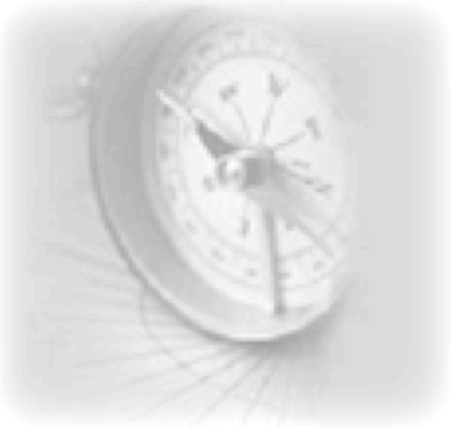
The Use of Industrial Wood Pellets as a Substitute for Coal in Power Plants

How Canada can join other developed countries and embrace a pragmatic transition to a more decarbonized future

William Strauss, PhD, President, FutureMetrics



FutureMetrics

Intelligent Analysis and Strategic Leadership for the Pellet Sector

8 Airport Road
Bethel, ME 04217, USA
www.FutureMetrics.com

Consultants to the World's Leading Companies in the Wood Pellet Sector

Selection of Current and Recent Clients

Award Winning and Well-Respected FutureMetrics Team Members that are Here

Dr. William Strauss, President

Named one of the most influential leaders in the biomass sector in 2016 and 2017 by Argus Media.

Recipient of the 2012 International Excellence in Bioenergy Award.

John Swaan, Pellet Plant Operations

Recipient of the 2014 International Founders Award.

Founder of Pacific BioEnergy and producer of the first transatlantic shipment of wood pellets from North America to Europe (1998). Leading expert on pellet plant operations.

