmosphere leading to increased average temperatures. Data is reported separately for all greenhouse gas emissions (E) from processes to extract, process and deliver the timber and for carbon uptake (CU) during tree growth (which is a negative number in GWP terms).
Primary energy demand (resources)	Use of fossil fuels in mega-joules. The impact category has limited application on its own because it does not differentiate between energy sources (e.g. oil or coal). Nor does it represent "embodied energy". However it is an important driver of other environmental impacts including global warming, acidification, eutrophication, and resource depletion.
Primary energy demand (renewables)	Use of energy derived from renewable raw materials in mega-joules.
Acidification Potential	Potential for acidification of soil and damage to plant health resulting from emissions to air, water and land of acidifying compounds such as sulphur dioxide (SO2) and nitrogen oxides (NOX). Expressed in kg of sulphur dioxide equivalent.
Eutrophication Potential	Nutrient enrichment of waters by release of phosphorous or nitrogen compounds (such as fertilisers) and organic matter (e.g. in effluents). This causes excess growth of plant matter and depletion of oxygen levels in the water. Expressed in kg of phosphate equivalent.
Photochemical Ozone creation Potential	Often referred to as "photochemical smog". Increased levels of ozone at ground level arise through the reaction of volatile organic compounds, for example ethene, with oxygen compounds or oxides of nitrogen in air and under the influence of sunlight. The problem afflicts modern cities and impacts human health and reduces vegetative production. Expressed in kg of ethene equivalent.
Abiotic depletion potential (Elements)	Measures depletion of non-renewable mineral resources. Compiled from the ratios of annual production to size of remaining reserves for all minerals consumed. Expressed in relation to the ratio for the mineral Antimony (SB).
Abiotic Depletion Potential (Fossil)	Measures depletion of non-renewable fossil resources in mega-joules.

Parameters and assumptions

Kilning	Kiln Efficiency (%) (19)	53	Kiln Thermal Energy (kwh/day,MBF,inch) (20)	25	Kiln Power (kwh/day,MBF,inch)	17	Kilning assumptions	Default US hardwood industry average calculated by PE drawing on data from AHEC members	
	Kiln fuel for thermal energy (%) (22)		Biomass	Heavy fuel oil	Light fuel oil	Natural gas			
			90	0	0	10			
Transport		Truck	Rail	Ship	Transport assumptions				
	Forest to sawmill (km)	116			Default US hardwood industry average for US hardwood drawn from AHEC-PE LCA study				
	Sawmill to kiln (km)	103			Default US hardwood industry average for US hardwood drawn from AHEC-PE LCA study				
	Kiln to port (km)	655			Central point of US tulipwood harvest region to Norfolk, the leading US East Coast port for tulipwood				
	Port to port (km)			6818	Sea distance from Norfolk Terminal to Bremerhaven Terminal				
	Port to customer (km)	350			Road distance from port of Bremerhaven to Cologne				

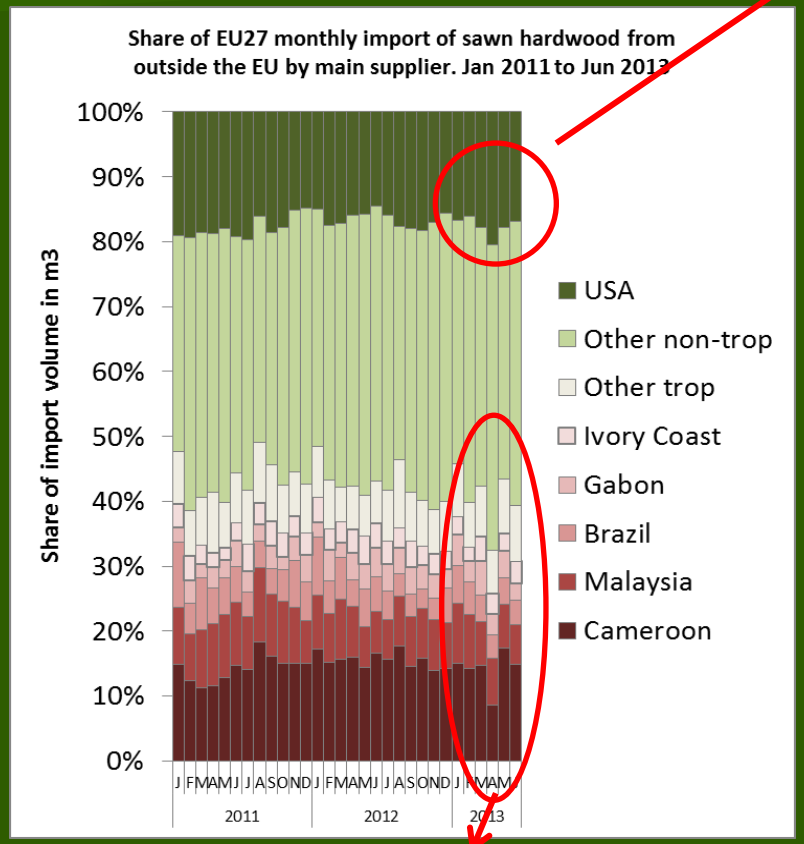
Will EUTR lead to decline in tropical timber imports?

EUTR会导致热带木材进口下降吗?



Long term decline in tropical imports continues

热带木材进口的长期下降趋势仍在持续

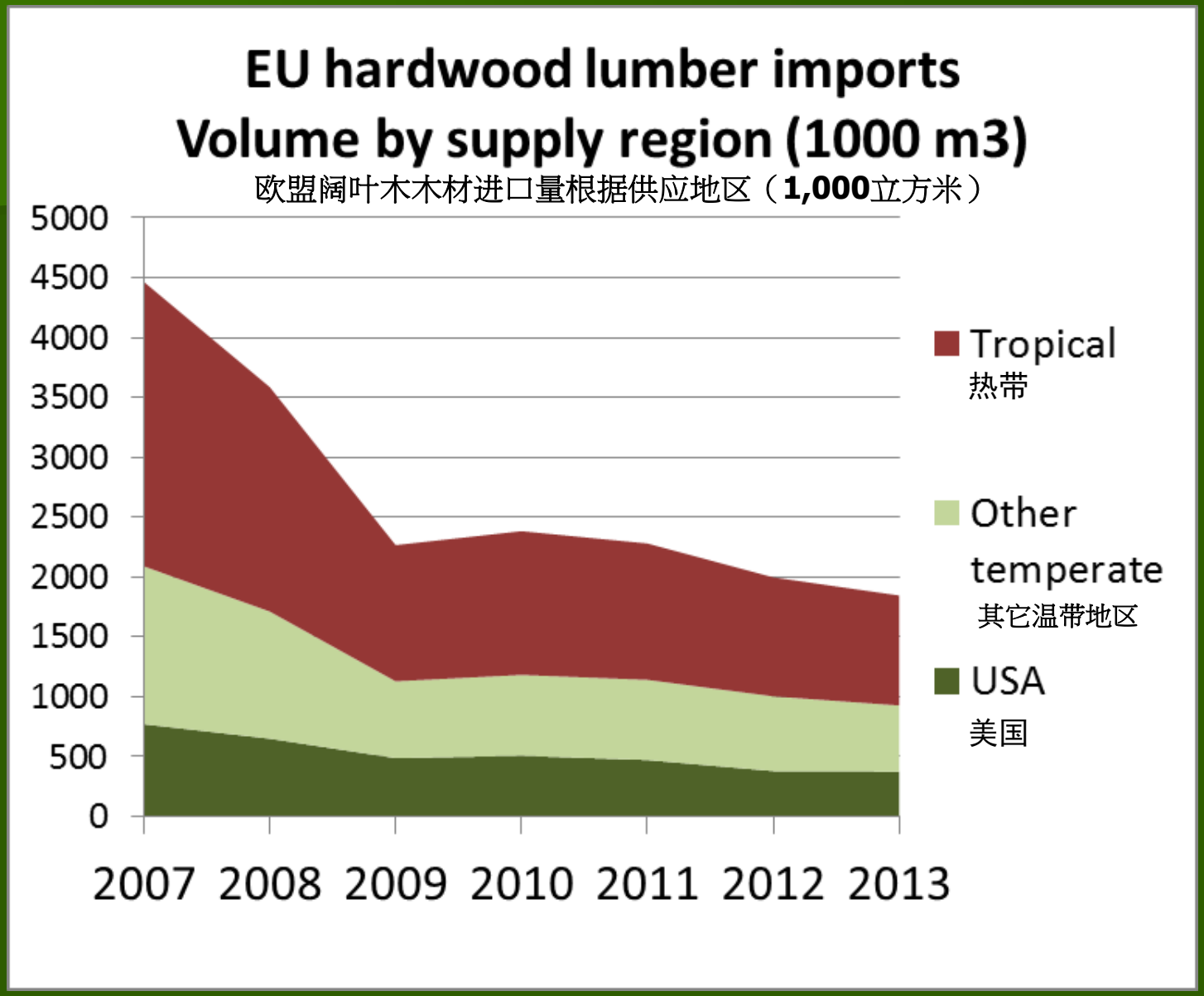


US hardwood rising share??

美国阔叶木份额上升?

Tropical imports have been particularly volatile in 2013. Imports from Cameroon declined sharply in April but rebounded in May.

2013年热带木材进口波动尤为剧烈。4月份从喀麦隆的进口大幅下降，但5月份反弹。

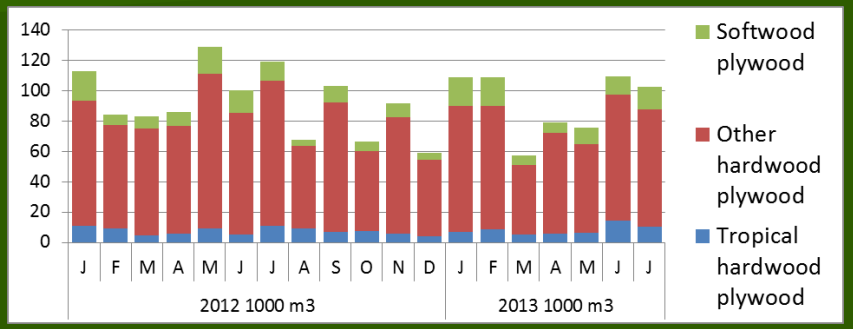


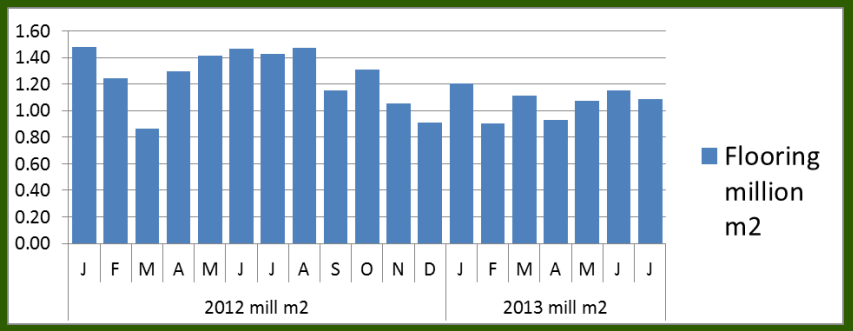
Source: FII Ltd drawing on Eurostat ***FII Ltd 据欧盟统计局分析结果***

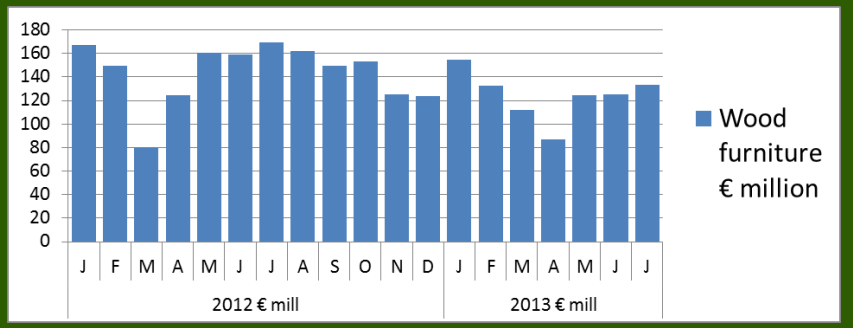
Will EUTR lead to decline in EU imports from China?
EUTR会导致欧盟从中国的进口下降吗?

