BOSTON METAL

Steel production through electrolysis: impacts for electricity consumption

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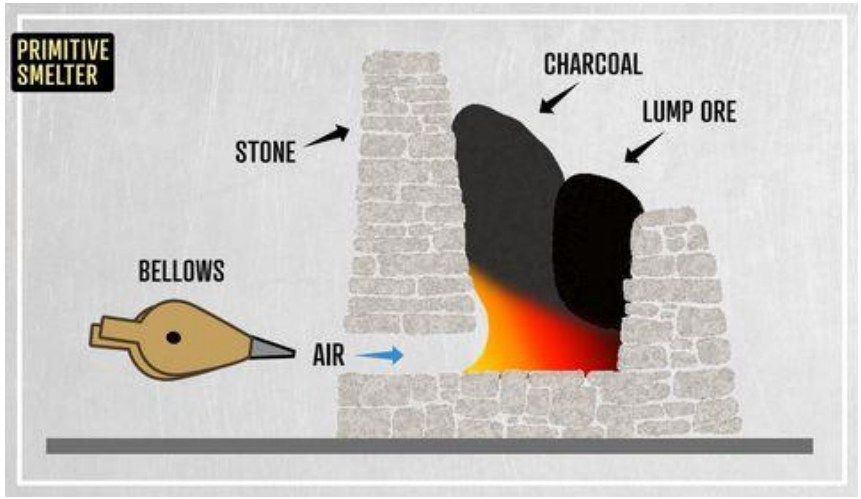
A 3,000 year old formula

Iron Ore		Carbon (Coal)		Iron		Carbon Dioxide
Fe_2O_3	+	C	=	Fe	+	CO_2



Iron Age 1000 BC

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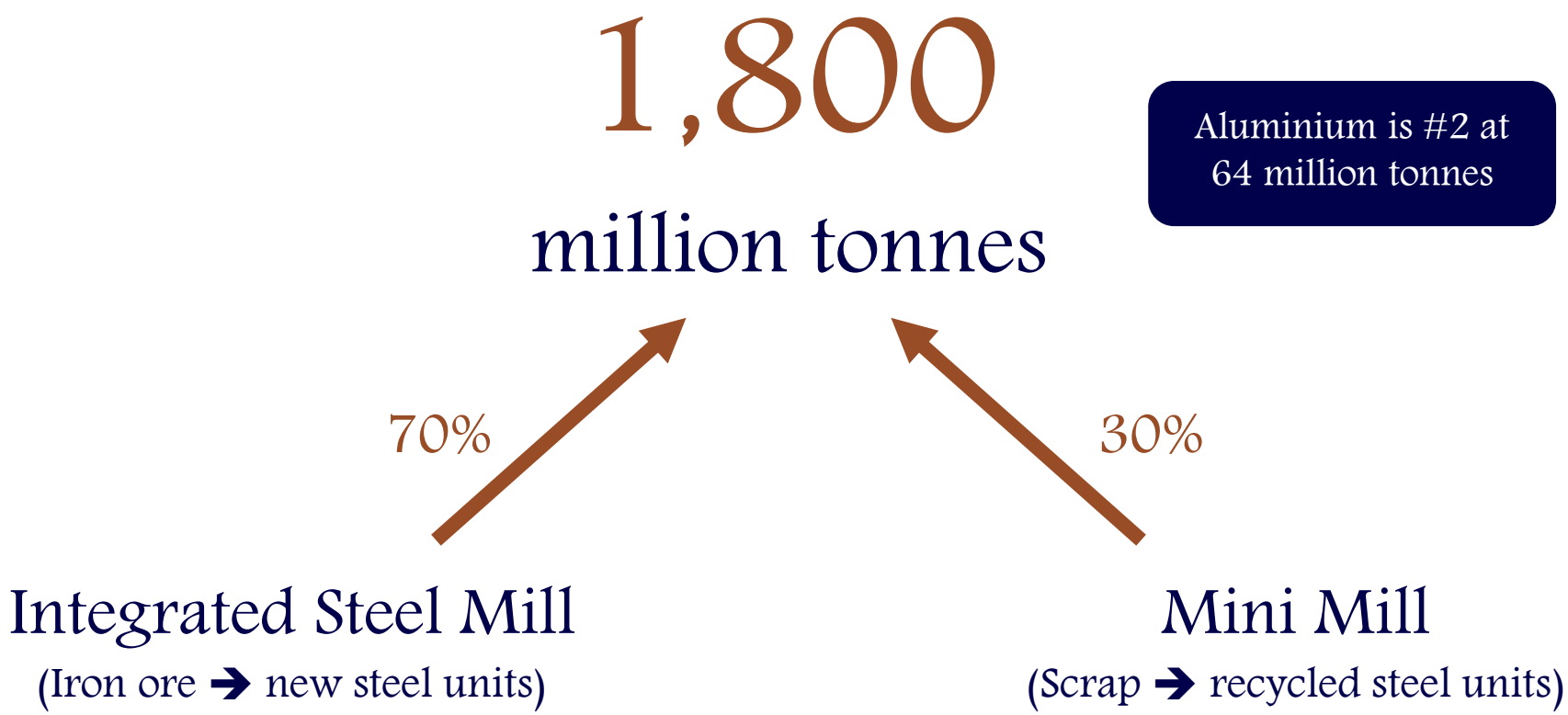
Gt CO_2 per year

