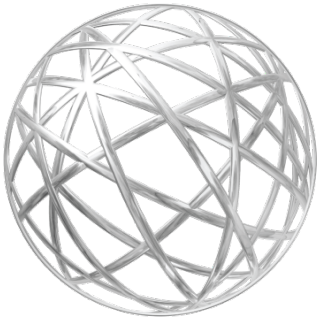
Global Industry Dialogue & Expert Review Workshop

Aluminium Sector

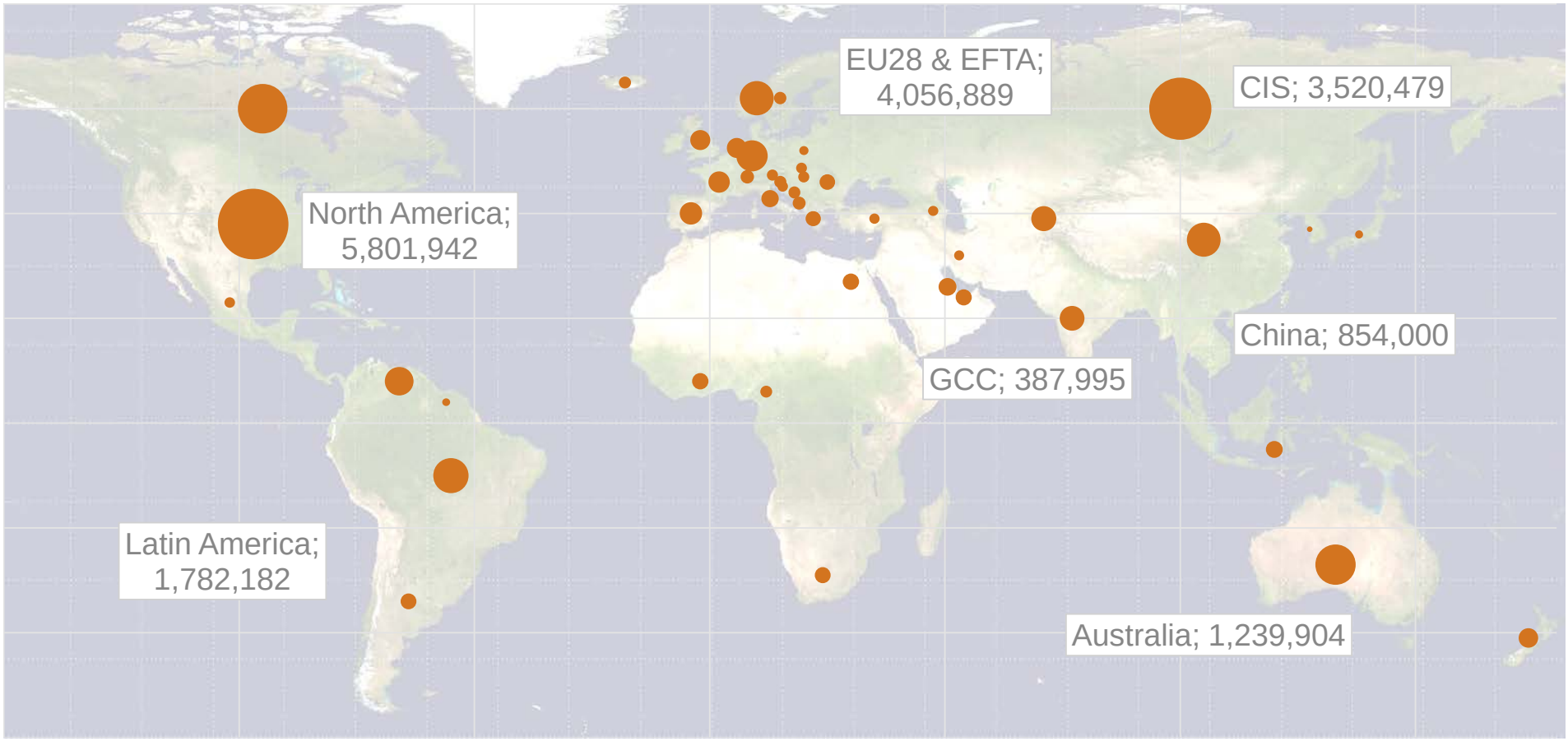


WORLD ALUMINIUM

@ChrisIAI

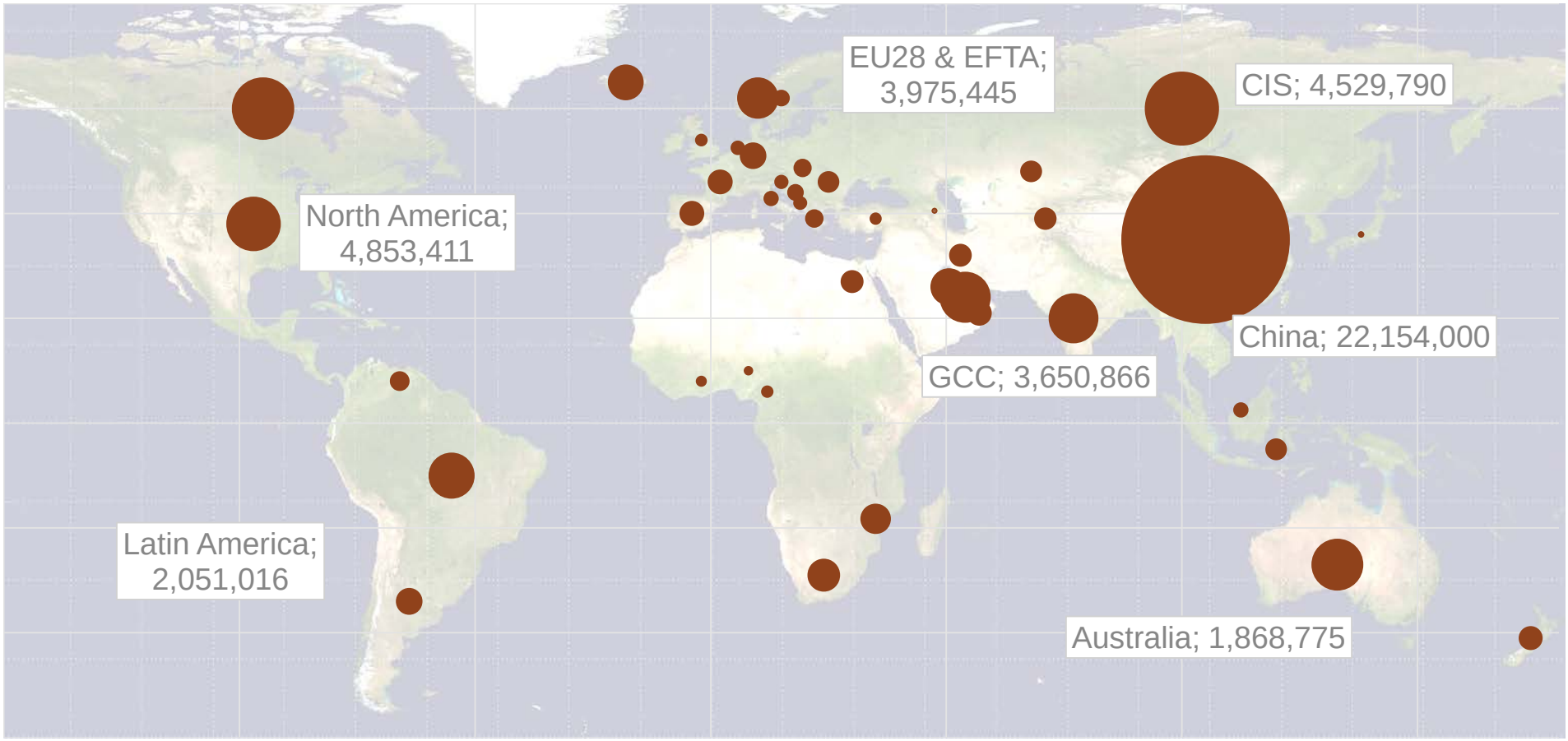
WORLD ALUMINIUM

Primary Production 1990



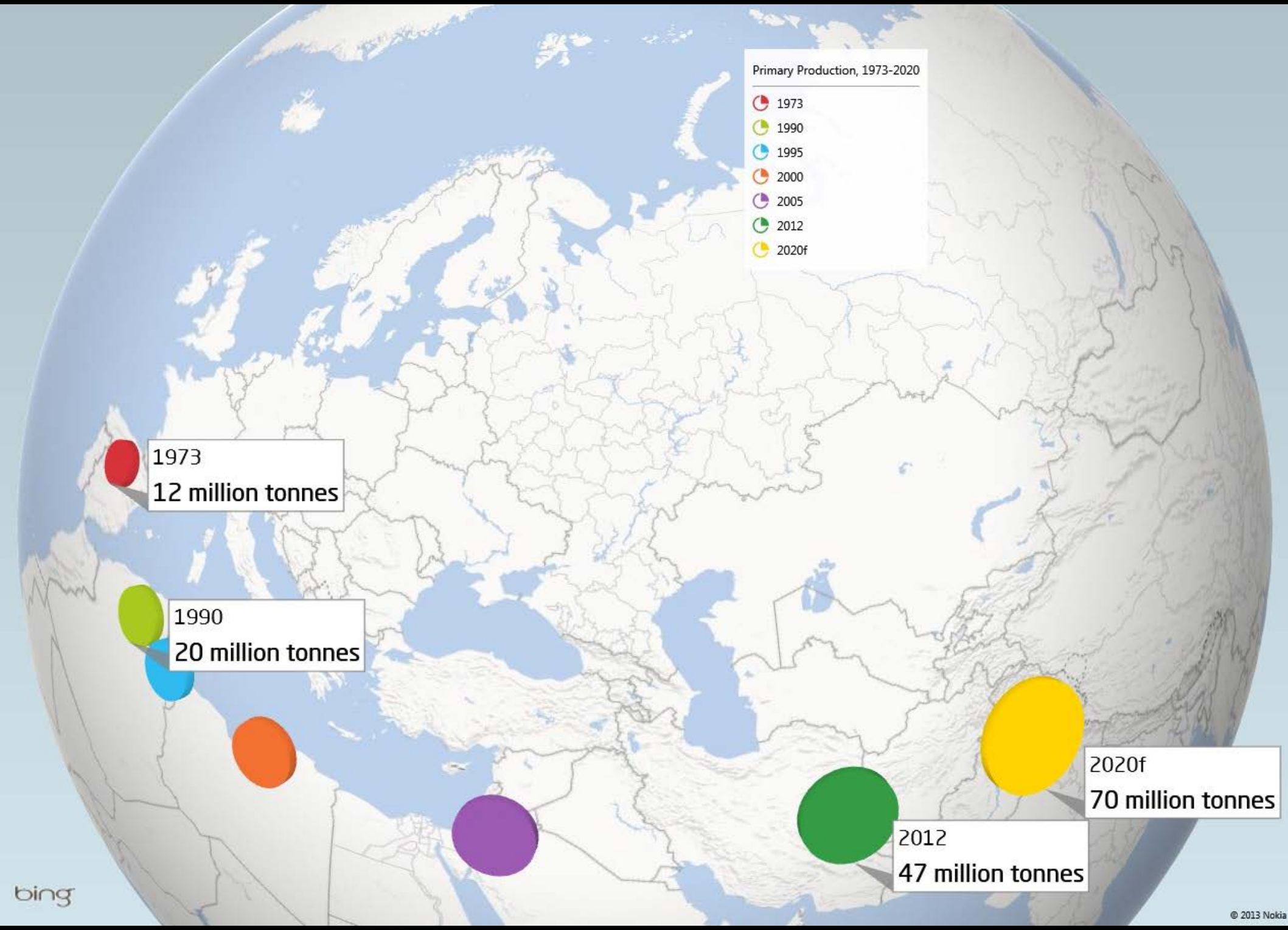
WORLD ALUMINIUM

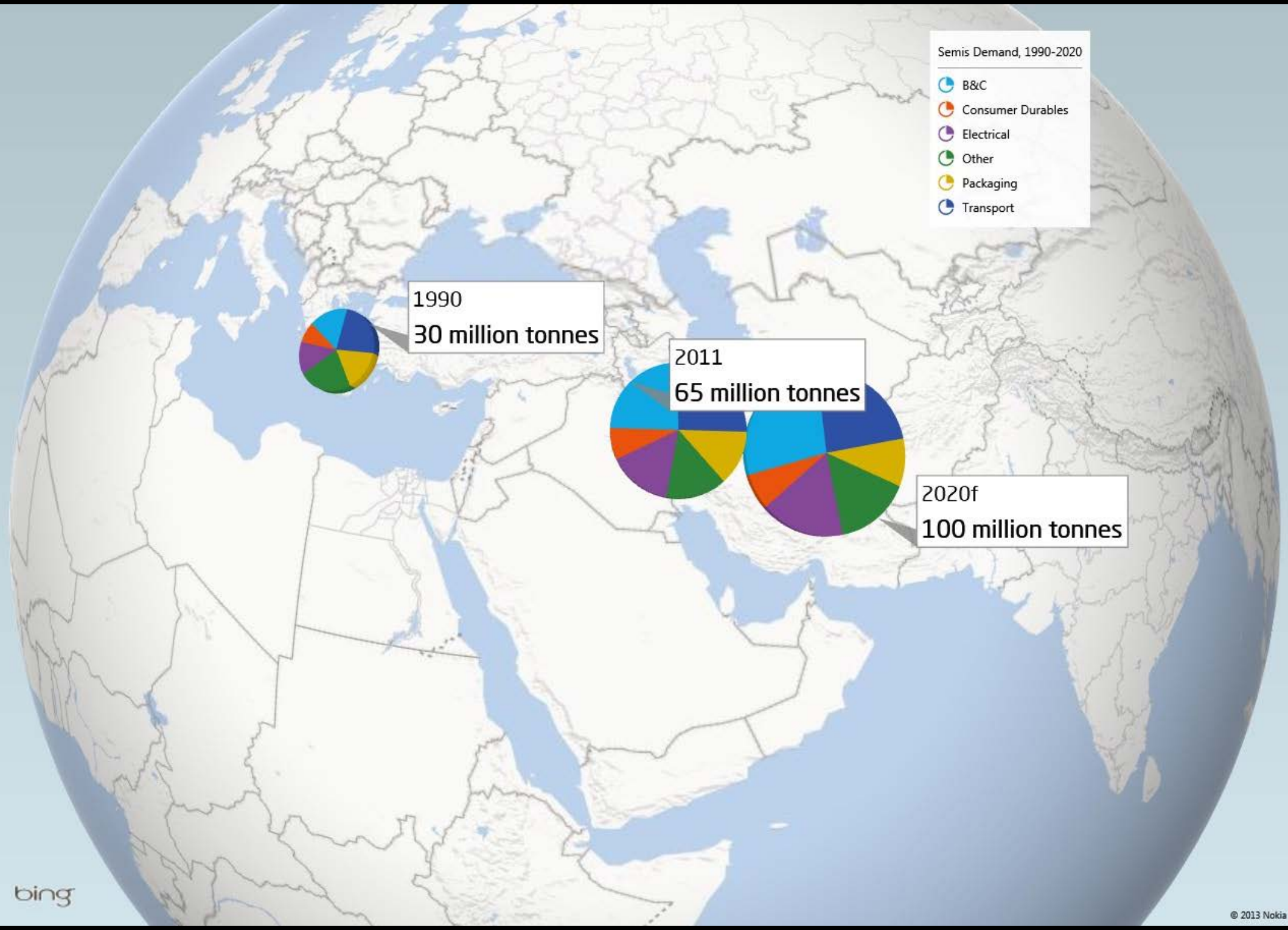
Primary Production 2012



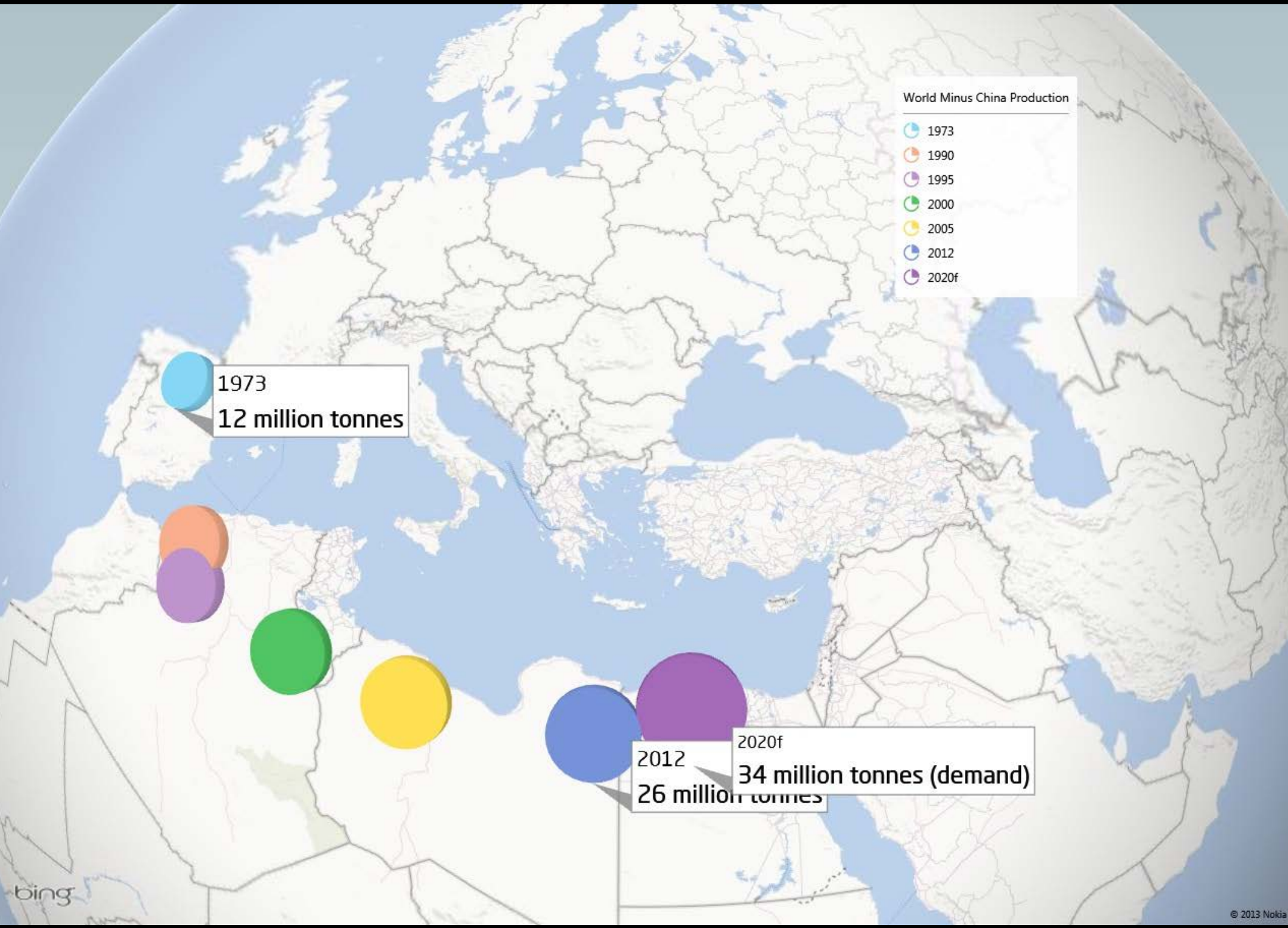
WORLD ALUMINIUM

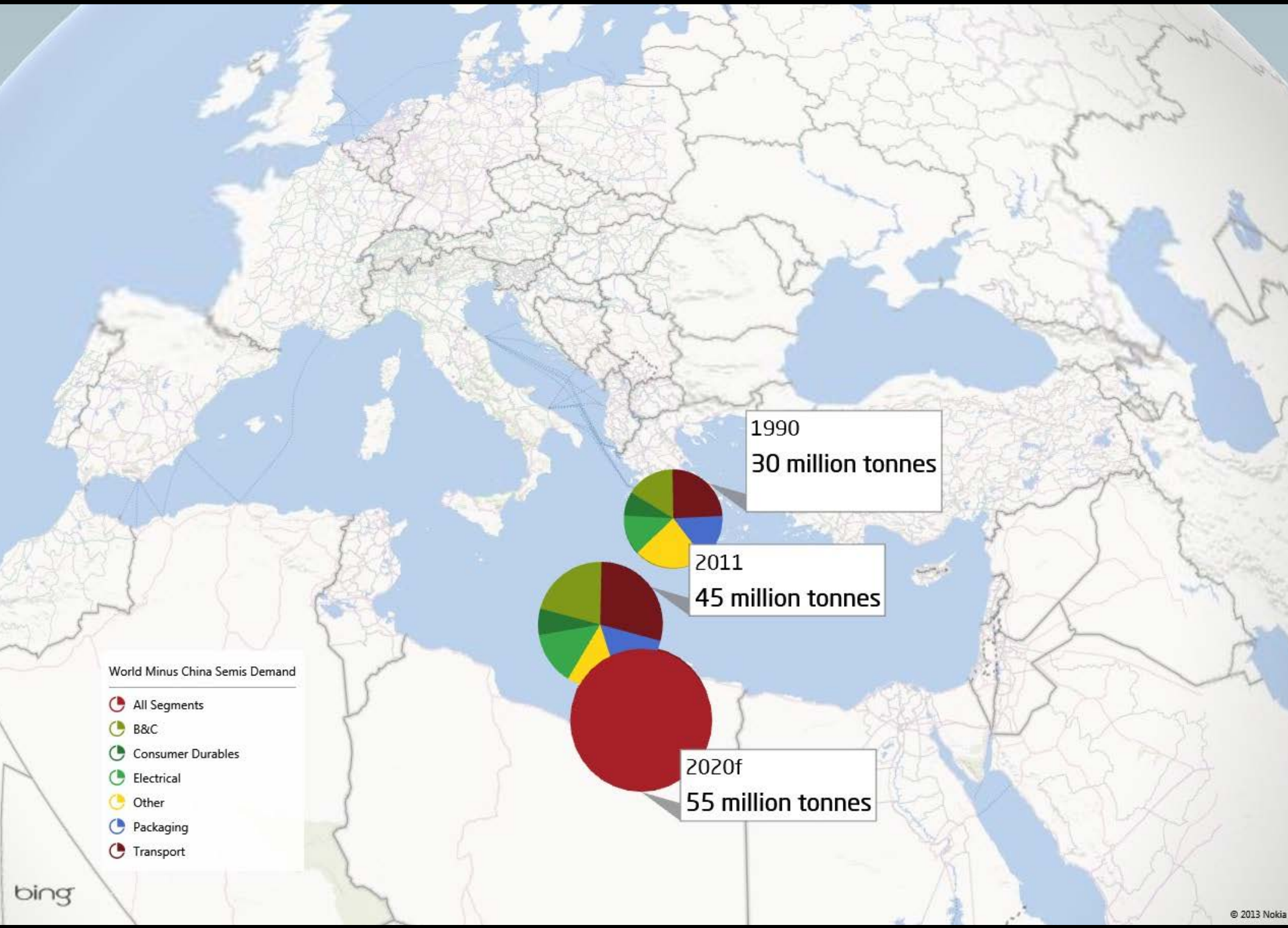
PRODUCTION & CONSUMPTION "CENTRES OF GRAVITY"


Primary Production, 1973-2020
1973
1990
1995
2000
2005
2012
2020f
1973
12 million tonnes
1990
20 million tonnes
2020f
70 million tonnes
2012
47 million tonnes
bing
© 2013 Nokia


Semis Demand, 1990-2020
B&C
Consumer Durables
Electrical
Other
Packaging
Transport
1990
30 million tonnes
2011
65 million tonnes
2020f
100 million tonnes
bing
© 2013 Nokia

THE WORLD (MINUS CHINA)


World Minus China Production
1973
1990
1995
2000
2005
2012
2020f
1973
12 million tonnes
2012
26 million tonnes
2020f
34 million tonnes (demand)
bing
© 2013 Nokia


1990
30 million tonnes
2011
45 million tonnes
2020f
55 million tonnes
World Minus China Semis Demand
All Segments
B&C
Consumer Durables
Electrical
Other
Packaging
Transport
bing
© 2013 Nokia

data:narrative

1. Increase transparency and functionality
   - Empower users to tell their own story
   - Give free access to credible data