- Possible in plywood, flooring & furniture sector due to complexity & opacity of supply chain
  由于供应链的复杂性和不透明性，在胶合板、地板和家具行业可能出现下降
- Search for replacements to PNG bintangor & Russian hardwoods
  寻找PNG巴布亚红厚壳木和俄罗斯阔叶木的替代品
- Further encouraging shift from Russian oak to US oak in furniture & flooring supplied to EU
  进一步鼓励出口欧盟的家具及地板用材从俄罗斯橡木向美国橡木转变
- Chinese manufacturers encouraged to cut out traders & buy direct
  鼓励中国制造商直接购买，以减少中间贸易环节

EU27 monthly imports of product from China
欧盟27国每月从中国进口的产品







Finding New Market Segments in "Mature" Markets:
在"成熟"市场中寻找新的细分市场

1) Exterior Uses for American Hardwoods
   美国阔叶木的室外使用
2) Structural Uses
   结构性使用

Research and Testing for New Applications and Technologies
新应用和技术的研究和测试

External Joinery

室外细木工制品

Infinity Bench
Designed by Martino Gamper
超级长凳 设计者：马蒂诺·甘博

Heat treated American red oak, ash, soft maple, yellow birch & tulipwood

经过热处理的美国红橡木、白蜡木、软枫木、黄桦木和鹅掌楸木

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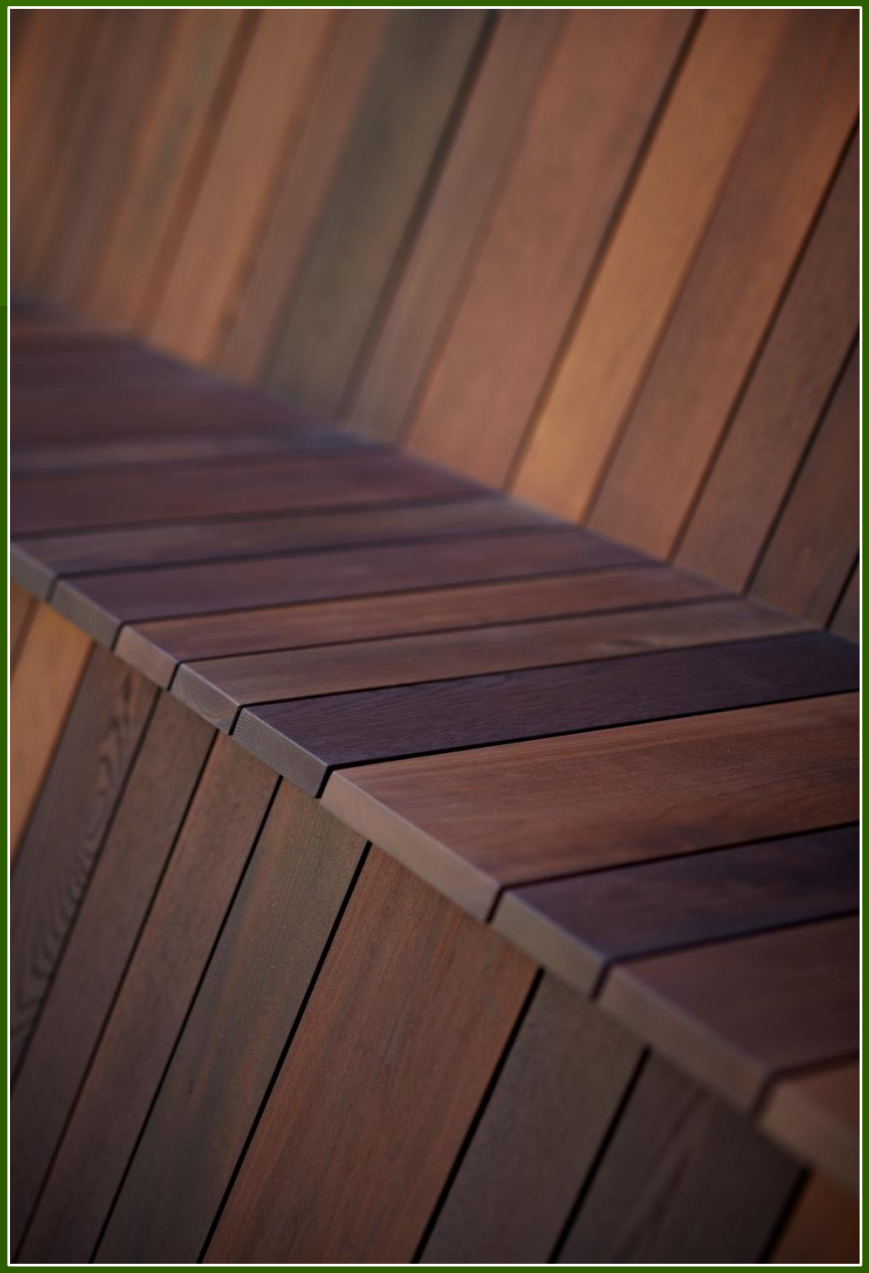
Heat treatment
热处理

Class 1 durability
一级耐久性
Improves stability
提高稳定性
Changes appearance
改变外观
Better U values
更好的U值



Tulipwood
鹅掌楸木
red oak
红橡木
soft maple
软枫木
yellow birch
黄桦木
Ash
白蜡木

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Museum of European and Mediterranean Civilisations in Marseille

位于马赛的欧洲和地中海文明博物馆

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Heat treated tulipwood cladding a commercial reality

经过热处理的鹅掌楸木覆盖一栋商业大楼

“Window of opportunity” – American tulipwood

“机会之窗”——美国的鹅掌楸木

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❶ Accoya-Kiefer strukturell modifiziert

❷ Pappel
❸ thermisch modifiziert

❹ Fichte naturbelassen

Beste Maßhaltigkeit und Dämmeigenschaften

Alle Hölzer aus nachhaltigem europäischen Anbau

Prüfzeugnisse für einbruchhemmende Sicherheitsausstattung

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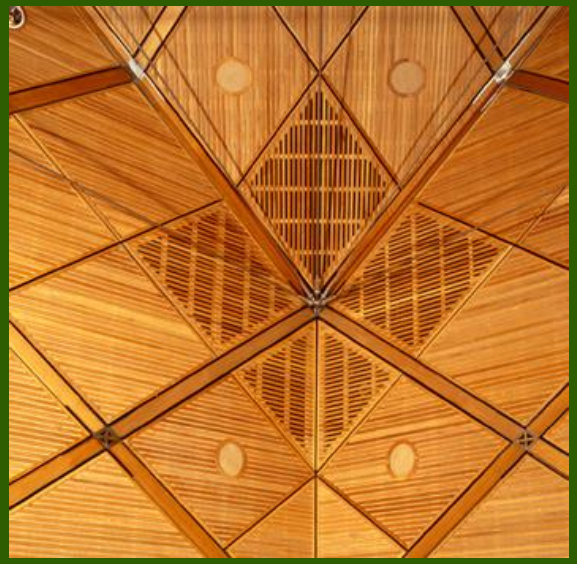
Structural Design
结构设计



Structural Design in American Hardwoods

美国阔叶木的结构设计

- **5 US Species Accepted into EU Building Codes following AHEC-Funded Strength Testing**

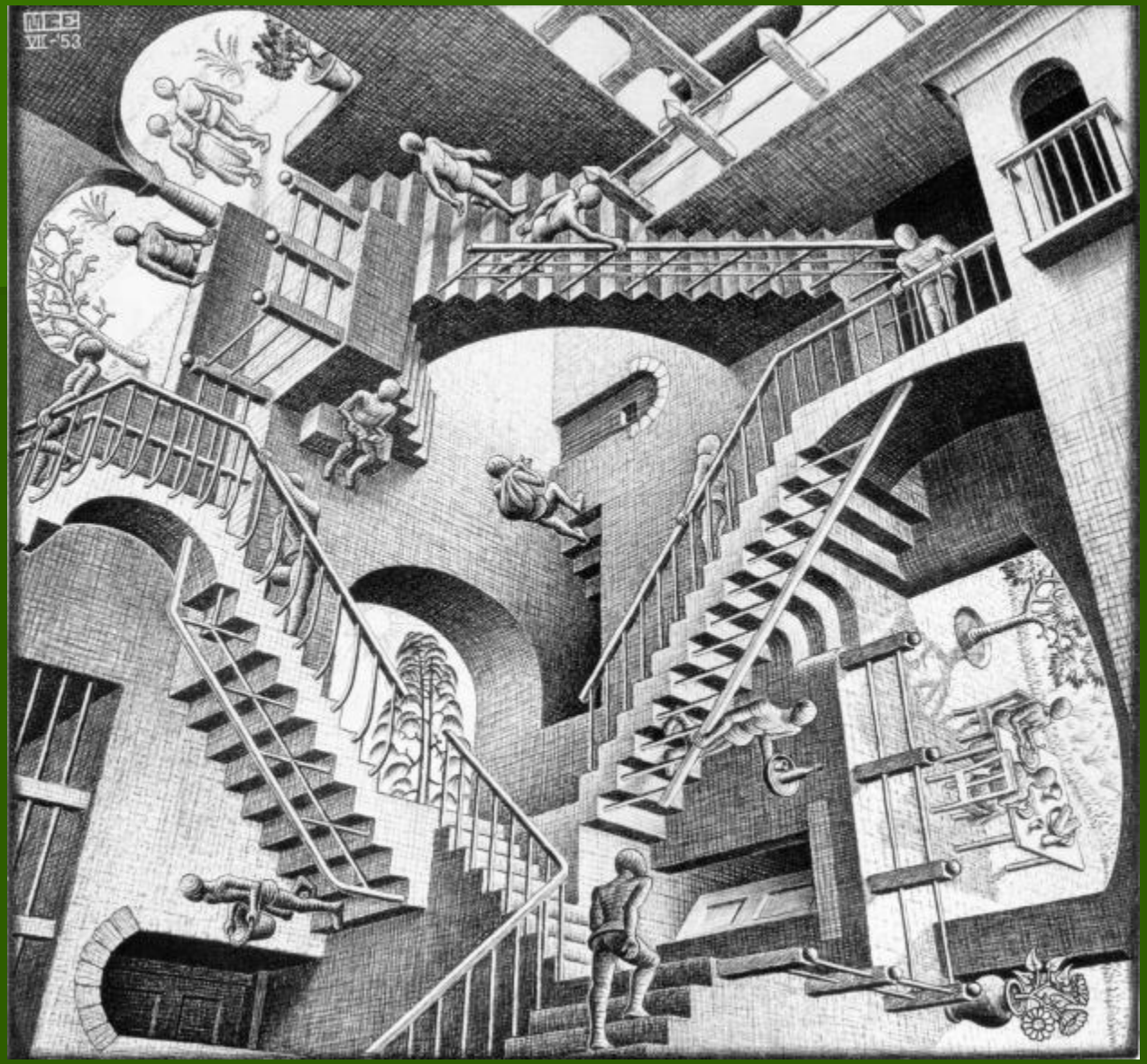
在经过**AHEC**资助的强度测试后，**5**个美国木材品种被纳入《欧盟建筑规范》