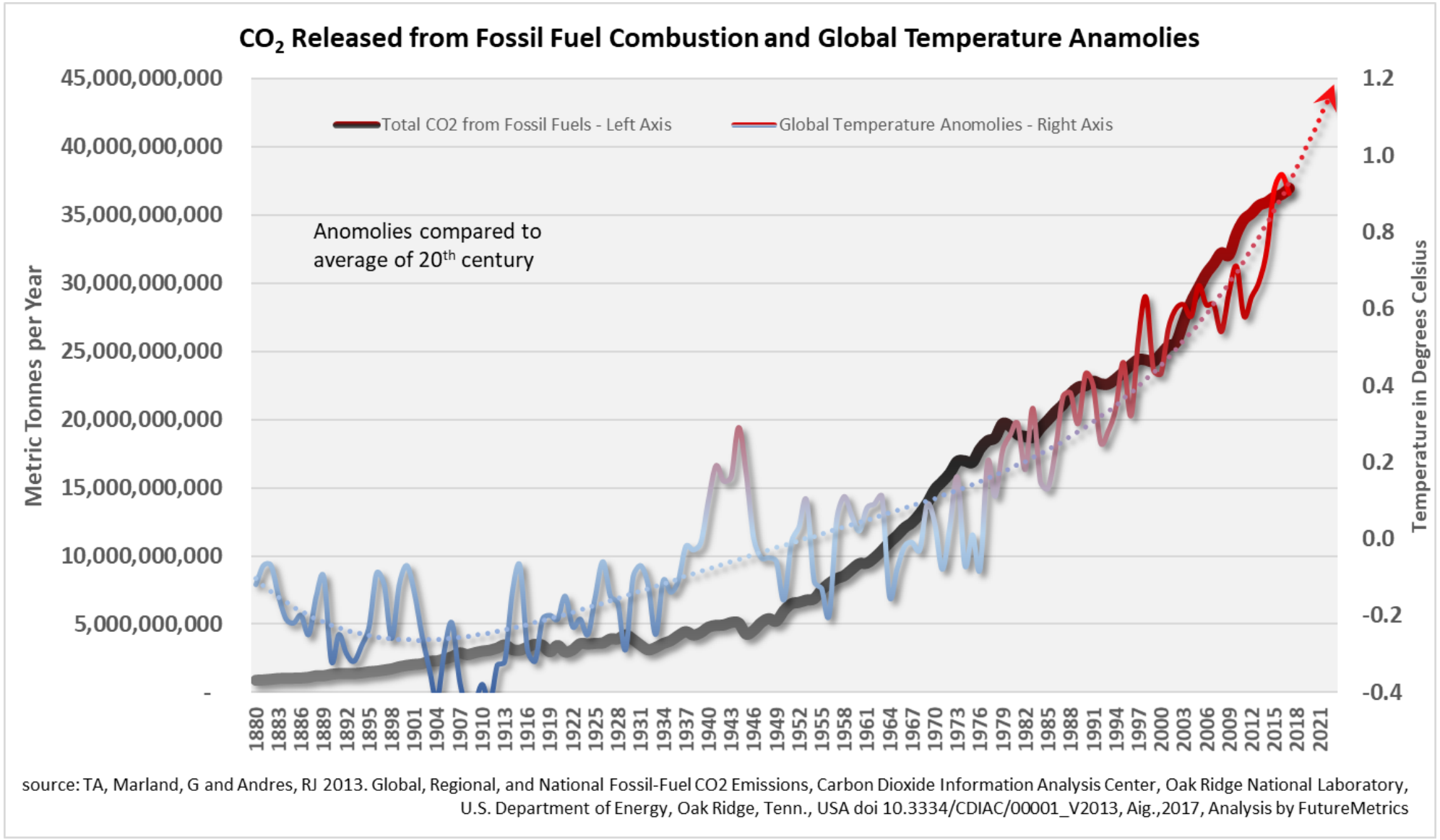
Seth Walker, Senior Economist

A leading researcher, analyst, and author in the wood pellet sector.

Has presented at dozens of conferences throughout the world.

Why Does the Industrial Wood Pellet Industry Exist?

Most of the countries of the world recognize the relationship shown in the chart below.



source: TA, Marland, G and Andres, RJ 2013. Global, Regional, and National Fossil-Fuel CO2 Emissions, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., USA doi 10.3334/CDIAC/00001_V2013, Aig.,2017, Analysis by FutureMetrics

The foundation of carbon emissions mitigation from the use of wood pellets is because the
NET carbon added to the atmosphere
from the combustion of wood pellets is **ZERO.**

The foundation for zero carbon emissions is the SUSTAINABLITY OF THE FOREST RESOURCES.

As long as the growth rate equals or exceeds the harvest rate, the net stock of carbon held in the forest landscape is held constant or is increasing.

Managed forests provide feedstock for many industries: lumber, pulp and paper, and pellets.

Sustainably managed forests cycle CO_2 continuously.

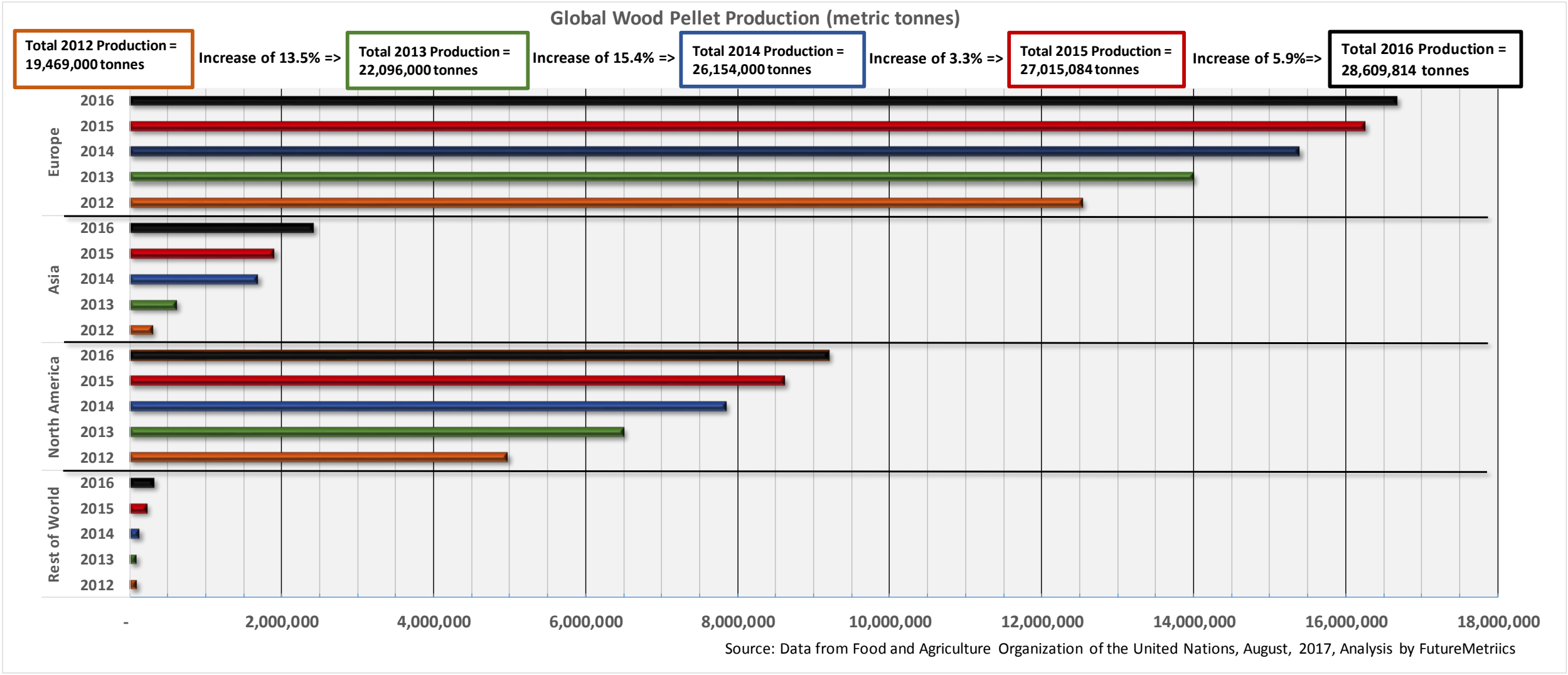
Sustainability of the forests
(and therefore the carbon stock held by the forests)
is certified by independent third party audits for every tonne of pellets exported from Canada and the US for use in power plants.