2. Tell *The Aluminium Story*
   - Narrative framework

WORLD ALUMINIUM

DATA

http://www.world-aluminium.org/statistics/

Data	Frequency	Coverage	Group	Since	User filters	Output *
Primary Aluminium Production (tonnes Al)	Monthly	Global	Regional	1973	• Period • Frequency (M/Q/A) • Region	• Map (snapshot in time, across space) • Histogram (across space through time) • Line graph (change over time per group) • Data (inc option to download .csv)
Alumina Production (tonnes Al_2O_3)	Monthly (quarterly pre-2012)	Global	Regional	1974	• Period • Frequency • Region • Alumina grade	• Map • Histogram • Line graph • Data
Primary Aluminium Capacity (tonnes Al)	Annual	Around 40-50%	Regional	1973	• Period • Region	• Map • Histogram • Line graph • Data
Alumina Capacity (tonnes Al_2O_3)	Annual	Around 40-50%	Regional	1974	• Period • Region	• Map • Histogram • Line graph • Data
Primary Aluminium Smelting Energy Intensity (kWh/t Al)	Annual	Over 90%	Regional	1980	• Period • Region • AC/DC	• Map • Line graph • Data
Primary Aluminium Smelting Power Consumption (GWh)	Annual	Over 90%	Regional	1980	• Period • Region • Power mix/source	• Map • Histogram • Data
Metallurgical Alumina Refining Energy Intensity (MJ/t Al_2O_3)	Annual	Over 90%	Regional	1985	• Period • Region	• Map • Line graph • Data
Metallurgical Alumina Refining Fuel Consumption (TJ)	Annual	Over 90%	Regional	1985	• Period • Region	• Map • Histogram • Data
Fluoride Emissions (kg F/t Al)	Annual since 2002	Global	Technology	1990	• Period • Technology	• Map • Histogram • Line graph • Data
Perfluorocarbon (PFC) Emissions (Gg CF_4, Gg C_2F_6, t CO_2e/t Al)	Annual since 1998	Global	Technology	1990	• Period • Technology • Reported/non-reported data	• Map • Histogram • Line graph • Data

CURRENT IAI STATISTICS

- Primary Aluminium Production
- Alumina Production
- Primary Aluminium Capacity
- Alumina Capacity
- Primary Aluminium Smelting Energy Intensity
- Primary Aluminium Smelting Power Consumption
- Metallurgical Alumina Refining Energy Intensity
- Metallurgical Alumina Refining Fuel Consumption
- Fluoride Emissions
- Perflurocarbon (PFC) Emissions

RELATED WEBSITES

- Antaike (China)
- Aluminum Association (US)
- European Aluminium Association
- Japan Aluminium Association

RELATED PUBLICATIONS

- Aluminium Inventories (1973-2013)
- 2011 Anode Effect Survey Report
- 2010 Sustainability Update
- Production Survey Forms
- Capacity Survey Forms
- Energy Survey Forms

PRIMARY ALUMINIUM PRODUCTION

Date of Issue: 27 Sep 2013

REGION FILTER:

- ☒ Africa
- ☒ Asia (ex China)
- ☒ GCC
- ☒ China
- ☒ North America
- ☒ South America
- ☒ West Europe
- ☒ East & Central Europe
- ☒ Oceania
- ☒ ROW Estimated Unreported

TIME PERIOD:

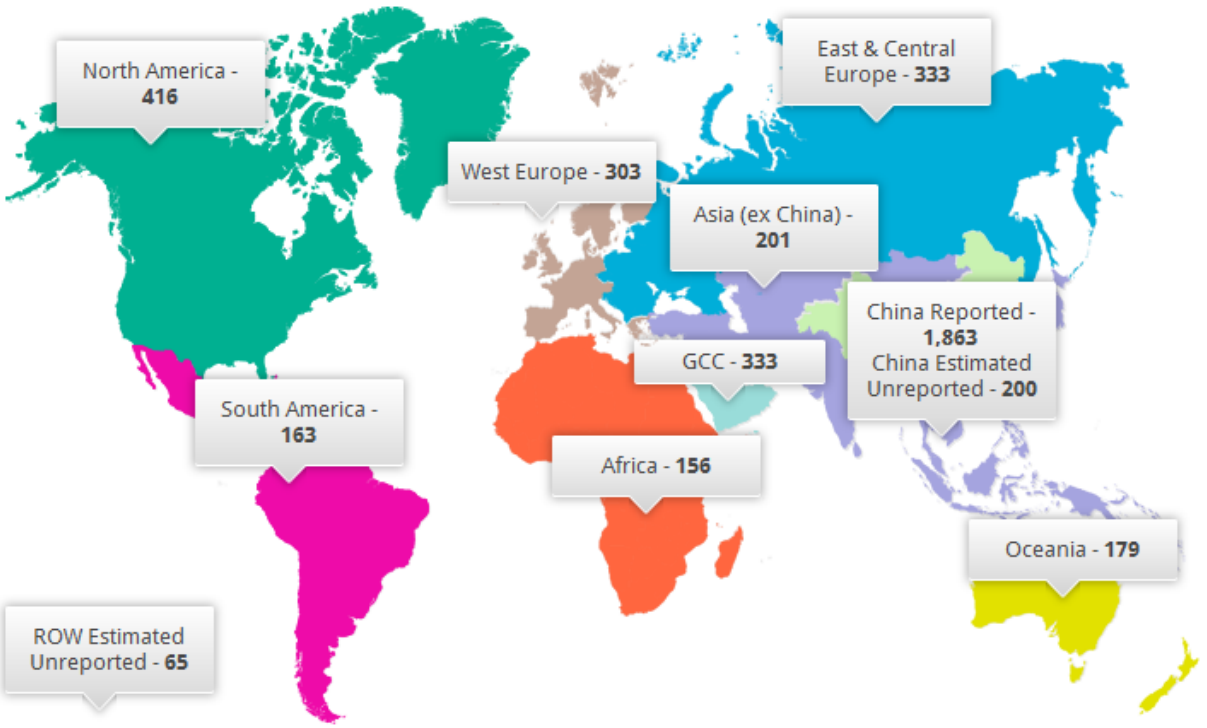
frequency: Monthly

from: August 2013

to: August 2013

VISUALISATION TYPE: MAP | HISTOGRAM | LINE GRAPH | DATA

Total for Aug 2013: 4,212 thousand metric tonnes of aluminium



NOTES

FILTER

Search Publications

Publication Year

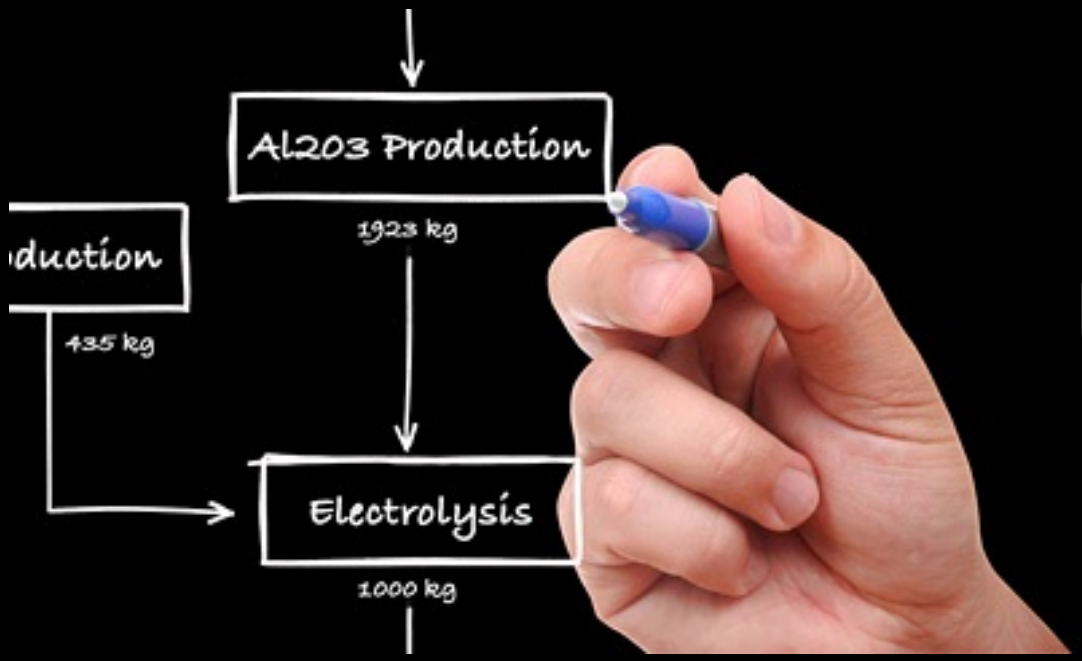
Tag Cloud

alumina bauxite bauxite residue carbon footprint energy environment GHG green buildings health life cycle light weighting mining packaging PFC power generation recycling red mud rehabilitation safety statistics sustainability transport 中文 绿色建筑

PUBLICATIONS

2010 Life Cycle Inventory for the Worldwide Primary Aluminium Industry (2013)	Download
2012 Anode Effect Survey Report (2013)	Download
Aluminium Recycling, OEA Congress, Duesseldorf, 25 - 26 February (2013)	Download
Alusil 21st International Recycling Conference and Exhibition, Moscow, 9 - 11 April (2013)	Download
A Review of the Global Aluminium Industry: 1972-2012 (2013)	Download
Bauxite Residue Management: Best Practice (2013)	Download
IAI Form 351 - Aluminium Inventories (1973-2013) (2013)	Download
Improving human toxicity LCA for polycyclic aromatic hydrocarbons (PAHs) – Executive Summary (2013)	Download
2011 Anode Effect Survey Report (2012)	Download
Aluminium Intensive Electric Vehicle Report (2012)	Download
Aluminium Recycling, MB Asian Recycled Aluminium Conference, Bangkok, 4 - 5 July (2012)	Download
Aluminium Recycling, MB Recycling Conference, Austria, 20 - 21 November (2012)	Download

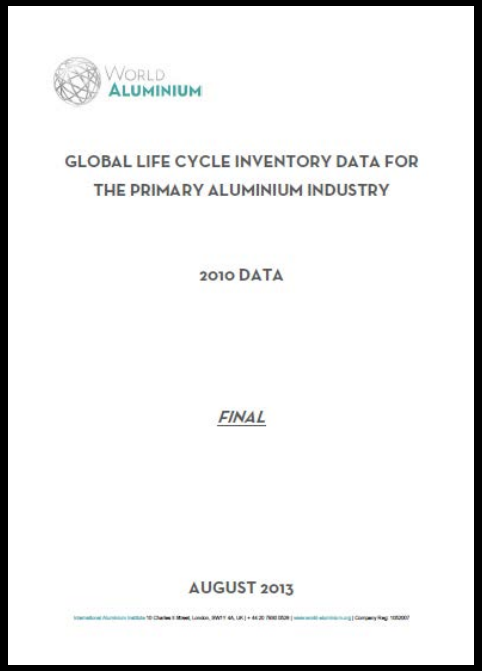
WORLD ALUMINIUM



Life Cycle Data

WORLD ALUMINIUM

http://www.world-aluminium.org/publications/



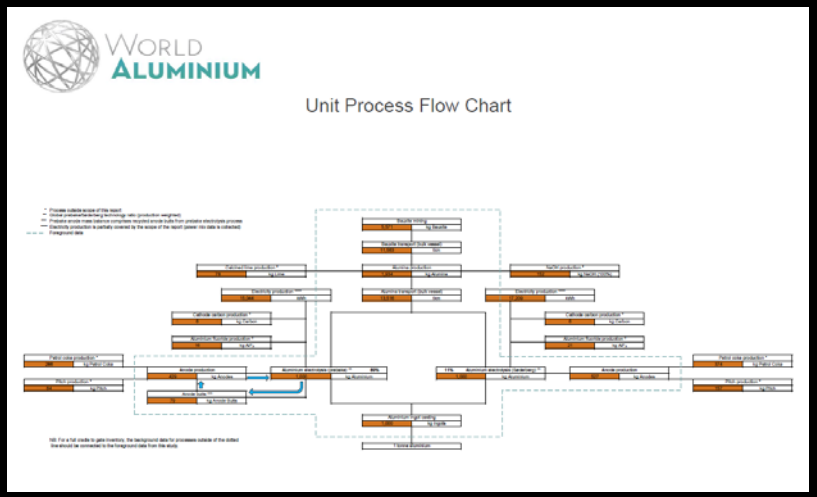
WORLD ALUMINIUM

GLOBAL LIFE CYCLE INVENTORY DATA FOR THE PRIMARY ALUMINIUM INDUSTRY

2010 DATA

FINAL

AUGUST 2013



WORLD ALUMINIUM

Unit Process Flow Chart

WORLD ALUMINIUM

Summary
(per tonne of aluminium ingot)