AMERICAN HARDWOOD EXPORT COUNCIL

BEMESSUNG VON HOLZKONSTRUKTIONEN MIT AMERIKANISCHEN LAUBHÖLZERN

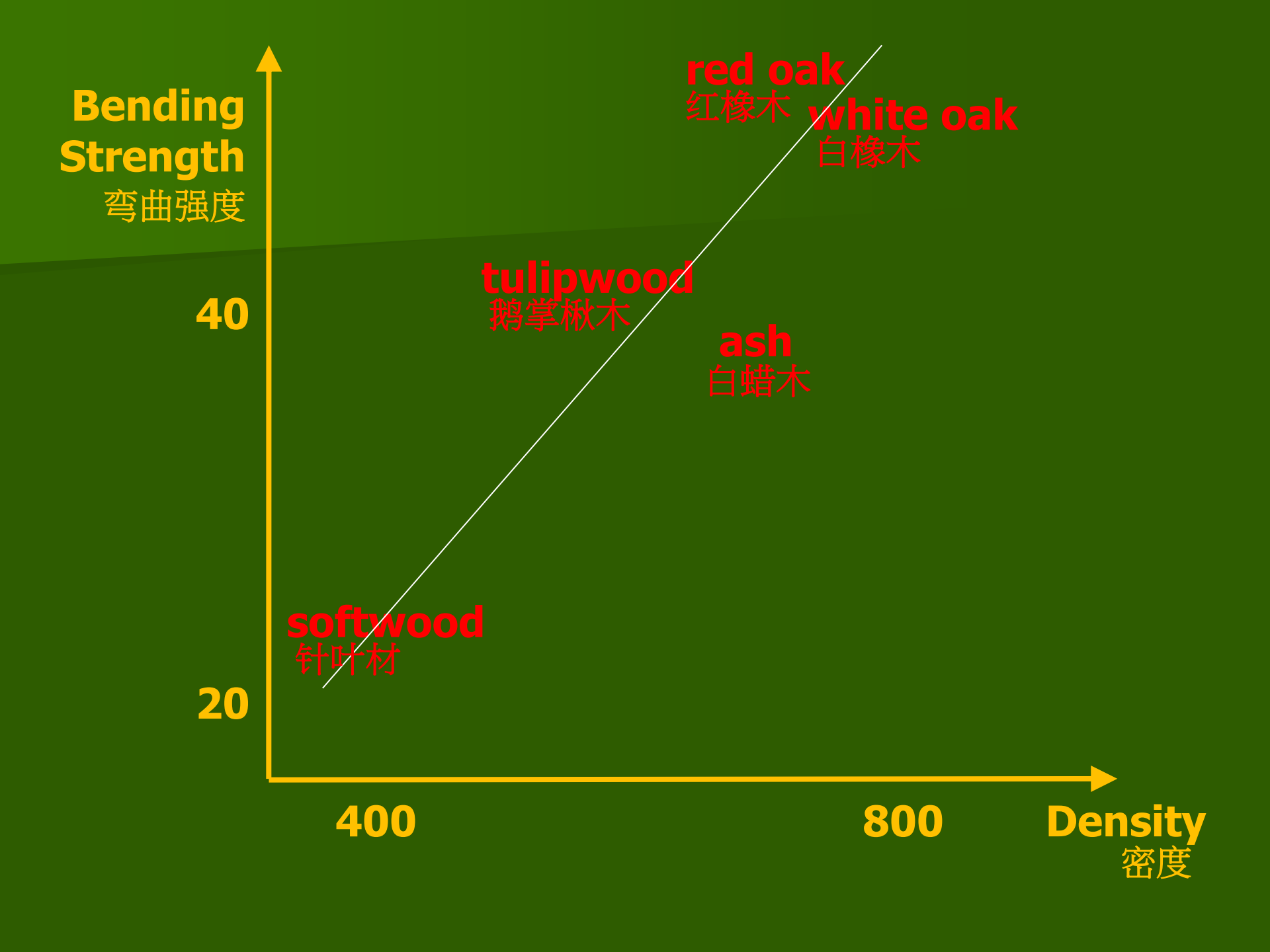
First ever production of hardwood cross-laminated timber (CLT)

史上首次阔叶木交错层压木材(CLT)生产


MCE
VII-'53

Endless Stair – adding a new dimension to timber in construction

无尽天梯：在建筑中为木材添加一个新的维度


Bending Strength
弯曲强度
40
20
400
800
Density
密度
red oak
红橡木
white oak
白橡木
tulipwood
鹅掌楸木
ash
白蜡木
softwood
针叶材

The aesthetic benefit of tulipwood 鹅掌楸木的美学优点

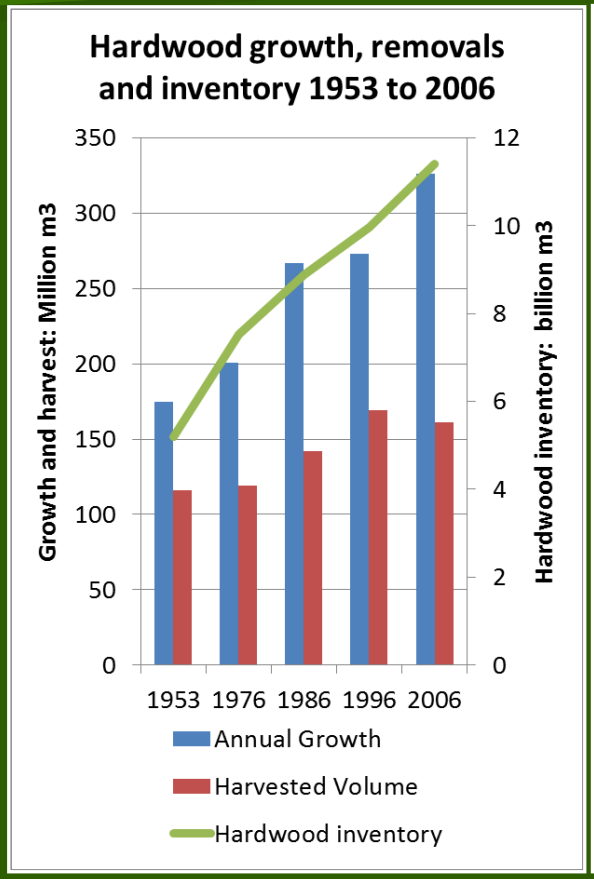
Murray Grove, London
伦敦的**Murray Grove**

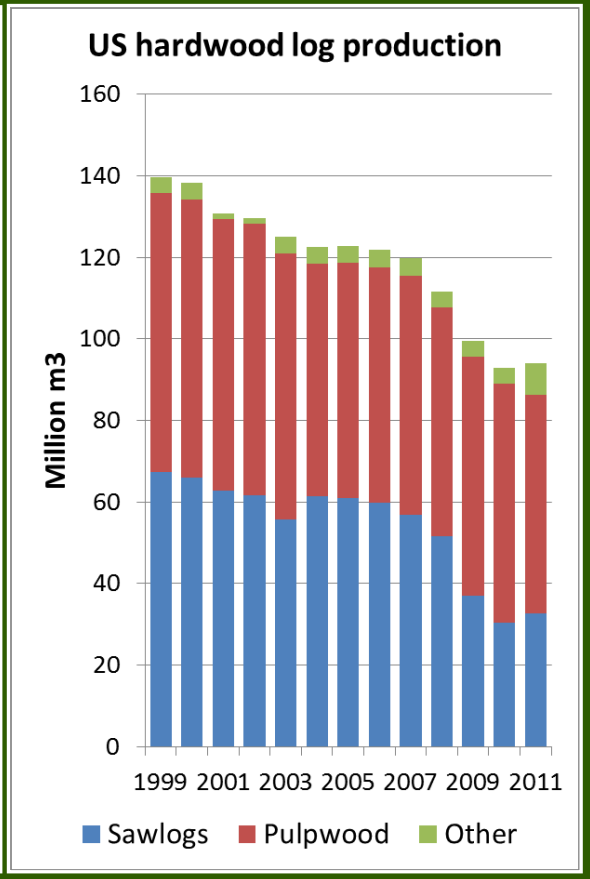
- Waugh Thistleton Architects
  Waugh Thistleton建筑师事务所
- 9 storey timber building
  9层楼的木建筑
- Cross laminated lumber
  交错层压木材
- Completed 2008
  2008年完工
- 4 carpenters assembled structure on-site at a rate of 1 storey a week
  4个木匠在现场以每周一层的速度组装结构
- Building weighs 300 tonnes
  建筑总重300吨
- ¼ weight of equivalent concrete building
  等于混凝土建筑的四分之一重量
- Saves 306 tonnes of carbon to a comparable steel and concrete tower, with 183 tonnes locked into the timber.
  相比类似钢铁混凝土大楼节省了306吨碳，且木材吸收了183吨碳。