(8% of global emissions)

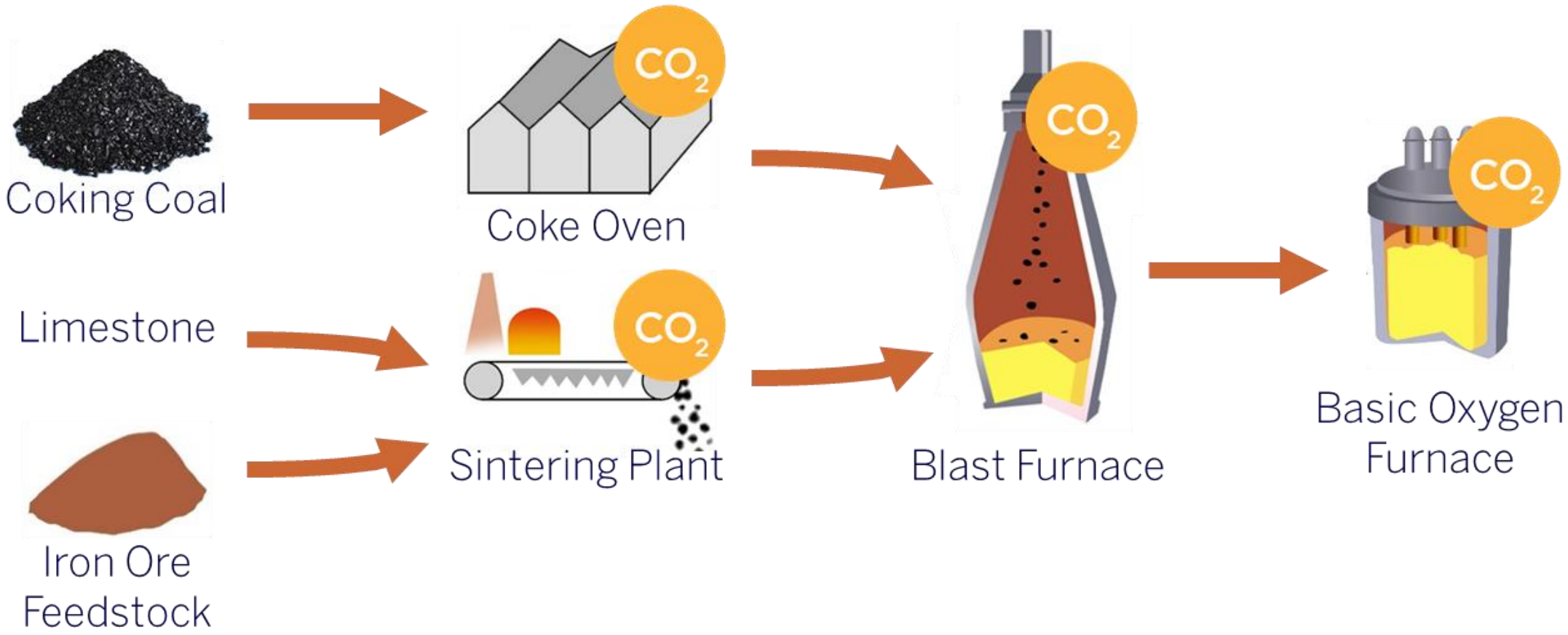
Digital Age 2019

Steel in 2018



Source: World Steel Association

Integrated steel mill: material flow



Molten oxide electrolysis (MOE) is emissions free

Molten Oxide Electrolysis (MOE)