Tonnes of prebake anode per tonne of aluminium:	0.429
Tonnes of Soderberg paste per tonne of aluminium:	0.007

Prebake Al production:	36,773,145
Soderberg Al Production:	4,376,995

Percentage Split:	89%
Percentage Split:	11%

			Bauxite mining	Alumina production	Anode/Paste production	Electrolysis	Casting	Total
		Reference Flow (Material	Bauxite	Alumina	Anode/Paste	Liquid Metal	Ingot	1 t Ingot
		Reference Flow (Tonnes)	5.571	1.934	0.439	1	1	
Transport								
Average sea transport	tkm/t Al Ingot			11,440		13,423		24,871
Average road transport	tkm/t Al Ingot			7		6		13
Average rail transport	tkm/t Al Ingot			100		87		195
Material Input								
Bauxite	kg/t Al Ingot			5,571.47				5,571.47
Caustic soda	kg/t Al Ingot			151.94				151.94
Calcined lime	kg/t Al Ingot			77.73				77.73
Fresh water	m^3/t Al Ingot	2.77	4.96		0.67	3.69	3.49	15.80
Sea water	m^3/t Al Ingot	3.69	1.00			6.25		11.02
Petrol coke	kg/t Al Ingot				295.19			295.19
Pitch	kg/t Al Ingot				73.59			73.59
Refractory material	kg/t Al Ingot				2.00	7.56		10.36
Steel	kg/t Al Ingot				2.36	3.95		6.31
Alumina (dry)	kg/t Al Ingot					1,934.14		1,934.14
Anodes (net)/Soderberg Paste	kg/t Al Ingot					439.06		439.06
Cathode carbon	kg/t Al Ingot					0.02		0.02
Aluminium fluoride	kg/t Al Ingot					16.17		16.17
Electrolysis metal	kg/t Al Ingot						1,000.00	1,000.00
Alloy additives	kg/t Al Ingot						19.57	19.57
Chlorine	kg/t Al Ingot						0.036	0.036
Energy Input								
Heavy oil	kg/t Al Ingot	0.95	160.40		12.45		2.66	176.55
Diesel oil	kg/t Al Ingot	1.58	0.15		2.10		0.74	4.63
Natural gas	m^3/t Al Ingot		268.10		19.24		20.02	307.44
Coal	kg/t Al Ingot		142.61				0.96	143.57
Electricity	kWh/t Al Ingot	5.11	152.20		50.20	15,274.63	67.65	15,549.78
Air emissions								
Particulates	kg/t Al Ingot	0.94	1.07		0.066	2.55	0.037	4.70
of which < 2.5microns	kg/t Al Ingot		0.043		0.078	2.34		2.46
Carbon dioxide from non-fuel combustion sources	kg/t Al Ingot				89.95	1,537.79		1,627.74
Sulfur dioxide	kg/t Al Ingot		4.73		1.71	14.91	0.11	21.46
Nitrous oxides (as NO_2)	kg/t Al Ingot		1.32		0.30	0.25	0.072	1.95
Mercury	g/t Al Ingot		0.47					0.47
Particulate fluoride (as F)	kg/t Al Ingot				0.00065	0.55		0.55
Gaseous fluoride (as F)	kg/t Al Ingot				0.0029	0.57		0.58
Total polycyclic aromatic hydrocarbons	kg/t Al Ingot				0.020	0.054		0.074
Benzo(a)pyrene	g/t Al Ingot				0.064	0.74		0.82
Tetrafluoromethane	kg/t Al Ingot					0.056		0.06
Hexafluoroethane	kg/t Al Ingot					0.0075		0.01
Hydrogen chloride	kg/t Al Ingot						0.024	0.024
Dioxin/furans	kg/t Al Ingot						1.32E-09	1.32E-09
Water emissions								
Fresh water	m^3/t Al Ingot	0.29	2.62		0.63	3.65	3.26	10.45
Sea water	m^3/t Al Ingot	3.69	1.00			5.81		10.50
Suspended solids	kg/t Al Ingot		0.029		0.013	0.51	0.14	0.69
Oil and grease/total hydrocarbons	kg/t Al Ingot		1.50		0.0000	0.0550	0.037	1.54
Mercury	g/t Al Ingot		0.00013					0.00013
Fluoride (as F)	kg/t Al Ingot				0.0034	0.060		0.064
Polycyclic aromatic hydrocarbons (6 Borneff components)	g/t Al Ingot				0.011	0.26		0.28
By-Products (for external recycling)								
Bauxite residue	kg/t Al Ingot		4.39					4.39
Spent pot lining carbon	kg/t Al Ingot					9.52		9.52
Spent pot lining refractory	kg/t Al Ingot					7.30		7.30
Refractory	kg/t Al Ingot				1.83	2.51	0.73	5.07
Steel	kg/t Al Ingot				2.96	6.83		9.81
Dross	kg/t Al Ingot						15.66	15.66
Filter dust	kg/t Al Ingot						1.49	1.49
Scrap solid	kg/t Al Ingot						4.41	4.41
Other	kg/t Al Ingot		10.83		3.85			14.68
Solid waste (for landfilling)								
Mine solid waste	kg/t Al Ingot	0.34						0.34
Bauxite residues (red mud)	kg/t Al Ingot		2,610.29					2,610.29
Spent pot lining	kg/t Al Ingot					7.66		7.66
Waste alumina	kg/t Al Ingot					4.25		4.25
Waste carbon or mix	kg/t Al Ingot				6.93	6.03		12.96
Scrubber sludges	kg/t Al Ingot				0.13	6.31		6.44
Refractory (excl. spent pot lining)	kg/t Al Ingot				1.75	1.23		3.44
Dross	kg/t Al Ingot						5.27	5.27
Filter dust	kg/t Al Ingot						0.46	0.46
Other solid industrial waste	kg/t Al Ingot		33.96		1.67		0.56	36.22
of which landfill waste	kg/t Al Ingot		16.50					16.50
of which hazardous waste	kg/t Al Ingot		17.99		1.13			19.12
Calculated air emissions from fuel combustion								
Methane from fuels	kg/t Al Ingot	0.00031	0.065		0.0004		0.0014	0.069
Nitrous oxide from fuels	kg/t Al Ingot	0.000061	0.010		0.00041		0.00020	0.011
Carbon dioxide from fuels	kg/t Al Ingot	7.71	1,345.38		91.06		54.03	1,498.20

Life Cycle Inventory Critical Review

“The life cycle inventory data of global primary aluminium production in 2010 are consistent, transparent, and of high quality. It provides the LCA practitioner with reliable life cycle inventory data of global primary aluminium. The lack of information about the Chinese primary aluminium production is addressed as good as possible.

The publication of unit process data allows for a consistent implementation of the data into LCA databases worldwide. The data are thus suitable for LCA studies compliant with ISO 14040 and ISO 14044 (ISO 2006a & b) and for implementation in LCI databases which are in line with the UNEP SETAC Global Guidance Principles for Life Cycle Assessment Databases.

For future updates it is recommended to include Chinese production in the survey, extending the inventory to cover land use and transformation and heavy metals leaching from red mud dumps, and regionalising the water use data.”

WORLD ALUMINIUM

Life Cycle Databases

ecoinvent Centre
Swiss Centre for Life Cycle Inventories

GaBi Databases

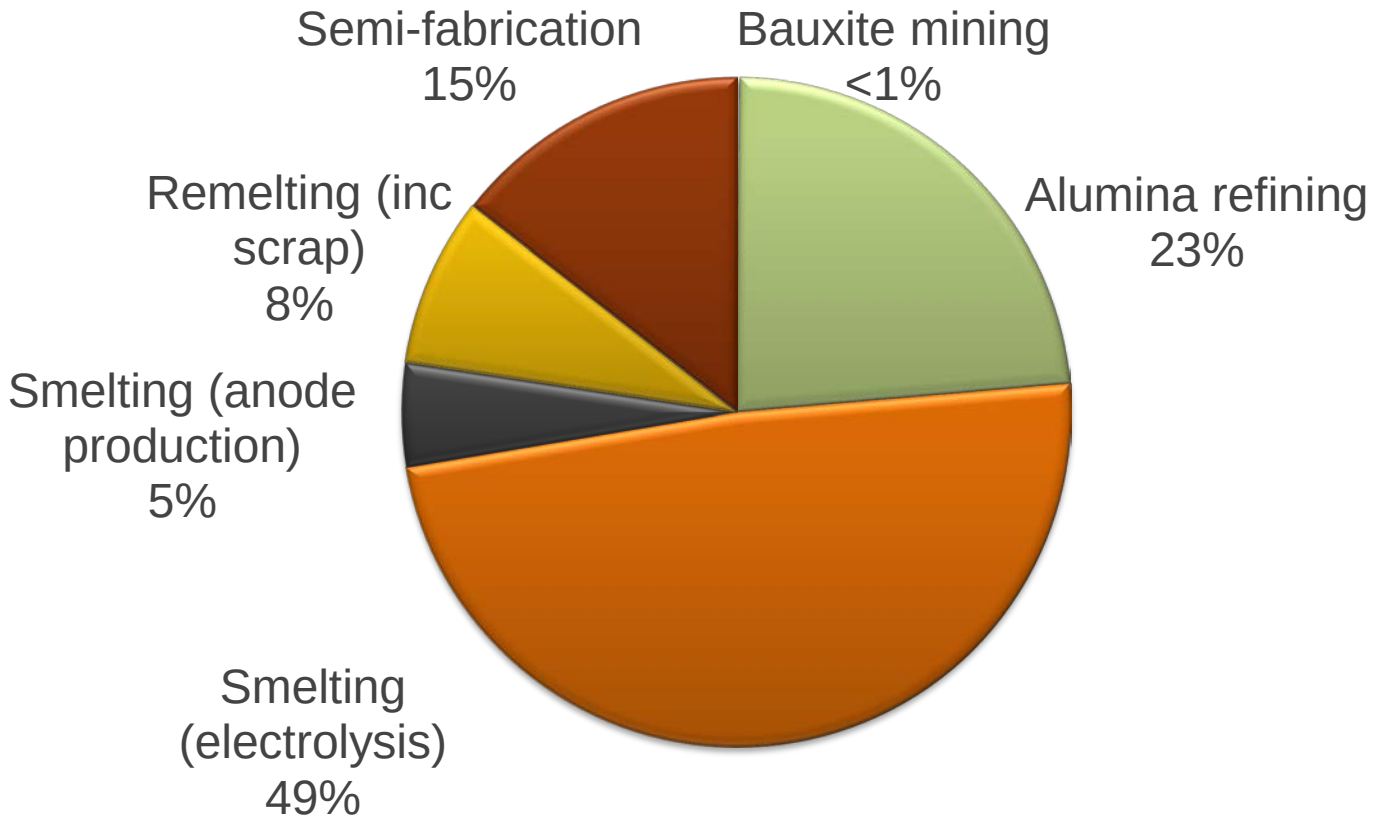
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
U.S. Life Cycle Inventory Database