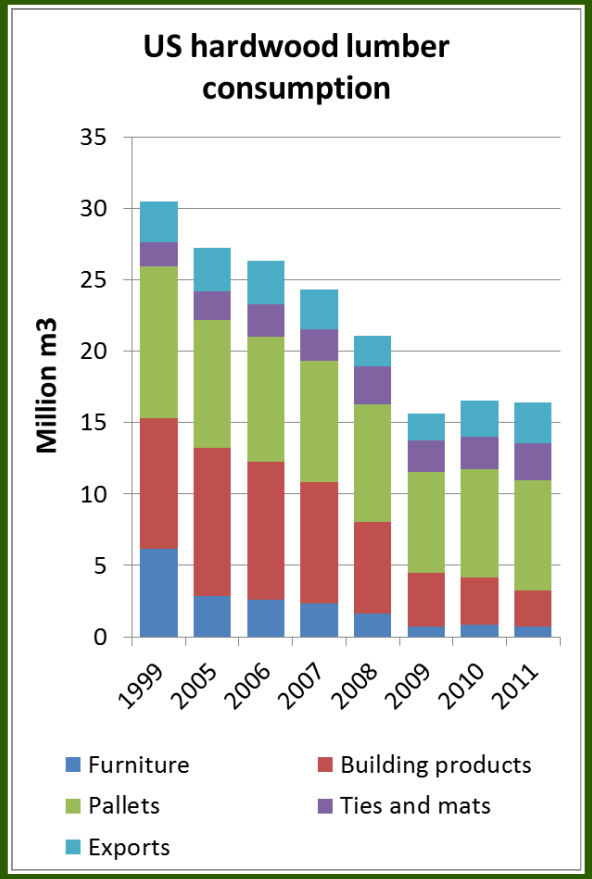
AHEC Strategy:
AHEC策略

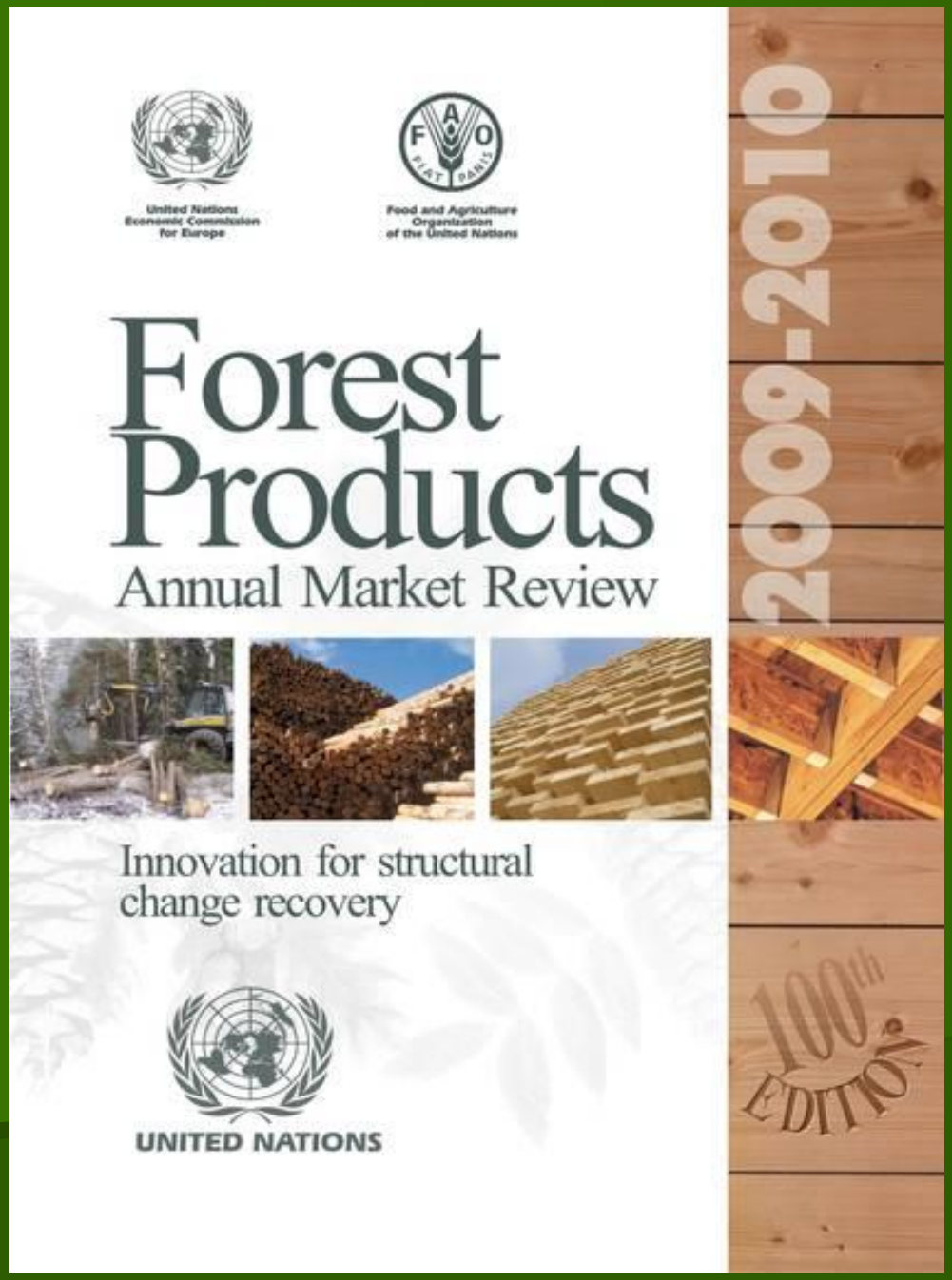
Capitalize on American Hardwoods Green Credentials
发挥美国阔叶木的绿色特质

US hardwood is under-utilised
美国阔叶木未得到充分使用



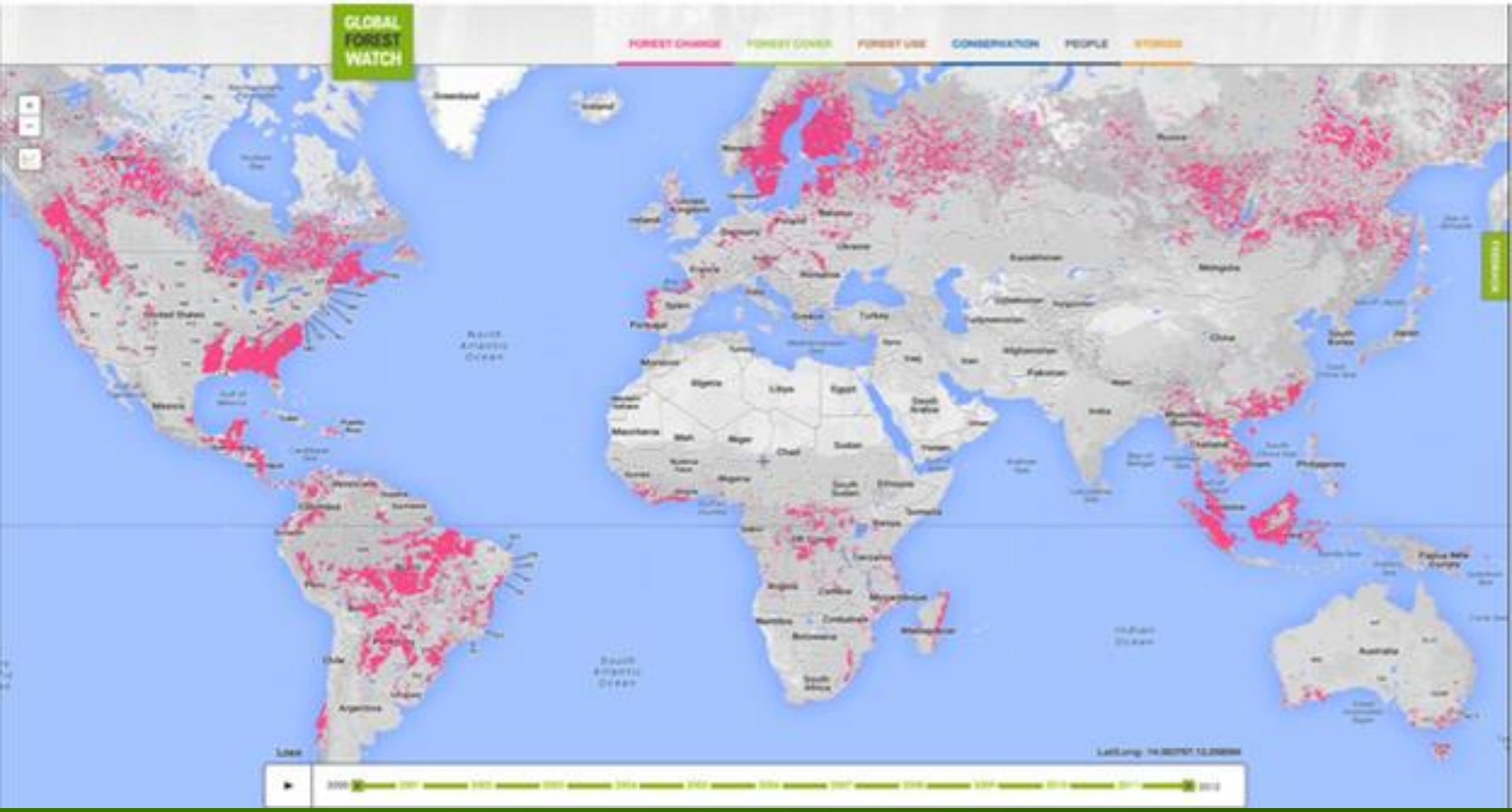






"…there is growing concern that the US hardwood resource is now being severely underutilized"

"…人们越来越担忧的是，美国阔叶木资源目前处于严重的未充分使用状态"



AP Wire/BBC News, February 23, 2014: "A new global monitoring system has been launched that promises "near real time" information on deforestation around the world. Forest campaigners say this is the equivalent of 50 football fields of trees being cut down, every minute of every day over the past 12 years."

美联社/ BBC新闻，2014年2月23日:"一个新的全球监测系统已经启动，有望发布全球各地"近乎实时的"森林砍伐信息。森林活动家表示，在过去12年中的每一天，每一分钟都有相当于50个足球场大小的树林被砍伐。"

Wood: The REAL "Green" Material

木材:真正的"绿色"材料

- **Wood outperforms all other building products**

木头优于所有其他建筑产品:

- **Recyclable and Renewable**

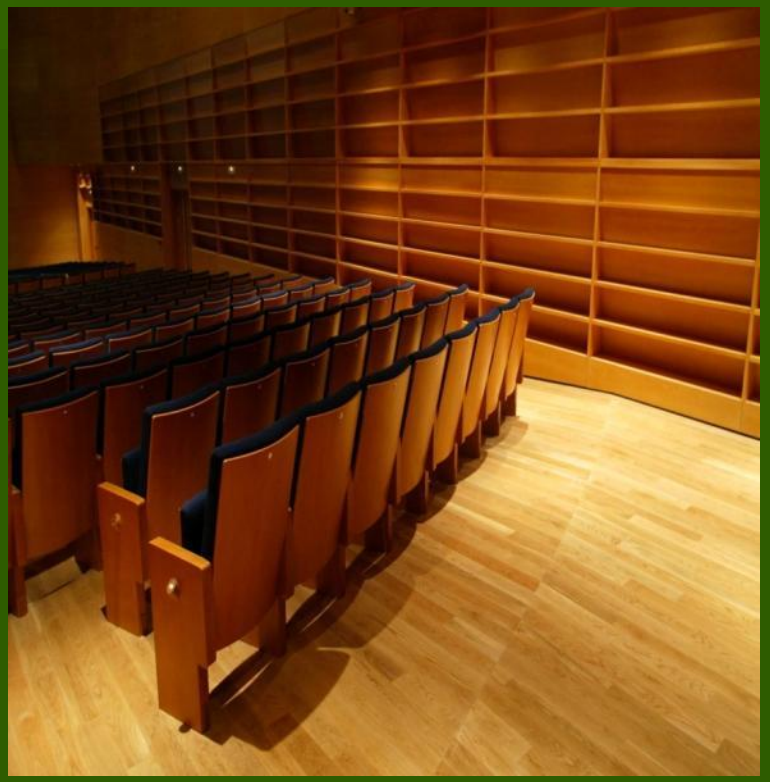
  可回收、可再生
- **Releases less effluents during manufacture**