The use of upgraded densified dried sustainably produced biomass-derived fuel as a substitute for coal is a well-established option that should be included in the *Canadian strategy* for

a rational and pragmatic transition to a more decarbonized future.

Overview of Global Pellet Markets

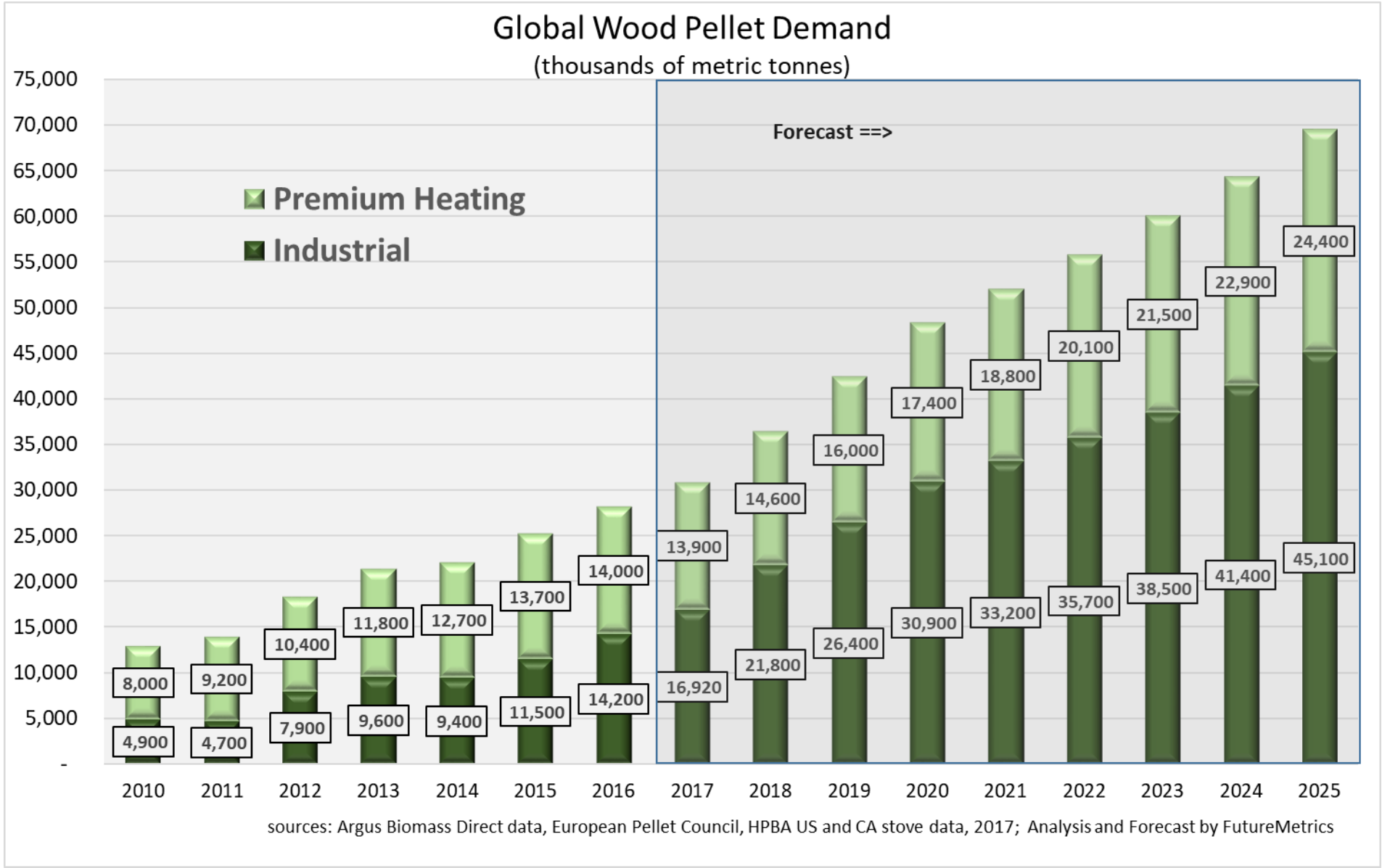
Global wood pellet markets have had significant growth in the past decade. The wood pellet market has experienced growth rates over the last few years of about 10% annually from about 19.5 million metric tonnes in 2012 to about 28.6 million metric tonnes in 2016.