ELCD core database

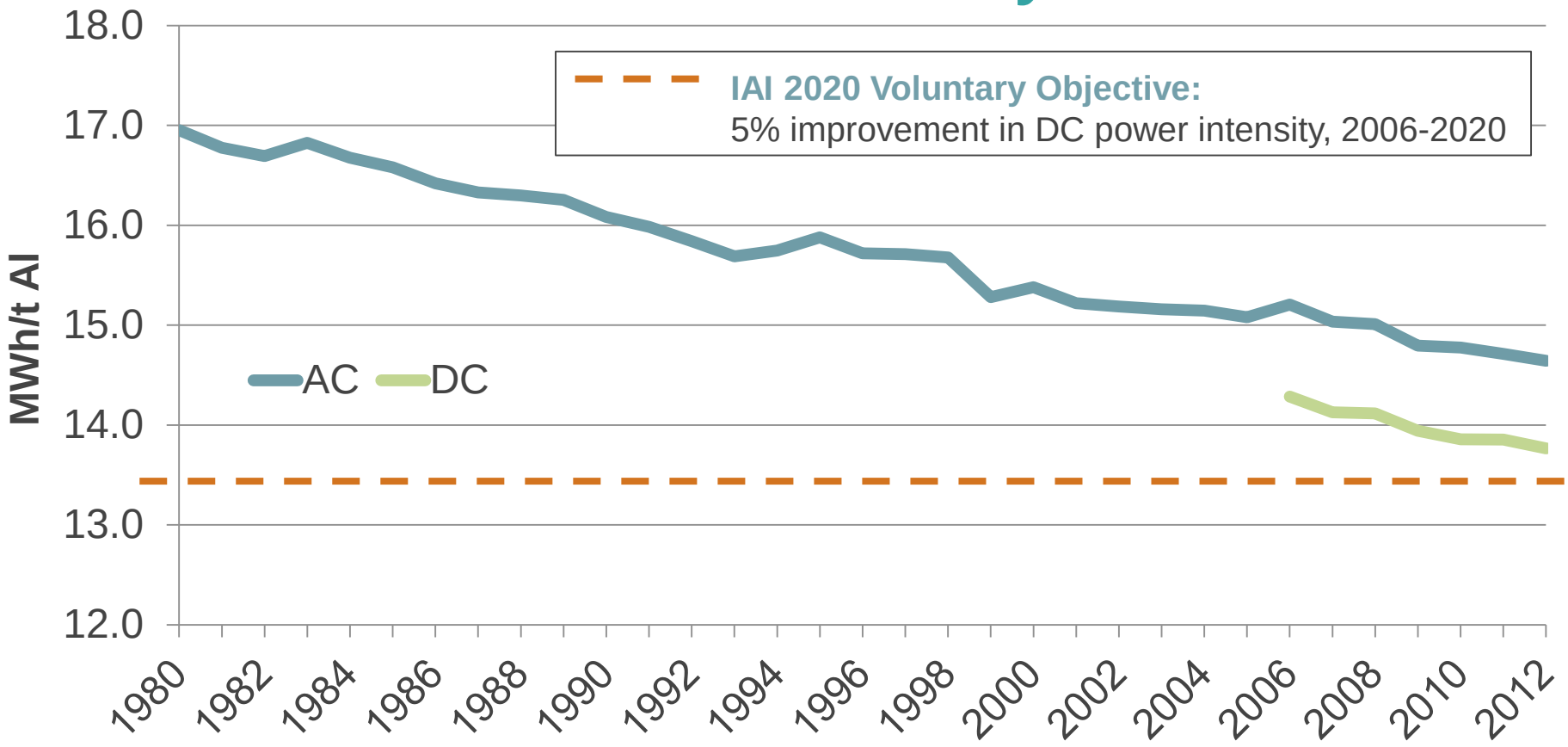
Regional Resources (downstream data)

- EAA *Environmental Profile Report (2012)*:
  - http://www.alueurope.eu/
- Aluminum Association LCA for North America (forthcoming)
- Both data incorporated into GaBi.

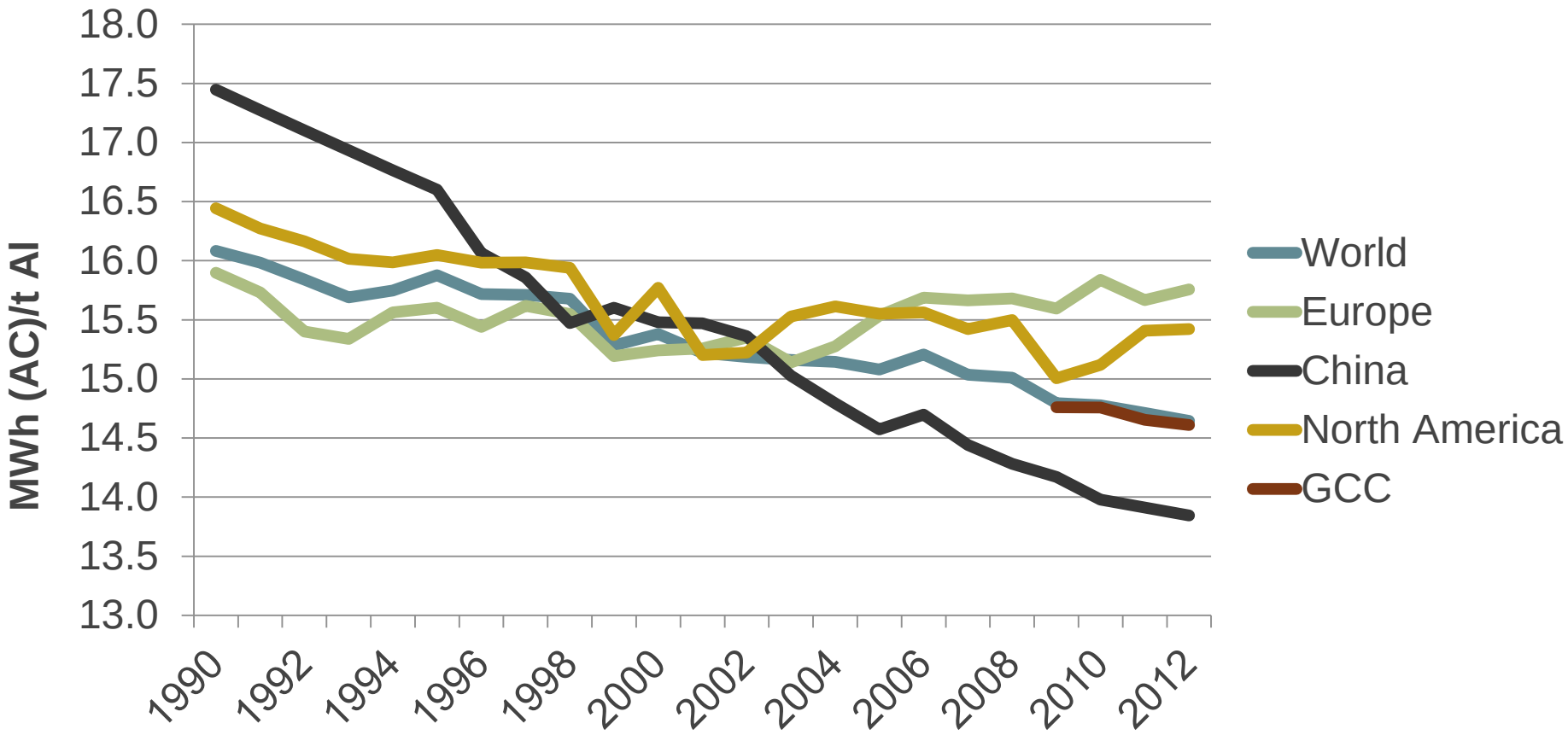
Global Aluminium Industry Energy Use 5,000,000 TJ (2013)



Electrolysis Energy Intensity Reduced by 15% over last 30 years

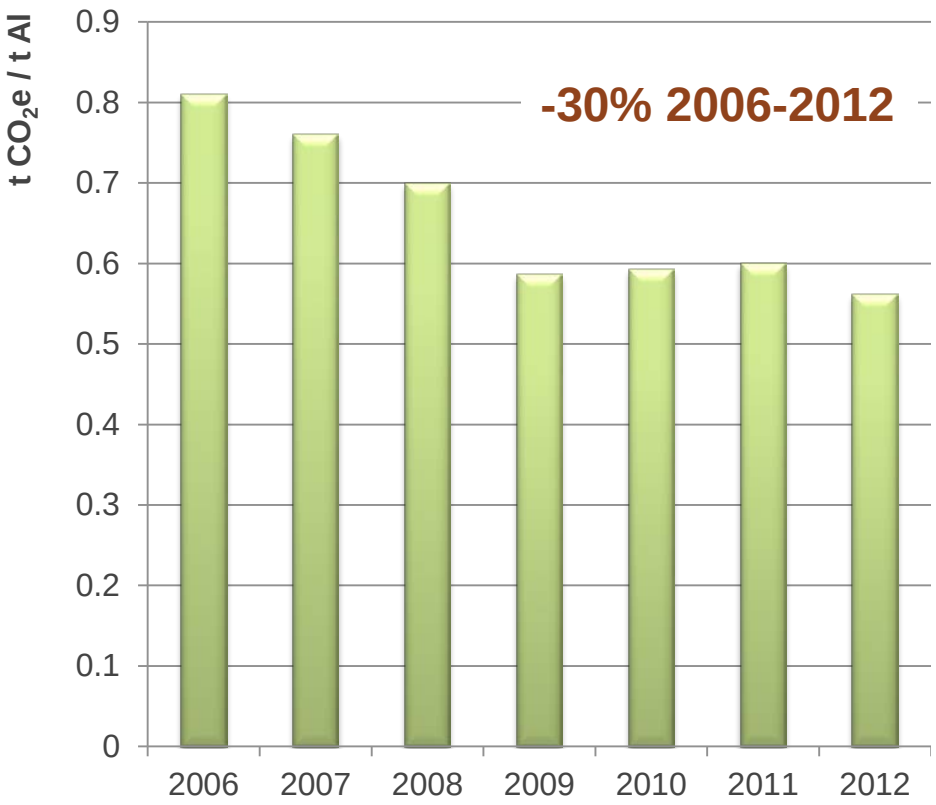


Regional Averages, 1990-2010

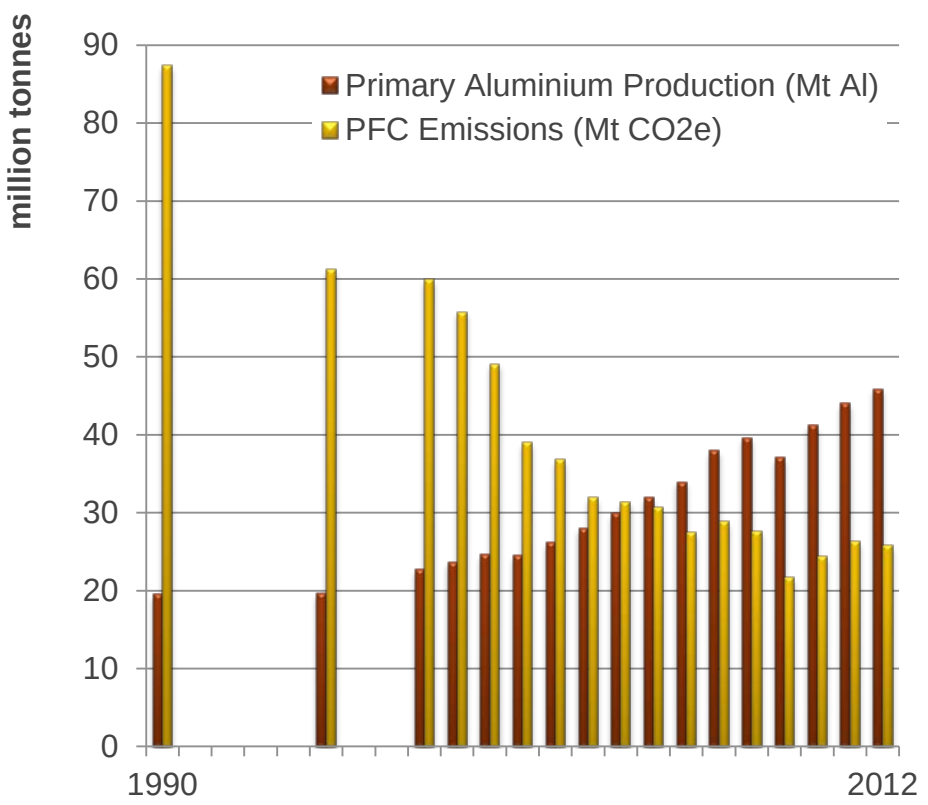


PFC Emissions

Intensity (-50% 2006-2020)