  生产中释放更少的废弃物
- **Requires less energy**

  需要更少的能源
- **Better insulator**

  更好的绝缘性
- **Stores carbon**

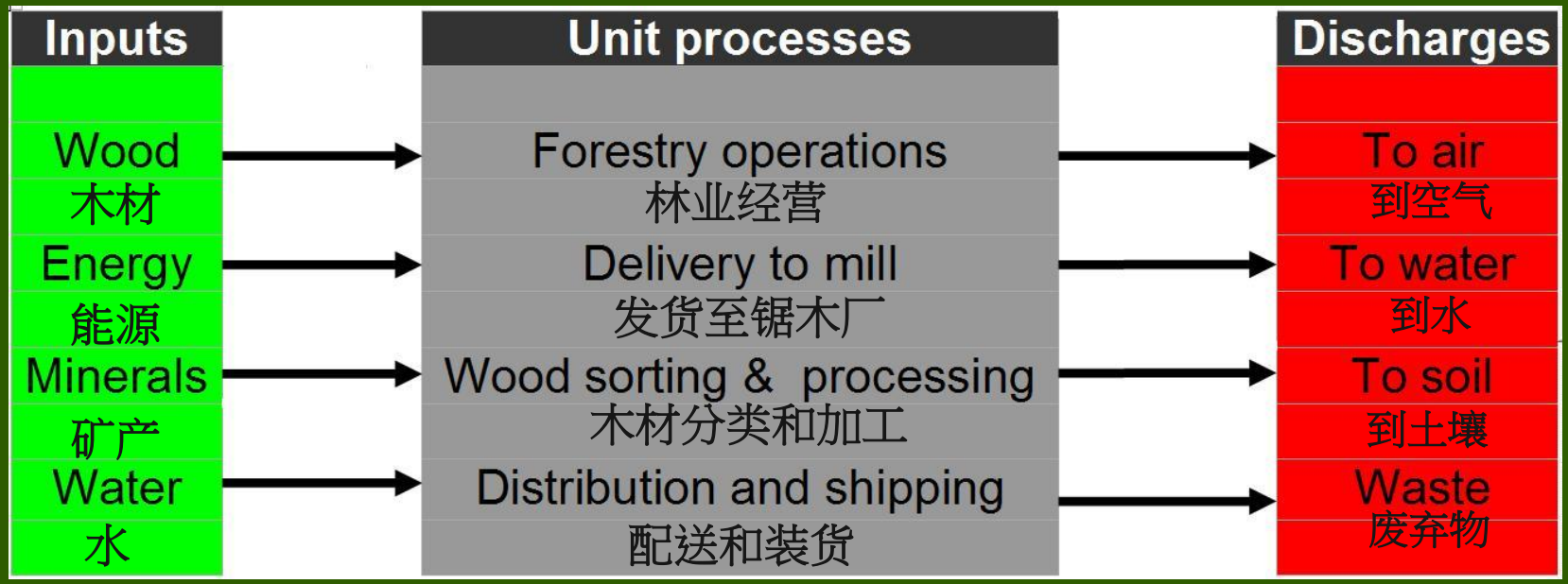
  能够储存碳



AHEC LCA Study Deliverables: Compile Life Cycle Inventory data

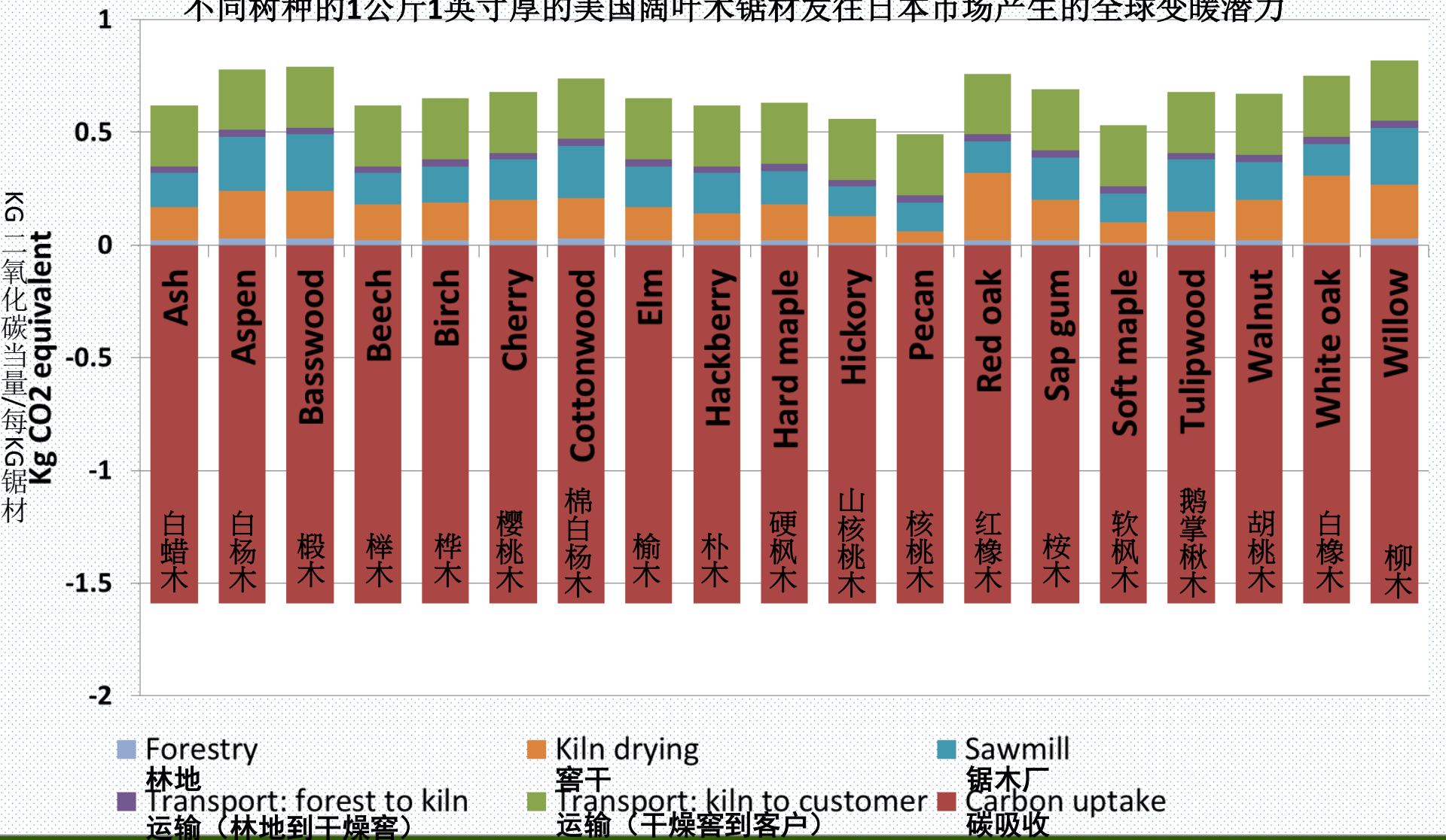
美国阔叶木外销委员会生命周期评估交付：编译生命周期清单数据

- Compile data in line with internationally recognised protocols for use in regional databases such as 根据国际公认的协议编译数据供区域数据库使用，如:
  - European Reference Life Cycle Data System (ELCD) 欧洲参考生命周期数据系统
  - The US Department of Energy Life-Cycle Inventory (LCI) Database 美国能源部生命周期清单部门数据系统
  - LCA-National Project in Japan日本的生命周期评估国家项目
- To cover major exported US hardwood species覆盖主要的出口美国阔叶木品种
- From point of extraction through to point of delivery in the EU and Asia
  从开采到输送至欧盟和亚洲



Global Warming Potential for 1 kg of different species of 1" KD US hardwood lumber delivered to the Japanese market

不同树种的1公斤1英寸厚的美国阔叶木锯材发往日本市场产生的全球变暖潜力

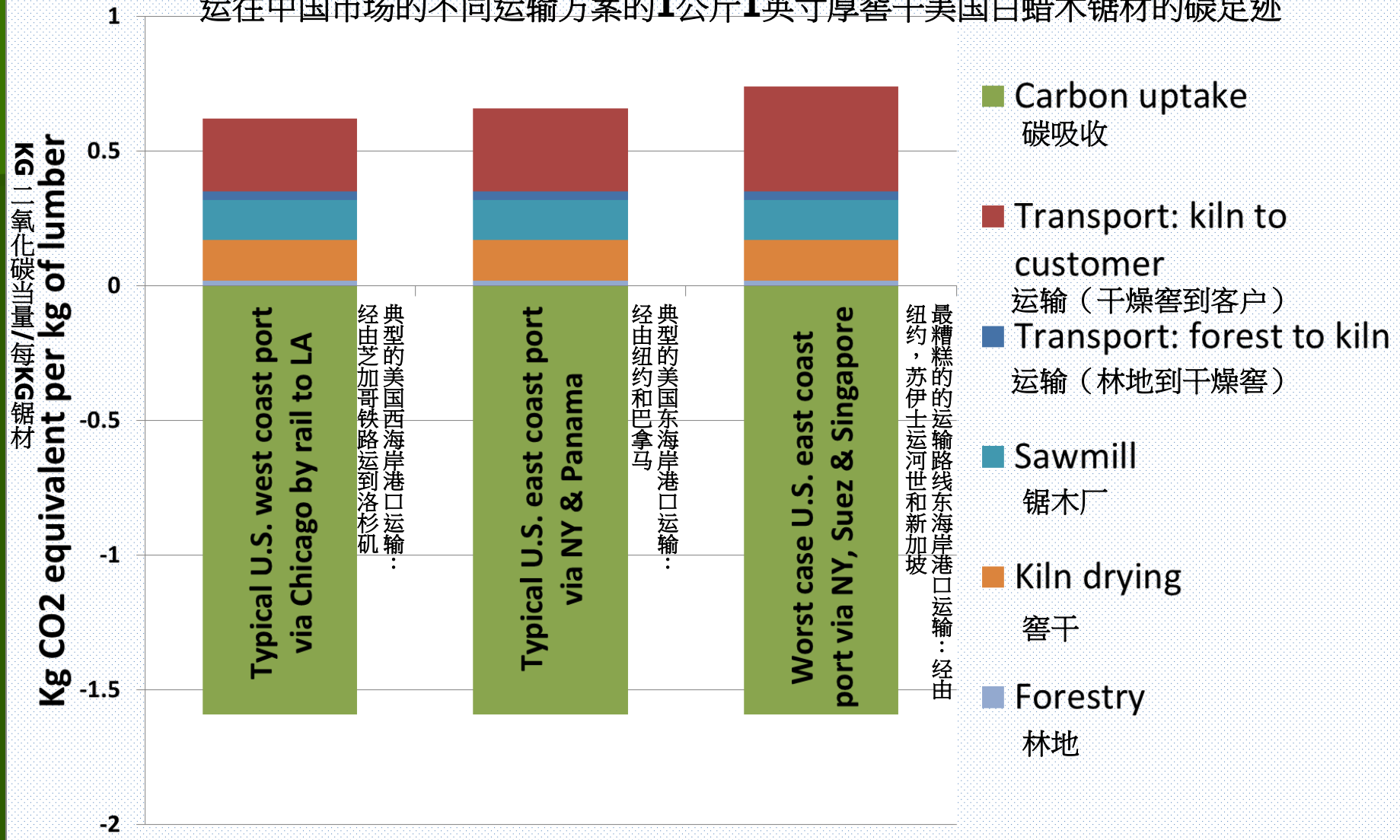


Derived from PE/AHEC ireport

来源于PE国际I美国阔叶木外销委员会的i-报告

Global Warming Potential (Carbon Footprint) of 1" KD US ash lumber for different transport routes to China