Iron Ore		Electricity		Iron		Oxygen
Fe_2O_3	+	e^-	=	Fe	+	O_2

No carbon in the process = No CO_2 emitted

Electricity decarbonization eliminates/reduces indirect emissions!

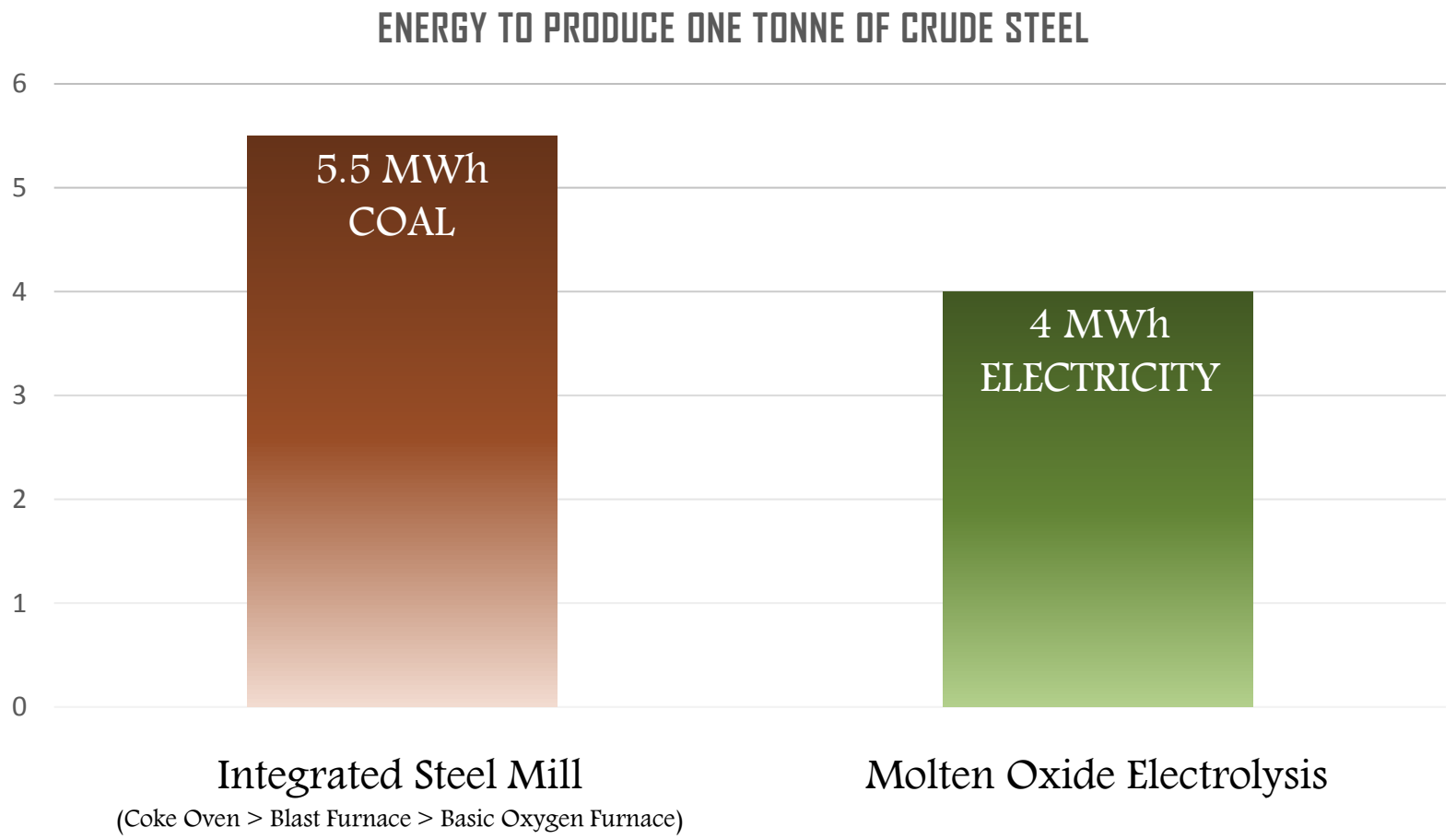
Changing the formula from coal to electricity