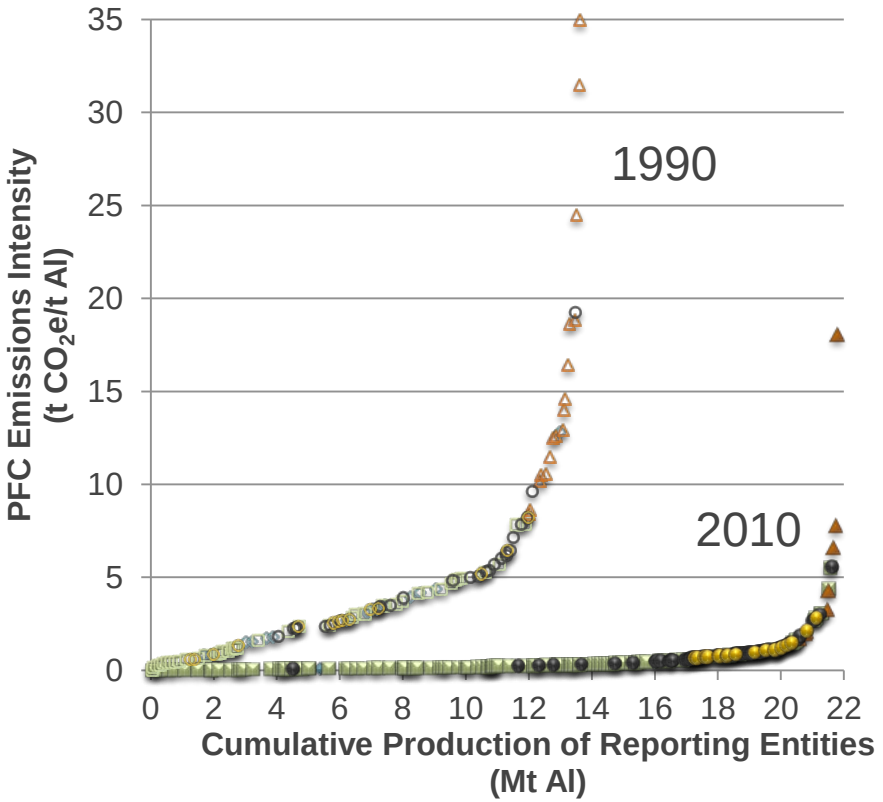


-70% Absolute, 1990-2012

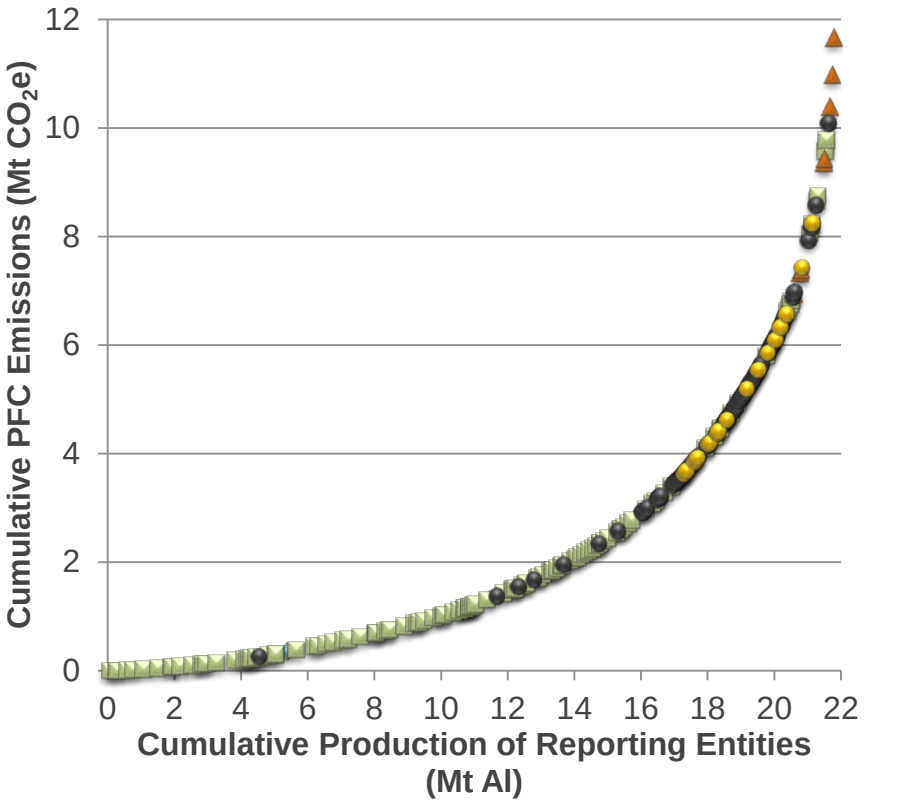


PFC Emissions Benchmarking

1990 vs 2010 intensities



Focus on high emitters (2010)



WORLD ALUMINIUM

NARRATIVE

The aluminium industry must demonstrate...

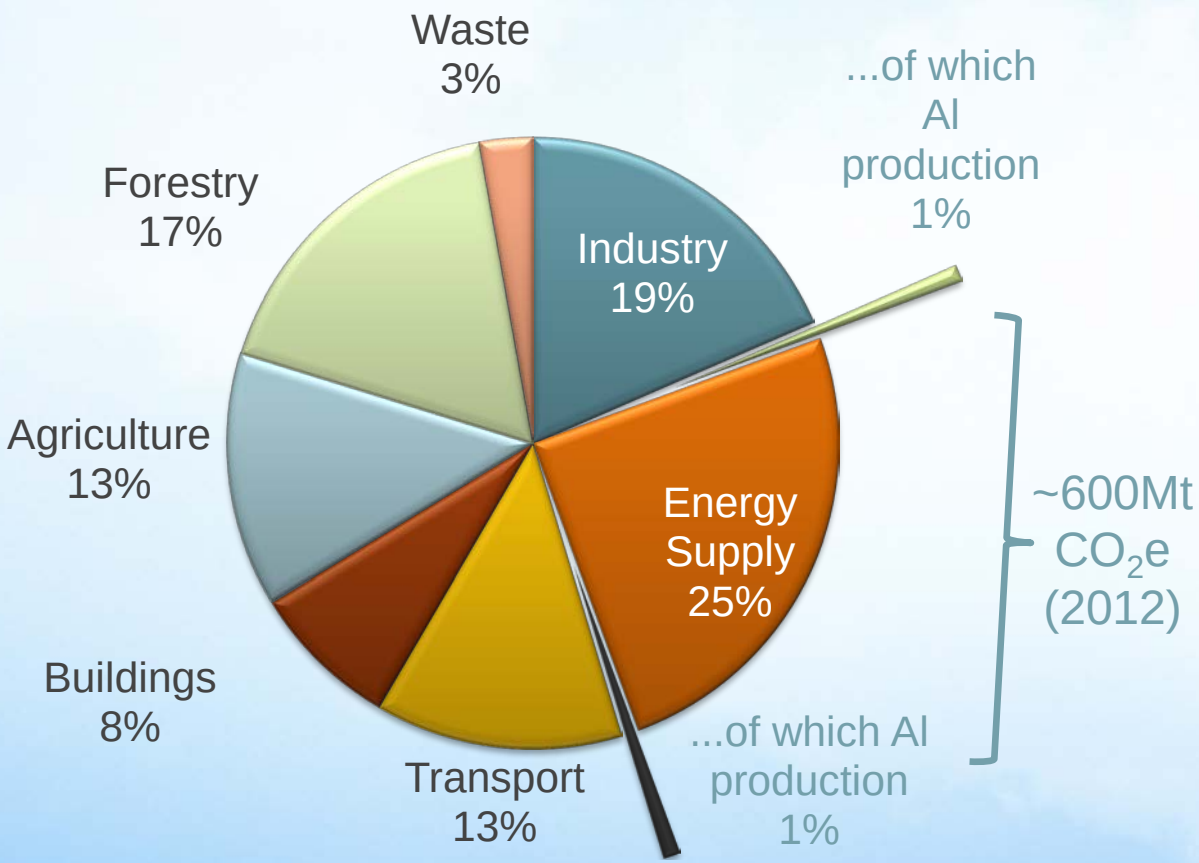
1. that it produces responsibly, by mitigating environmental impacts and positively impacting the communities in which it operates;
2. that its products bring a net benefit to society in terms of reduced environmental impact; improved quality of life, health, safety & wellness and economic growth;
3. that at the end of product life, the value of the metal, the energy that went into its production and the resource inputs are retained and realised as another product or service, through collection and recycling or energy recovery.

ENERGY BANK FOR THE FUTURE

THE ALUMINIUM STORY™

www.thealuminiumstory.com

Anthropogenic GHG Emissions by Sector



Opportunities to reduce emissions through use of aluminium in:

- Green buildings;
- Lightweight vehicles;
- Protective Packaging;
- Efficient machinery;
- Cables;
- Turbines & Solar Panels;
- Efficient Consumer Durables;
- Intelligent Control Systems.

Source: IPCC 2007

WORLD ALUMINIUM

THE ALUMINIUM STORY

ENERGY BANK FOR THE FUTURE

- Mining & refining best practice
- Production processes
- Transport application benefits
- Green building application benefits
- Packaging benefits
- Recycling & value recovery