运往中国市场的不同运输方案的1公斤1英寸厚窖干美国白蜡木锯材的碳足迹



Derived from PE/AHEC ireport

来源于PE国际/美国阔叶木外销委员会的 i-报告

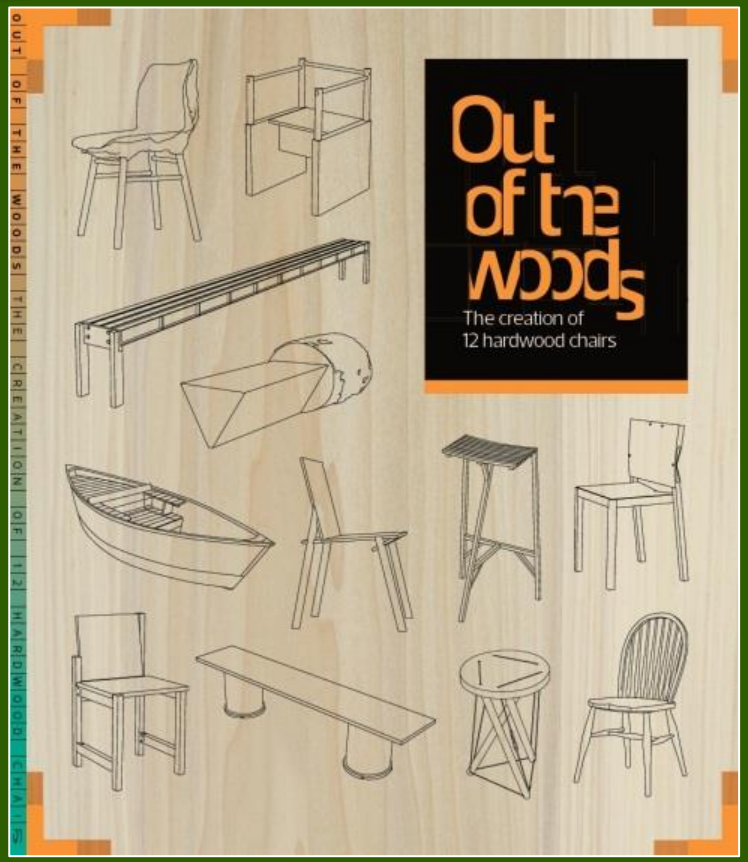
Wood: The Substitution Effect

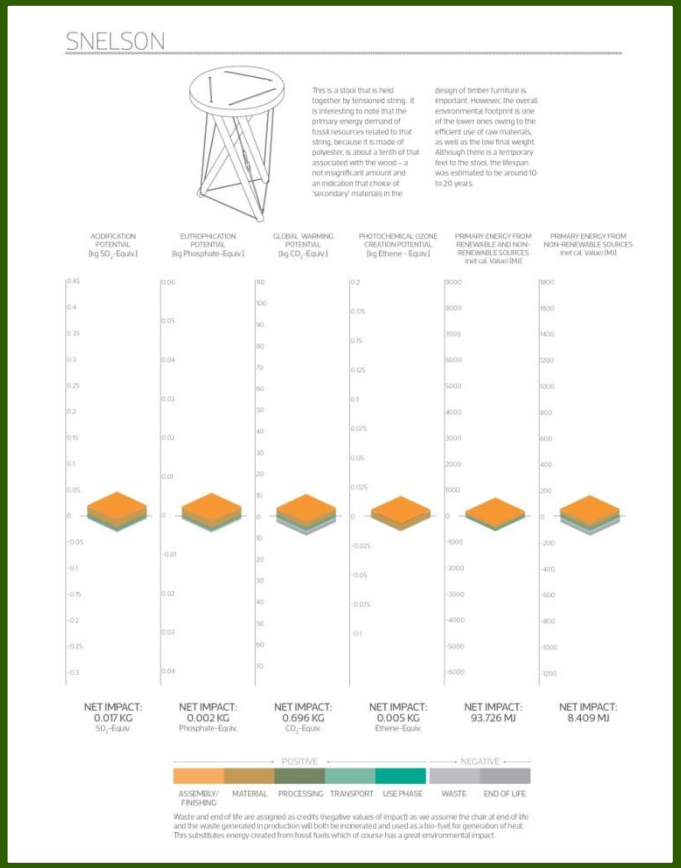
木材：用木材代替其他材料的好处

1 立方米混凝土　　1 立方米木材　　1 吨二氧化碳

Out Of The Woods Environmental Profiling

环境总则





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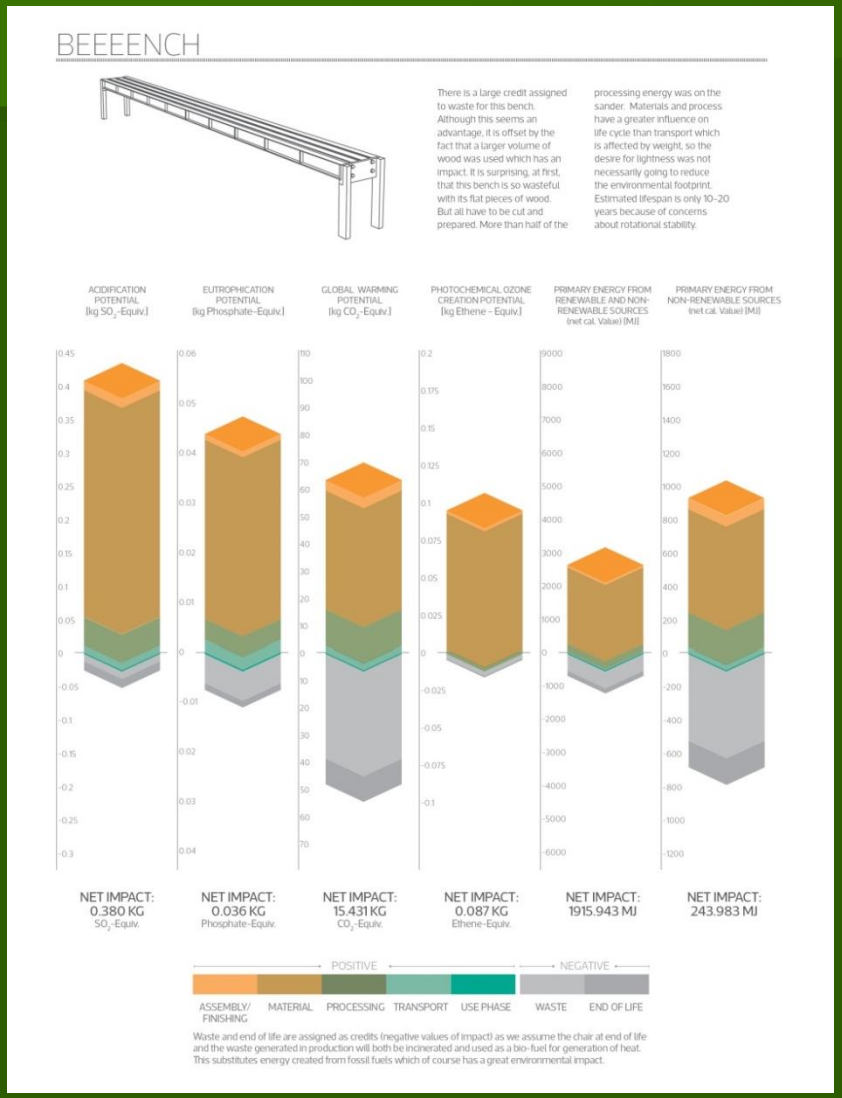
Out of the Woods: Data collection for Life Cycle Assessment

为生命周期评估收集数据

Out of the Woods: Full Life Cycle impact assessment for 12 hardwood chairs –BEEEENCH

12种阔叶木椅子的全生命周期影响评估– BEEEENCH



- **Designer aimed for dematerialisation, creating a product that contains more air than matter**
  设计师力争实现去物质化，创建一个包含空气多于物质的产品
- **Large credit assigned to waste because of high levels of machining**
  因为高水平的加工，生产过程减少了大量浪费
- **Lightweight solution reduces environmental footprint in transport**
  轻重量型的解决方案减少了运输过程的环境足迹
- **Issues of durability**
  耐久性的问题
- **Dematerialisation means the product can be disposed of regularly without creating much waste**
  去物质作用意味着产品可以定期处置，而不会产生太多废弃物

Out of the Woods: High profile exhibition at the Victoria & Albert Museum for London Design Festival 2012