Iron Ore		Carbon (Coal)		Iron		Carbon Dioxide
Fe_2O_3	+	C	=	Fe	+	CO_2

Molten Oxide Electrolysis (MOE)

Iron Ore		Electricity		Iron		Oxygen
Fe_2O_3	+	e^-	=	Fe	+	O_2

MOE is more energy efficient



Source: World Steel Association

But the sheer volume (and energy) is immense

1.2 Bt

Integrated Steel production requires:

Today

Nearly 1 Bt of Coal
(~15% of 2018 consumption)

100% MOE

4,800 TWh of Electricity
(~20% of 2018 consumption)

Aluminium production used 870 TWh

Source: World Steel Association

Transportation will be demand far more electricity

	Fossil Fuel Retirement (TWh)	Electricity Growth (TWh)
Steel Production (100% MOE Adoption)	6,600 (Coal)	4,800
Transport (2º Scenario)	15,900 (Oil)	7,100
Transport (Beyond 2º Scenario)	22,900 (Oil)	10,200

TWh (2014 vs 2060)

Source: IEA 2017 Technology Perspectives

In US, LED savings could power all MOE steel

26 Mt

US Integrated Steel production 2017

MOE Production

104 TWh

Electricity needed

ACEEE: US LED Lighting Electricity Savings (2030 vs 2019)