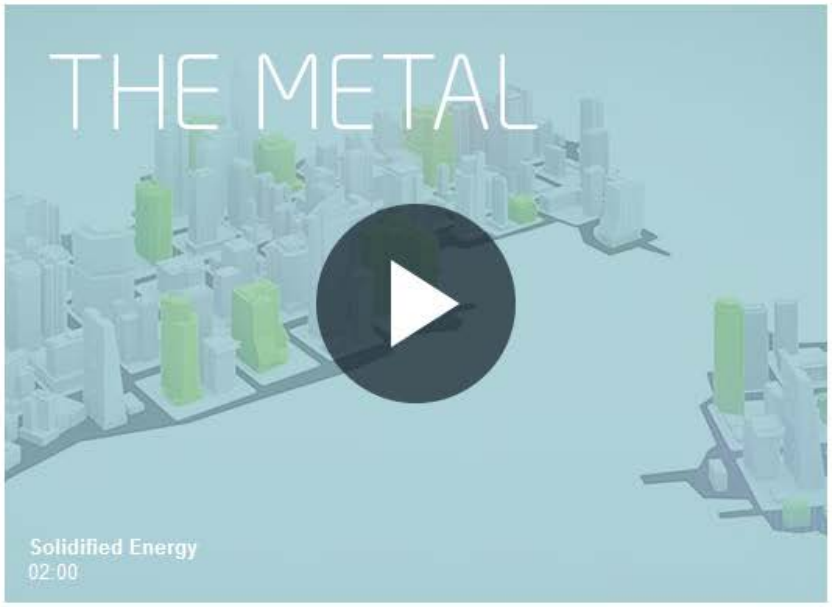
CN | EN

Almost infinite

ENERGY BANK FOR THE FUTURE

The Aluminium Story

From Mine to Market



USE

Strong & Light

02:30

RECYC

Value Retained

01:45

Carrier 100%

http://bauxite.world-aluminium.org

Google

Untitled

alu Aluminium for Future Generations™

ENGLISH Open Menu

PRE-MINING STEWARDSHIP COMMUNITIES PRODUCTION GROWTH SUSTAINABLE DEVELOPMENT

Carrier 100%

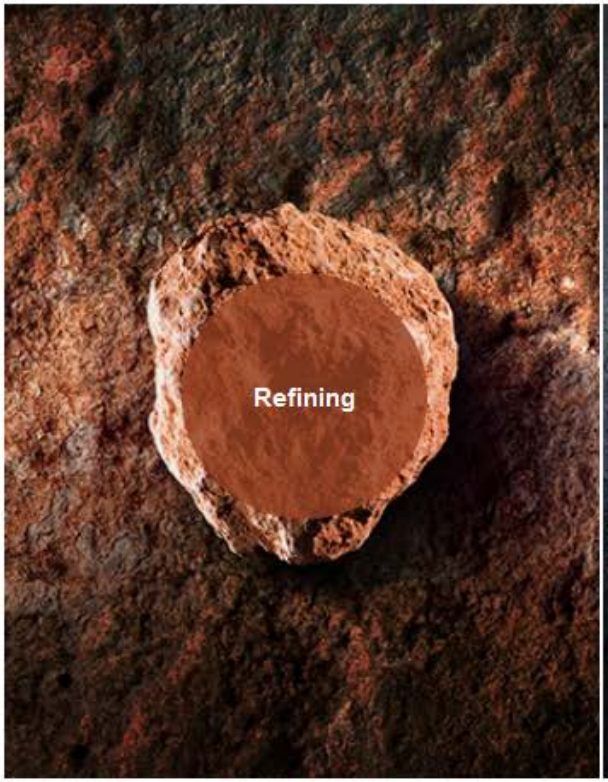
http://primary.world-aluminium.org

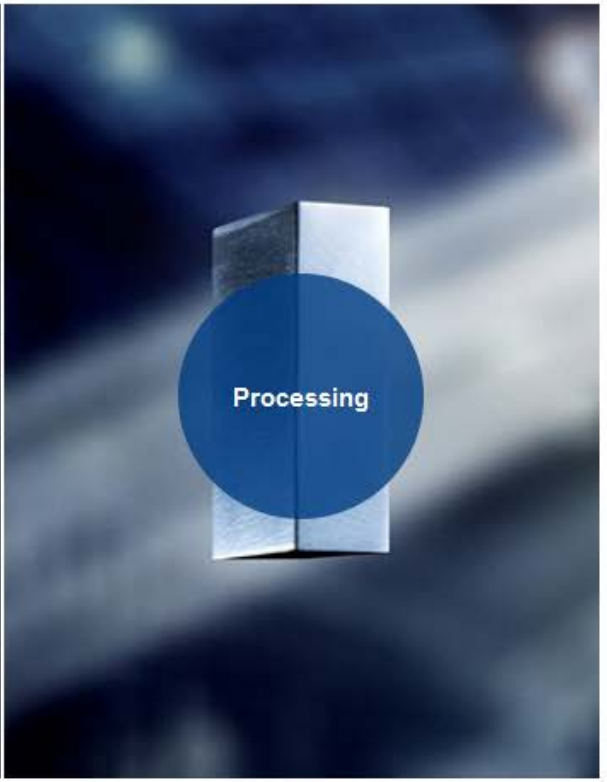
Google

Untitled

alu Aluminium for Future Generations™

ENGLISH Open Menu





INDUSTRY
STATISTICS

Carrier 100%

http://greenbuilding.world-aluminium.org

Google

Untitled

alu The Future Builds with Aluminium™

ENGLISH Open Menu

DURABLE FLEXIBLE LIGHT RECYCLED EFFICIENT ECONOMIC SYMPATHETIC

Experience the

Benefits of Aluminium in Green Architecture

Carrier 100%

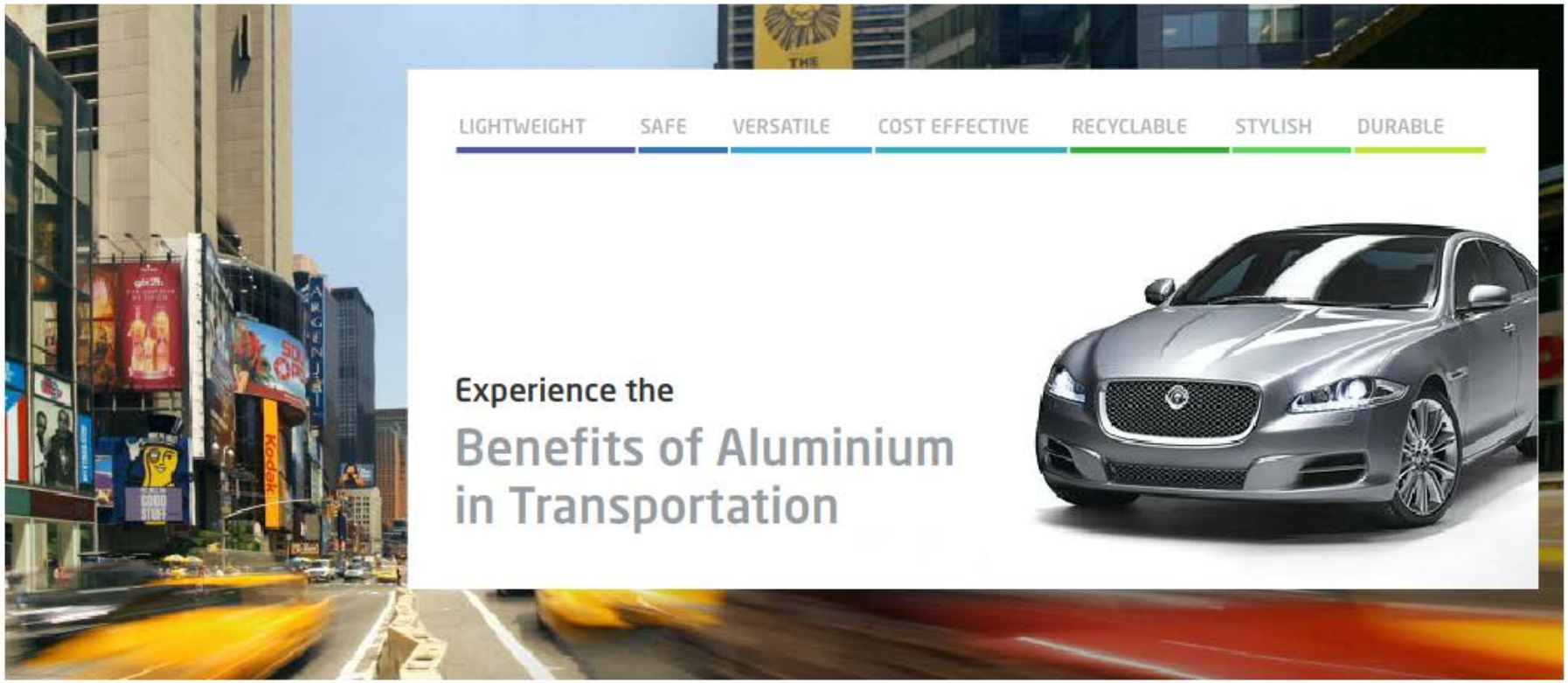
http://transport.world-aluminium.org

Google

Untitled

alu The Future Moves with Aluminium™

ENGLISH Open Menu



FRESHNESS & FLEXIBILITY

30% of the food in developing countries perishes due to the lack of packaging. Aluminium has the best barrier properties to keep food and drink, pharmaceuticals and toiletries fresh and safe, guaranteeing longer shelf-life and contributing to the sustainability of packaged products.

Carrier 100%

http://recycling.world-aluminium.org

Google

Untitled

alu Aluminium for Future Generations™

ENGLISH Open Menu

RECYCLING TRANSFORMS PRODUCTS & SOCIETIES

The recycling of aluminium products ensures that this valuable metal can change its use over and over again, while retaining its unique qualities. Thus, what was once a drinks can could one day form part of an aircraft, a laptop computer or even another can.

ELECTRICAL & CABLES

WORLD ALUMINIUM

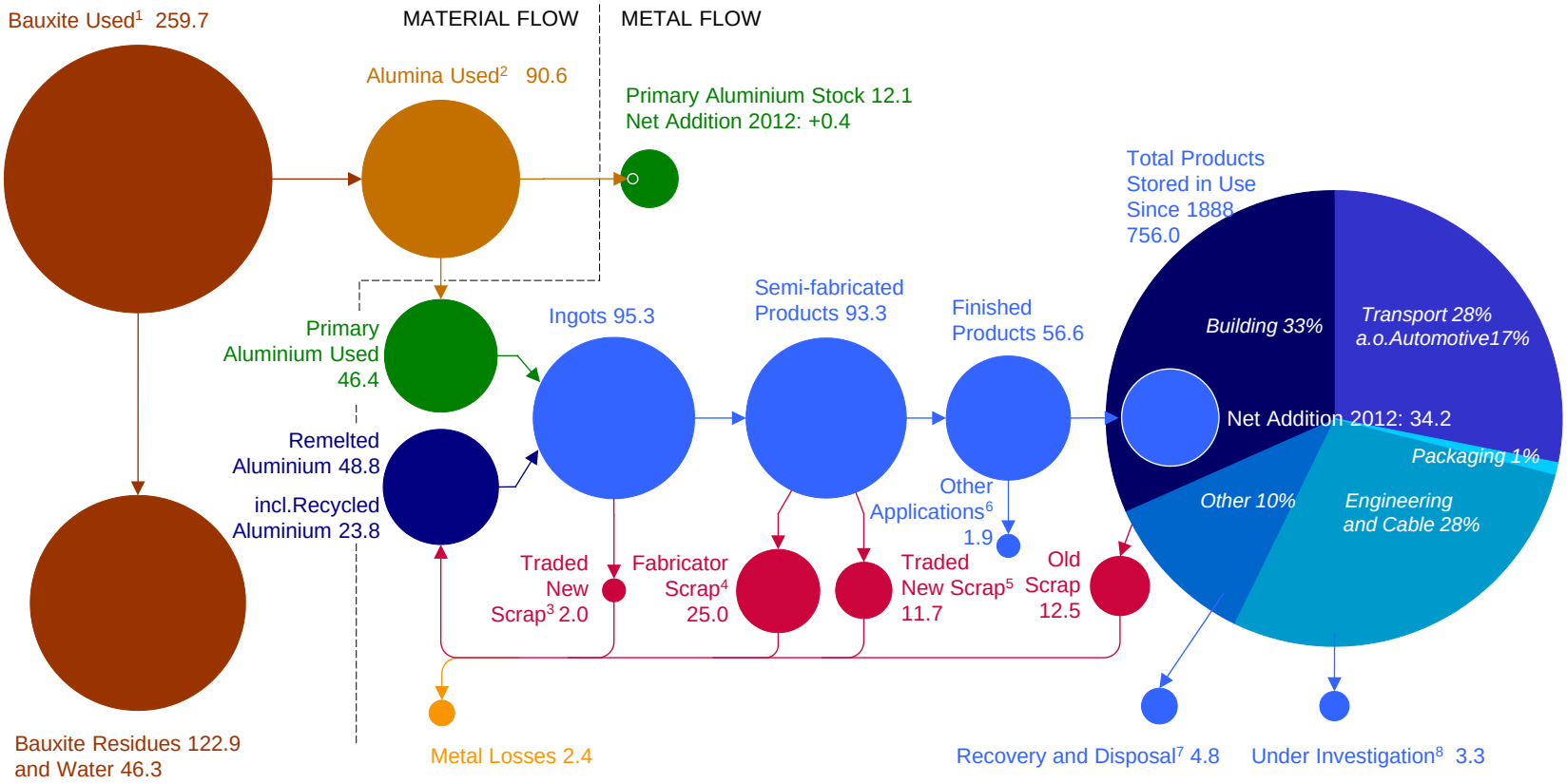
- www.thealuminiumstory.com
- www.world-aluminium.org
- www.youtube.com/thealuminiumstory

WORLD ALUMINIUM

MASS FLOW

WORLD ALUMINIUM

Global Mass Flow 2012 (DRAFT)



Values in millions of metric tonnes. Values might not add up due to rounding.
1 Calculated based on "2010 Life Cycle Inventory Data for the Worldwide Primary Aluminium Industry (2013)". Includes, depending on the ore, between 30% and 50% alumina; 2Calculated based on "2010 Life Cycle Inventory Data for the Worldwide Primary Aluminium Industry (2013)". Includes, on a global average 52% aluminium; 3 Aluminium in skimmings; 4 Scrap generated by foundries, rolling mills and extruders. Most is internal scrap and not taken into account in statistics; 5 Scrap generated during the production of finished products from semis; 6 Such as deoxidation aluminium (metal property is lost); 7 Either incinerated with/without energy recovery, material recovery or disposal; 8 Area of current research to identify final aluminium destination (reuse, recycling, recovery or disposal).