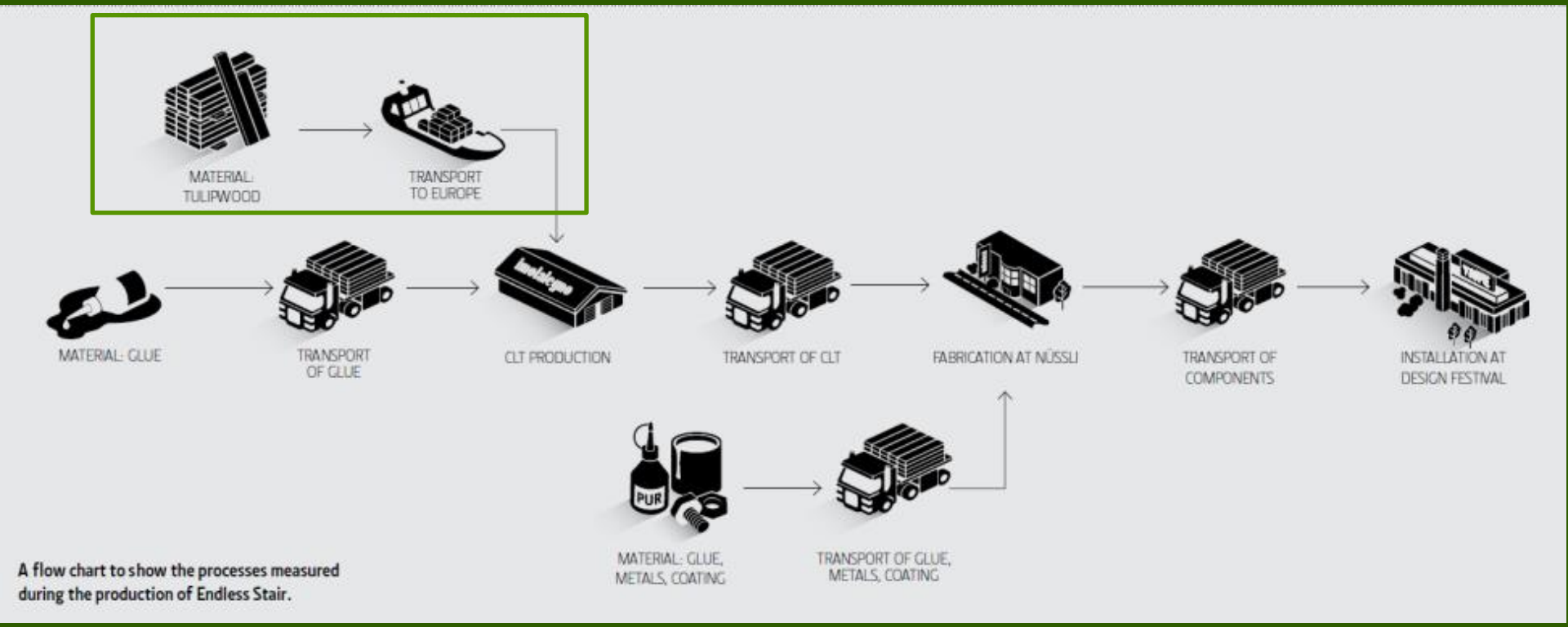
2012伦敦设计周V&A博物馆著名参展作品

Endless Stair LCA data collection & modelling

无尽天梯：生命周期评估数据 收集& 建模

AHEC lumber study data

AHEC 木材研究数据



A flow chart to show the processes measured during the production of Endless Stair.

Endless Stair LCA data collection & modelling

无尽天梯：生命周期评估数据 收集& 建模

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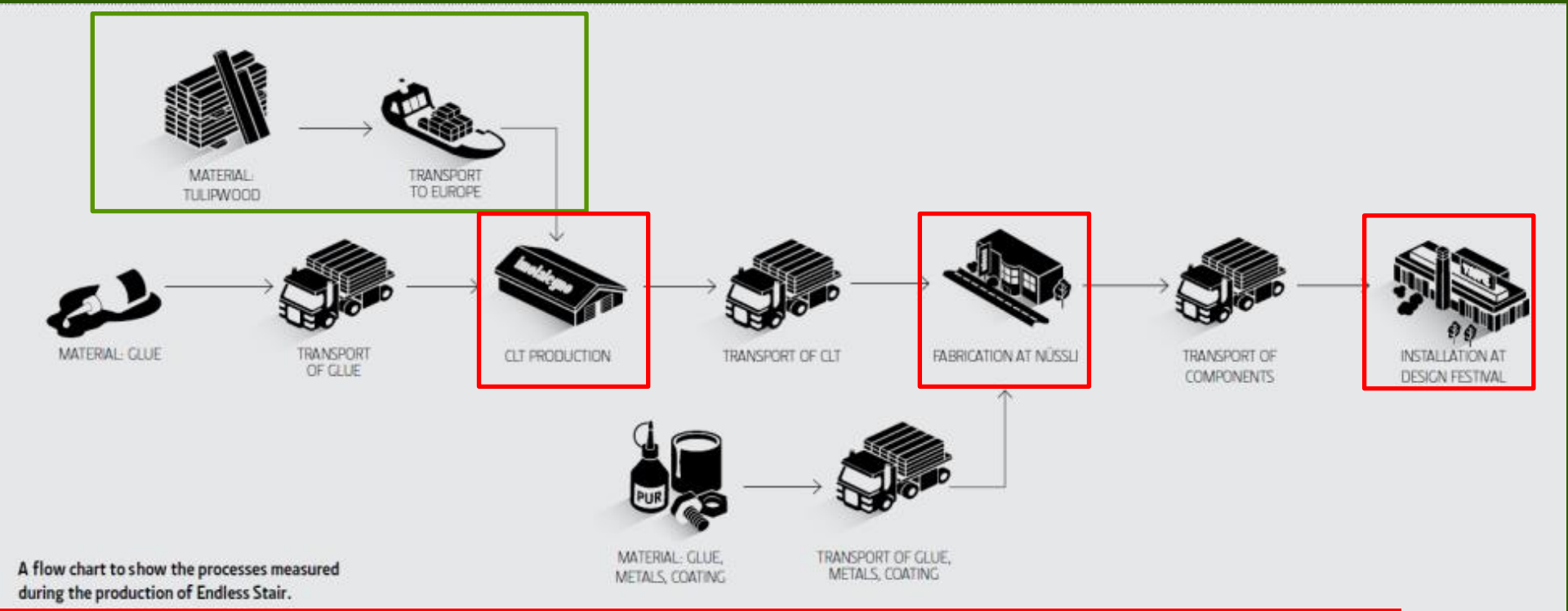


A flow chart to show the processes measured during the production of Endless Stair.

Project specific data derived from project partners & collated by PE

项目具体数据来源于项目合作伙伴并由**PE**整理

Endless Stair LCA data collection & modelling

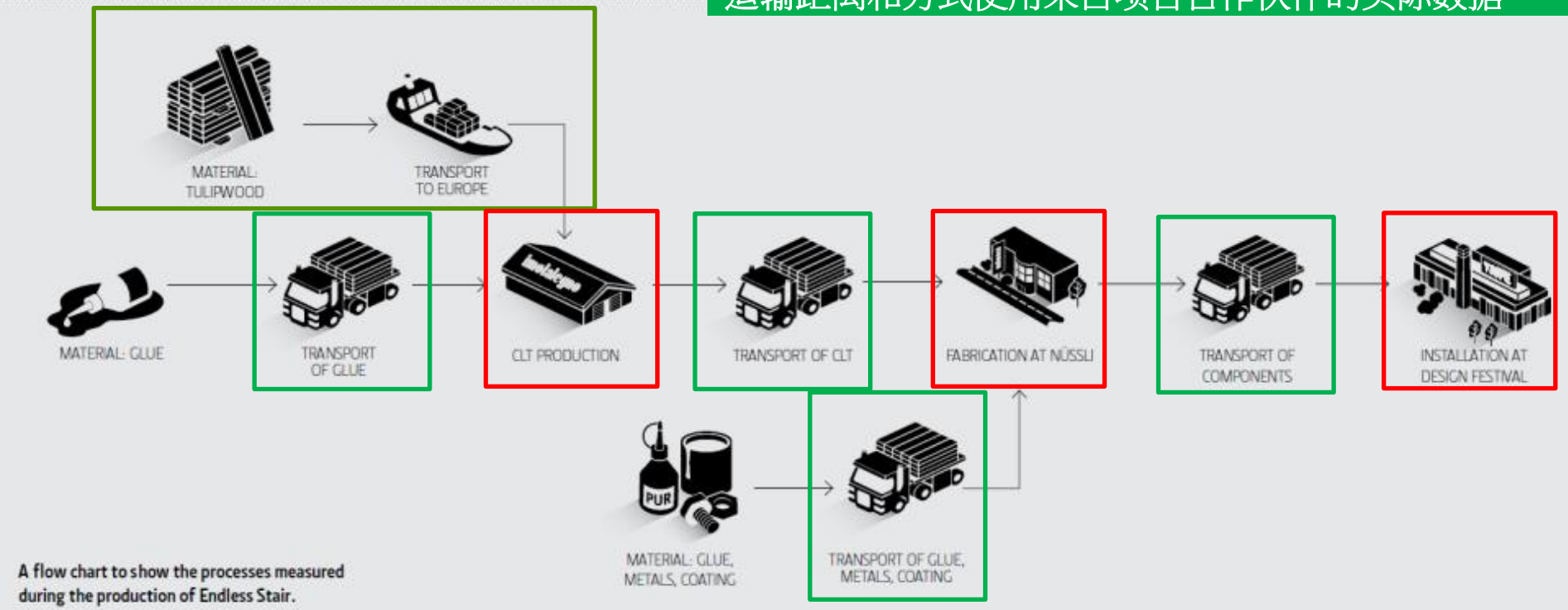
无尽天梯：生命周期评估数据 收集& 建模

AHEC lumber study data

AHEC 木材研究数据

Transport distances and modes using actual data from project partners

运输距离和方式使用来自项目合作伙伴的实际数据



A flow chart to show the processes measured during the production of Endless Stair.

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Endless Stair LCA data collection & modelling

无尽天梯：生命周期评估数据 收集& 建模

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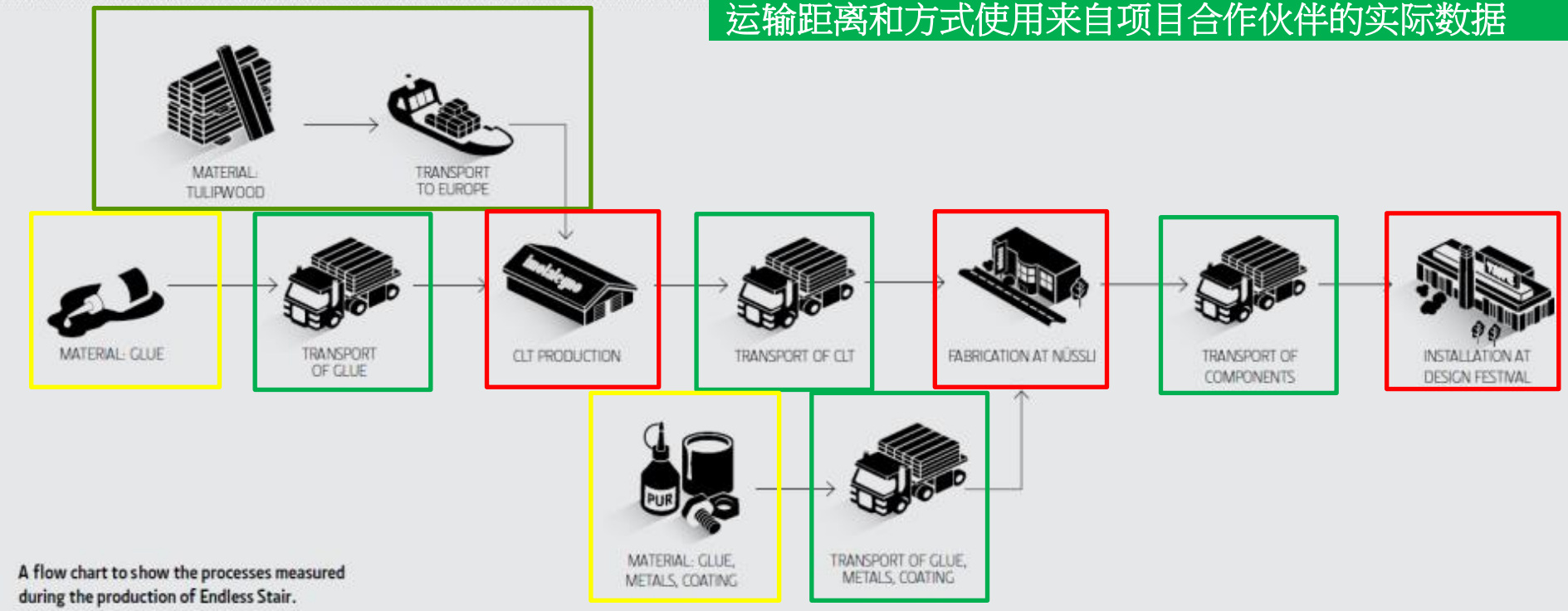
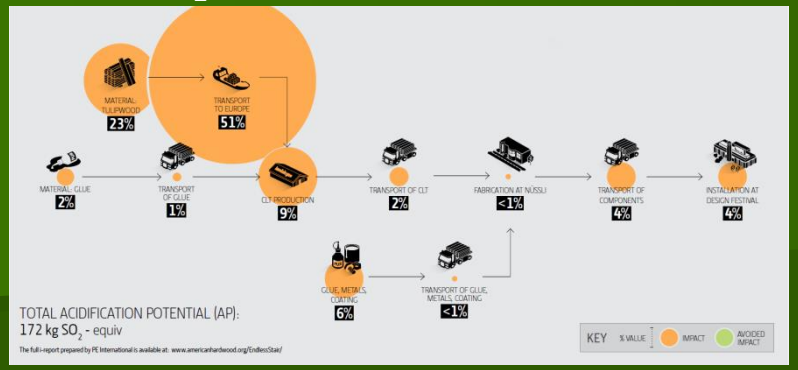