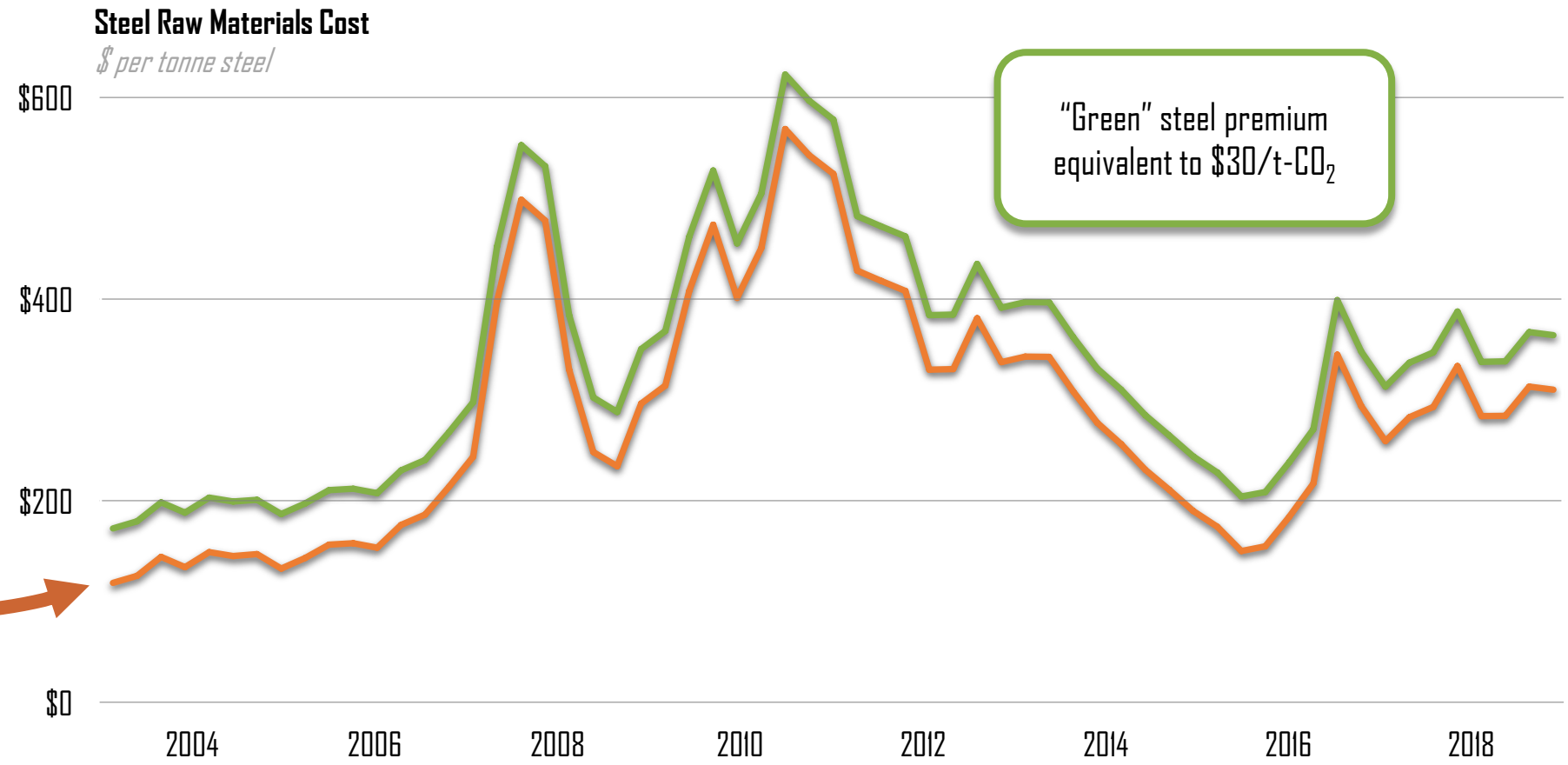
45 TWh + 56 TWh

Residential

Commercial

Source: American Council for an Energy-Efficient Economy
New Horizons for Energy Efficiency: Major Opportunities to Reach Higher Electricity Savings by 2030