Three quarters of all aluminium ever produced is still in productive use

- 1 billion tonnes primary produced since 1888
- 750 million tonnes in products in use

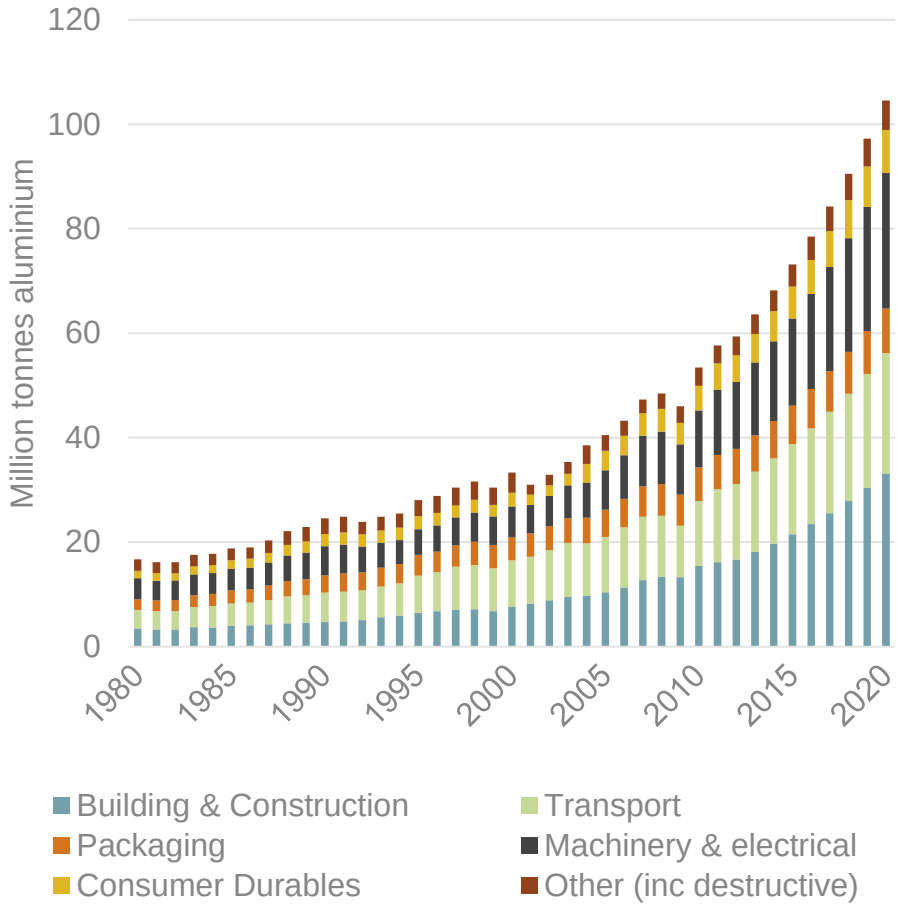
- A positive recycling story but…

…more significantly a story of

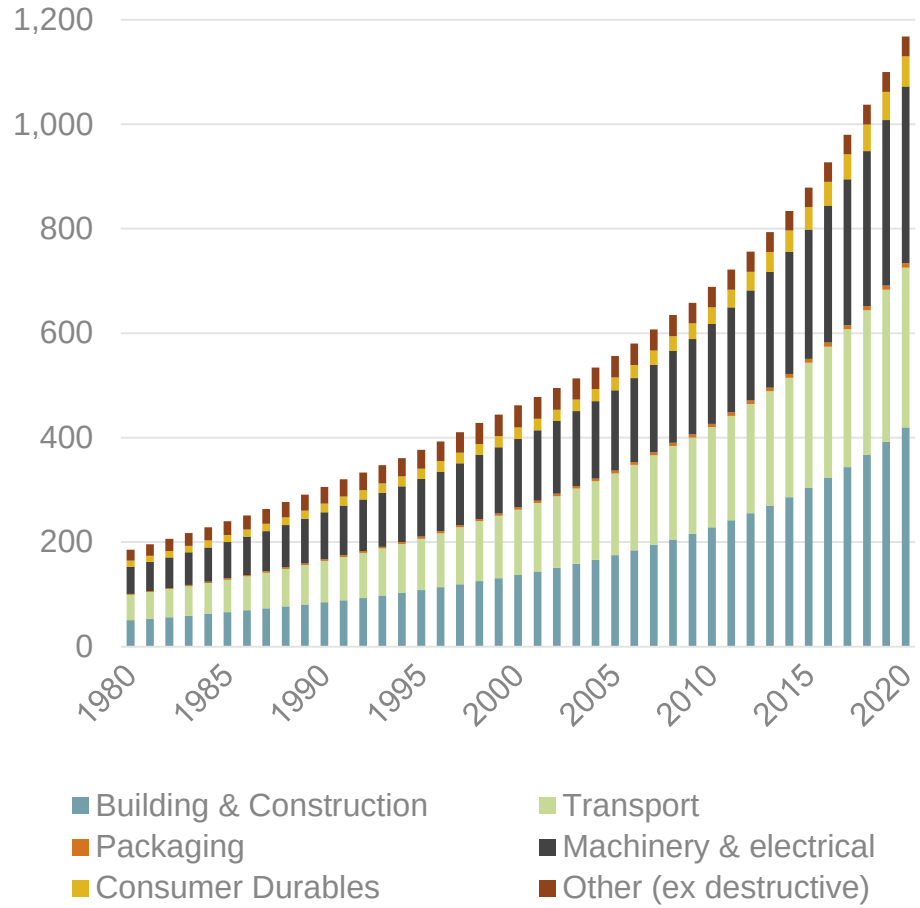
- Demand growth
  - For light, strong, conductive, protective products
  - 800 million tonnes produced since 1980
- Durability
  - Aluminium in long lifetime products have not yet reached the end of their “First Life”
  - Long lifetime products tend to have high recycling rates (>90%)

WORLD ALUMINIUM

Apparent Consumption (fabricated products)

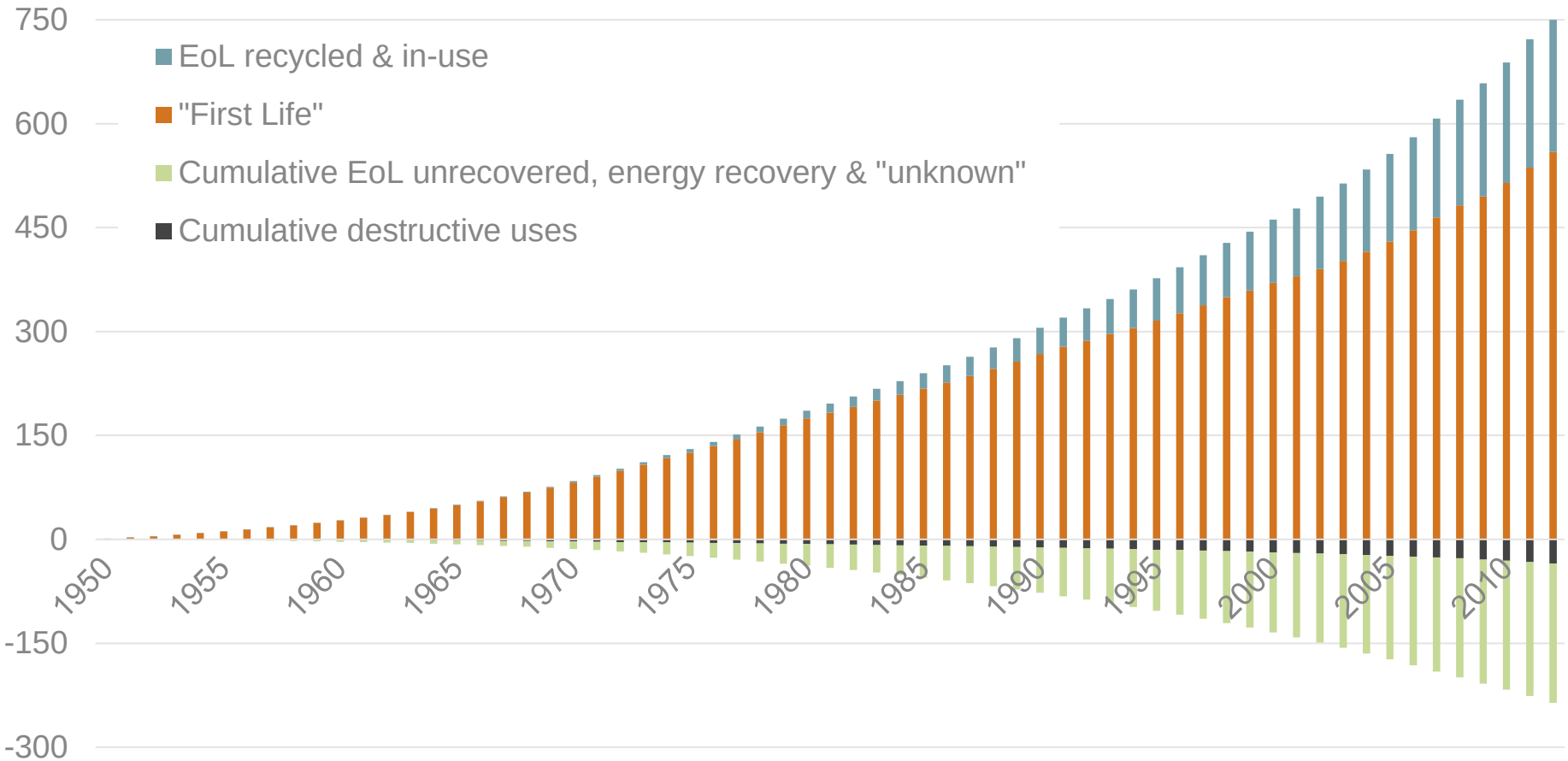


Aluminium “in use”



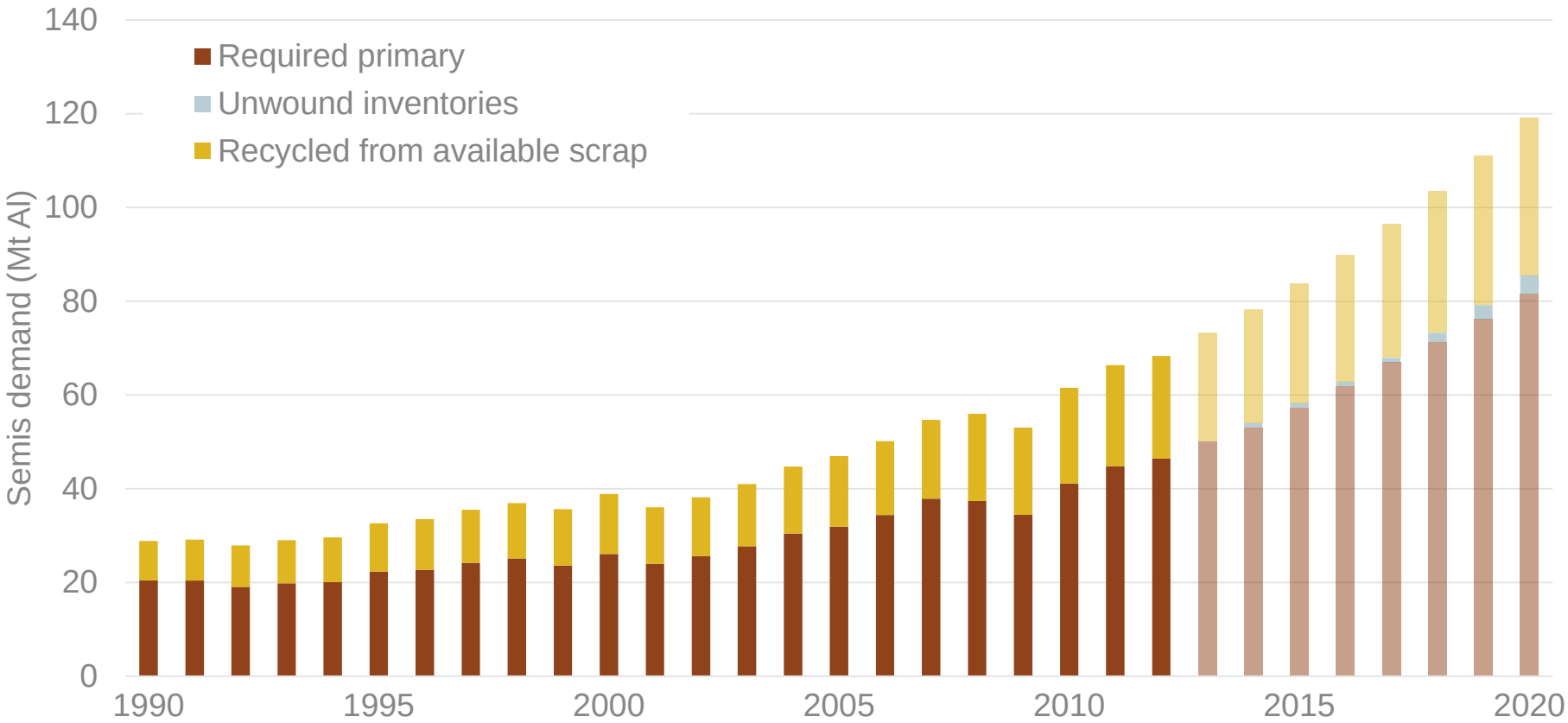
WORLD ALUMINIUM

75% still in use; 60% still in “first use”



WORLD ALUMINIUM

Demand will continue to be met from both primary & recycled sources



Mass Flow Ongoing

- Regionalisation of all flows (inc. trade, use and EoL);
- Stocks “not in use”, e.g. inventories;
- Lifetime distributions & regional specifics
  (e.g. buildings in China are not like buildings in EU);
- GHG & Energy modules;
- User-defined variables and scenarios:
  - Model architecture rather than “bundled data”

ENERGY BANK FOR THE FUTURE

THE ALUMINIUM STORY™

www.thealuminiumstory.com