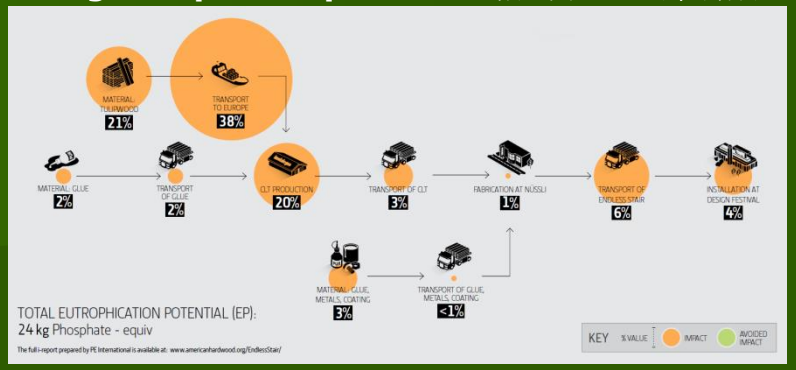
A flow chart to show the processes measured during the production of Endless Stair.

Project specific data derived from project partners & collated by PE 项目具体数据来源于项目合作伙伴并由PE整理

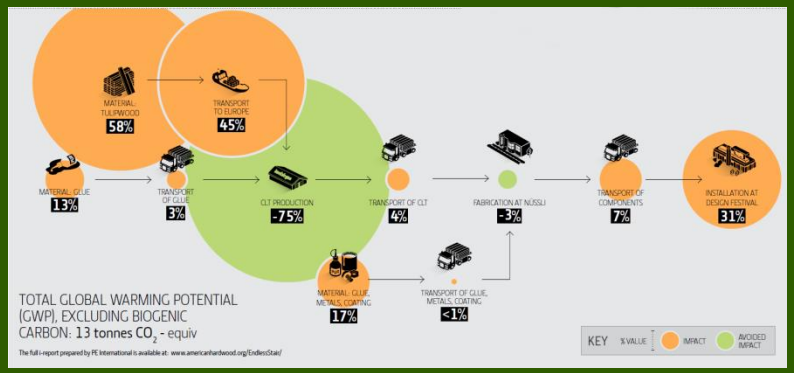
Acidification Potential
172 kg SO_2 equivalent
酸化潜力
相当于172公斤二氧化硫



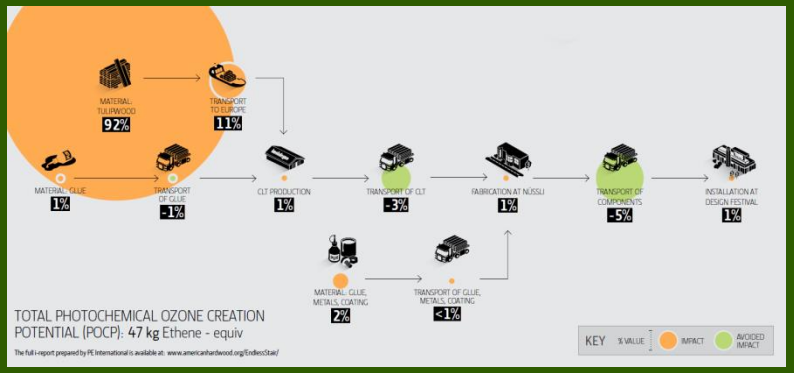
Eutrophication Potential
24 kg Phosphate equivalent
富营养化潜力
相当于24公斤磷酸盐



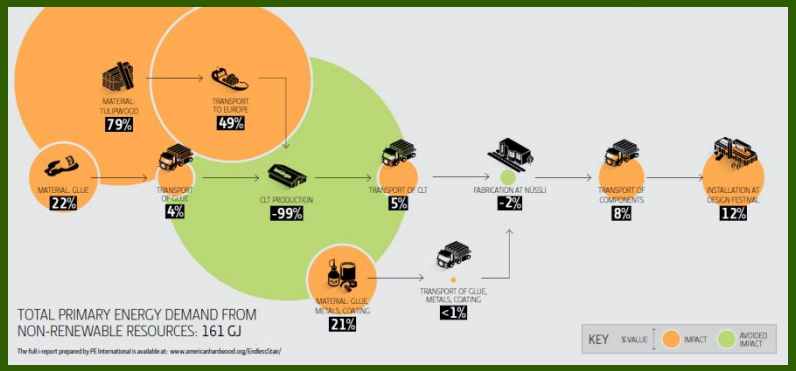
Global Warming Potential
13 tonnes CO_2 equivalent
全球变暖潜力
相当于13吨二氧化碳



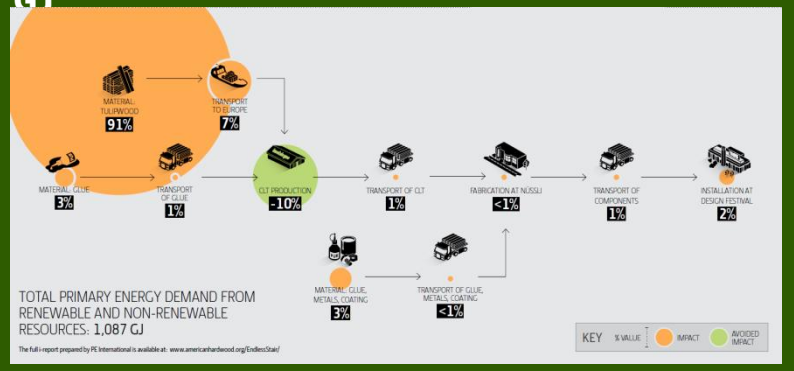
Photochemical Ozone Creation Potential 47 kg Ethene equivalent
光化学臭氧形成潜力
相当于47公斤乙烯



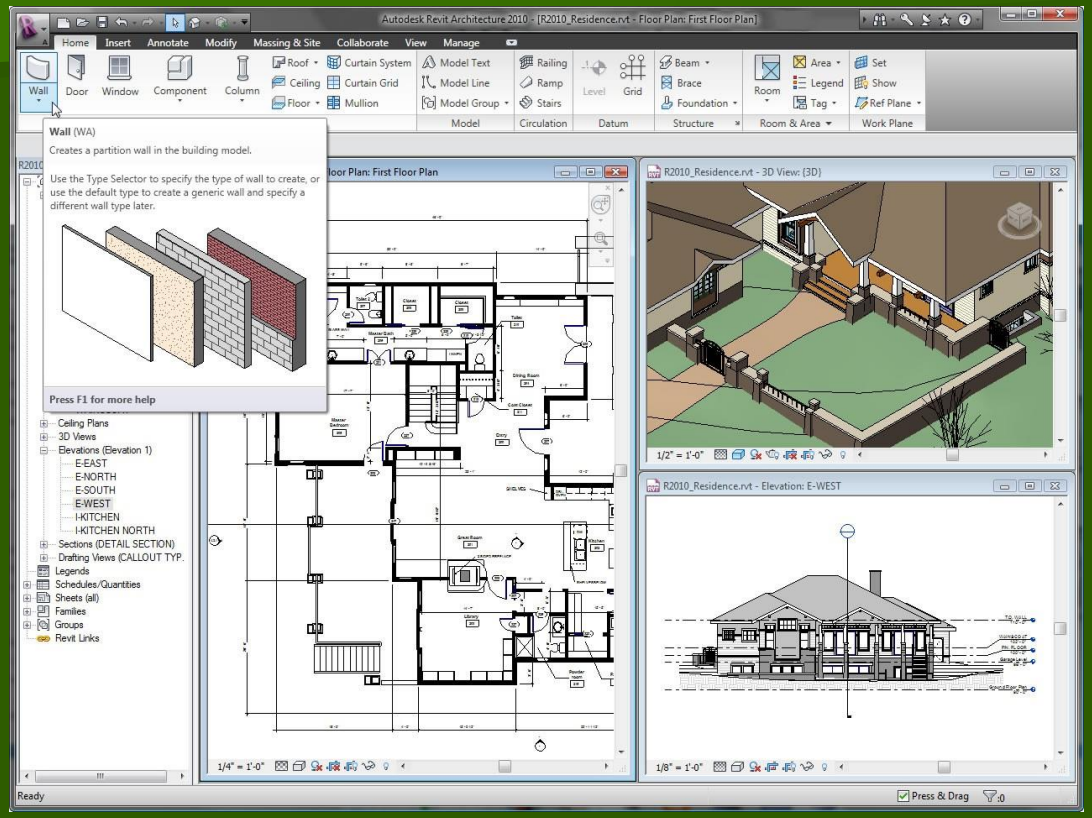
Total Primary Energy Demand from non-renewables 161 GJ
一次能源总需求来自不可再生能源 **161 GJ**



Total Primary Energy Demand from renewables & non-renewables 1087 GJ
一次能源总需求来自可再生能源&不可再生能源 **1087**



Building Information Modelling
建立信息模型



- One system integrating

  一个系统集成：
  - 3-D CAD 3-D CAD
  - Cost data 成本数据
  - LCA data 生命周期评估数据
- All building life cycle stages - building, use & decommissioning

  所有建筑生命周期阶段——建造、使用&停用
- Standardised data requirements and decision-making processes

  标准化的数据需求和决策过程
- Shared knowledge resource for clients, designers and contractors

  客户、设计师和承包商共享的知识资源

Questions?
欢迎提问

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