Lower cost and lower volatility



Lower cost and lower volatility

Molten Oxide Electrolysis

Iron Ore

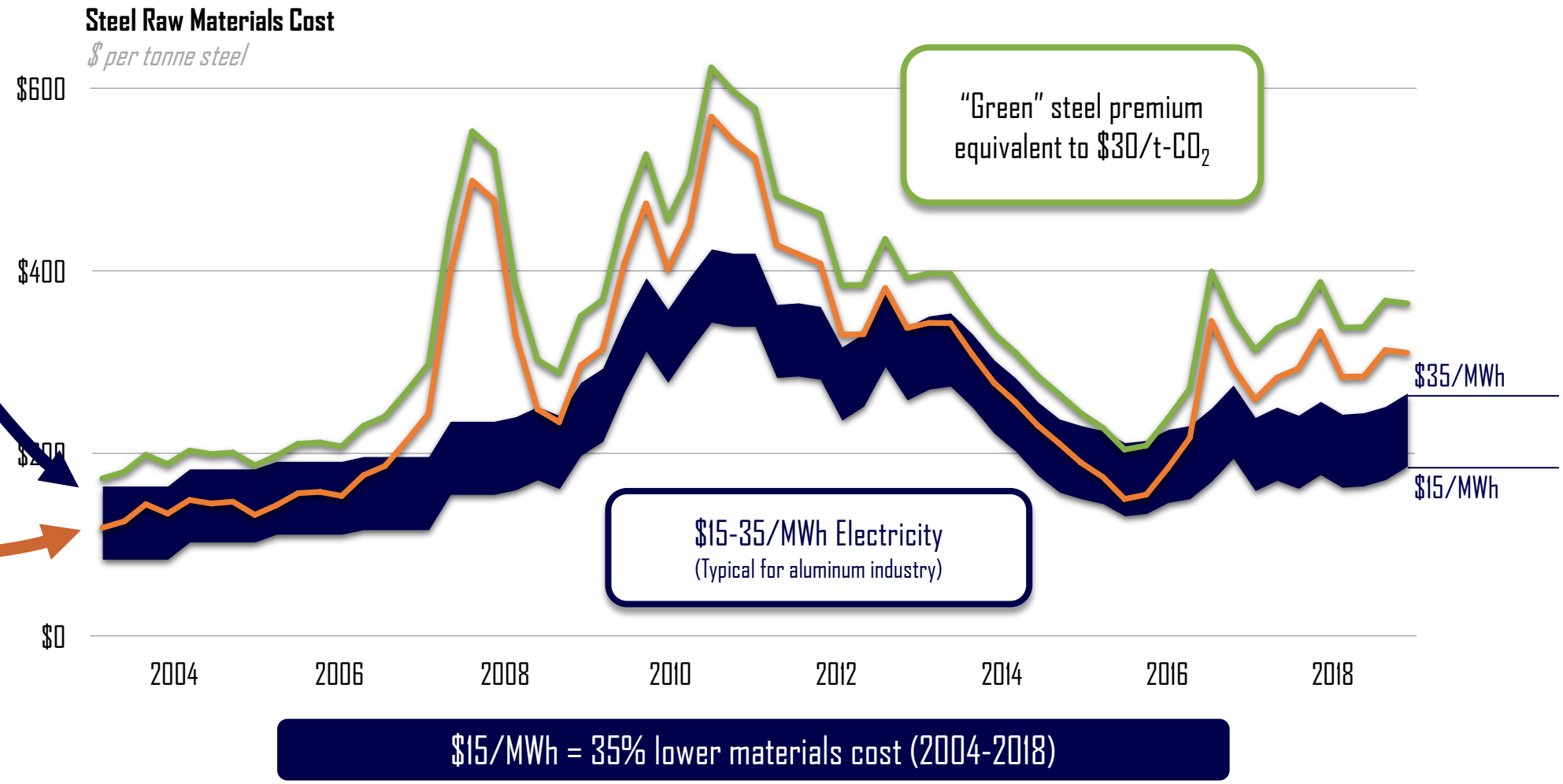
Electricity

Blast / Basic Oxygen Furnace

Iron Ore

Coking Coal

Scrap



$15/MWh = 35% lower materials cost (2004-2018)

World-class partners

Breakthrough Energy VENTURES

THE ENGINE
Built by MIT

Tavarua International

Prelude VENTURES

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA ·

OGCI CLIMATE INVESTMENTS
OIL AND GAS CLIMATE INITIATIVE

MINTZ

Metals made better

Emissions free steel

Electrifying the largest industrial source of CO_2

Lower commodity cost

Competitive without a carbon tax

Industrial-scale modularity

Efficient allocation of capital