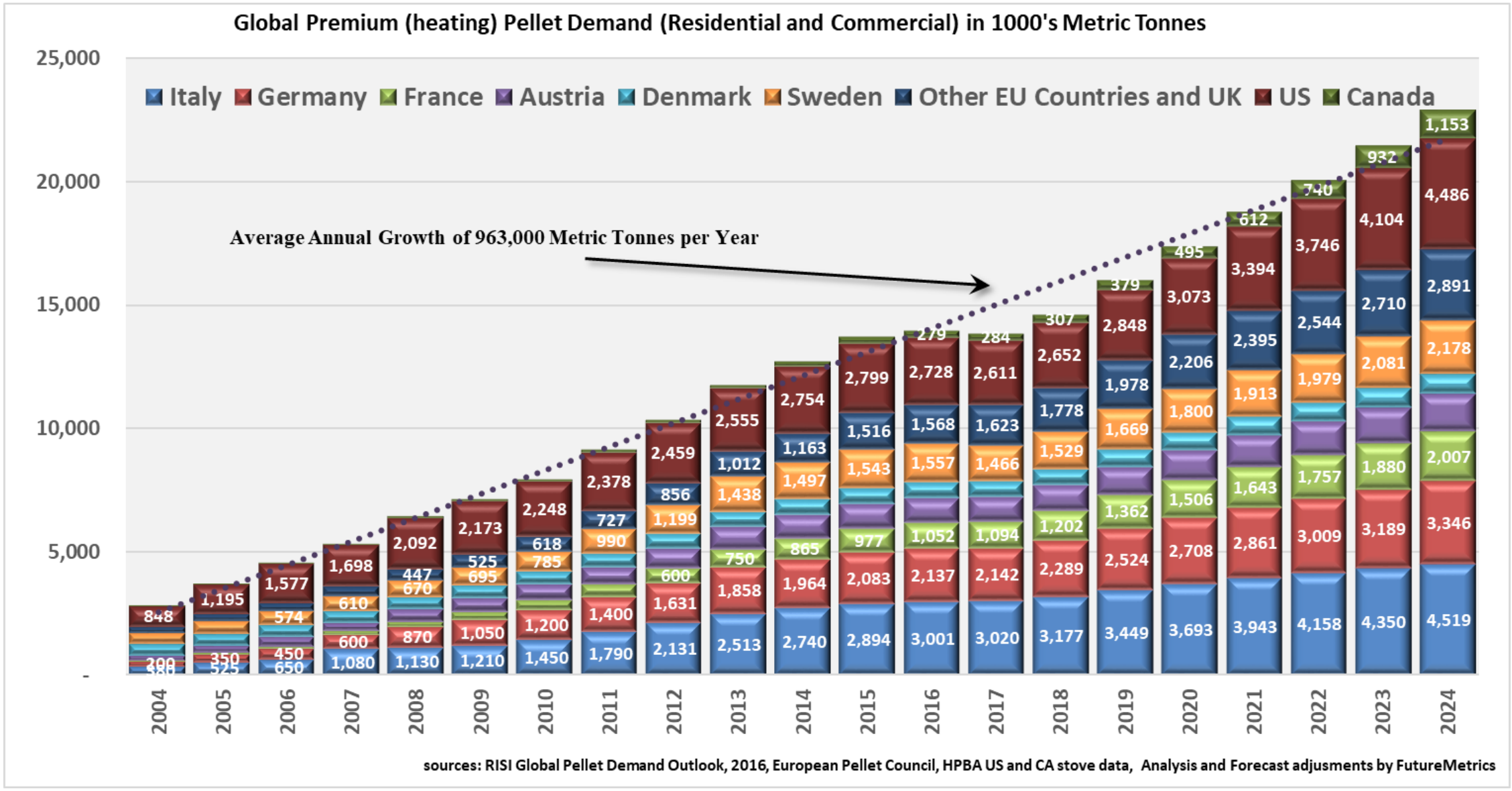
The two major markets for pellets:

(1) industrial pellets used as a substitute for coal in large utility power stations;

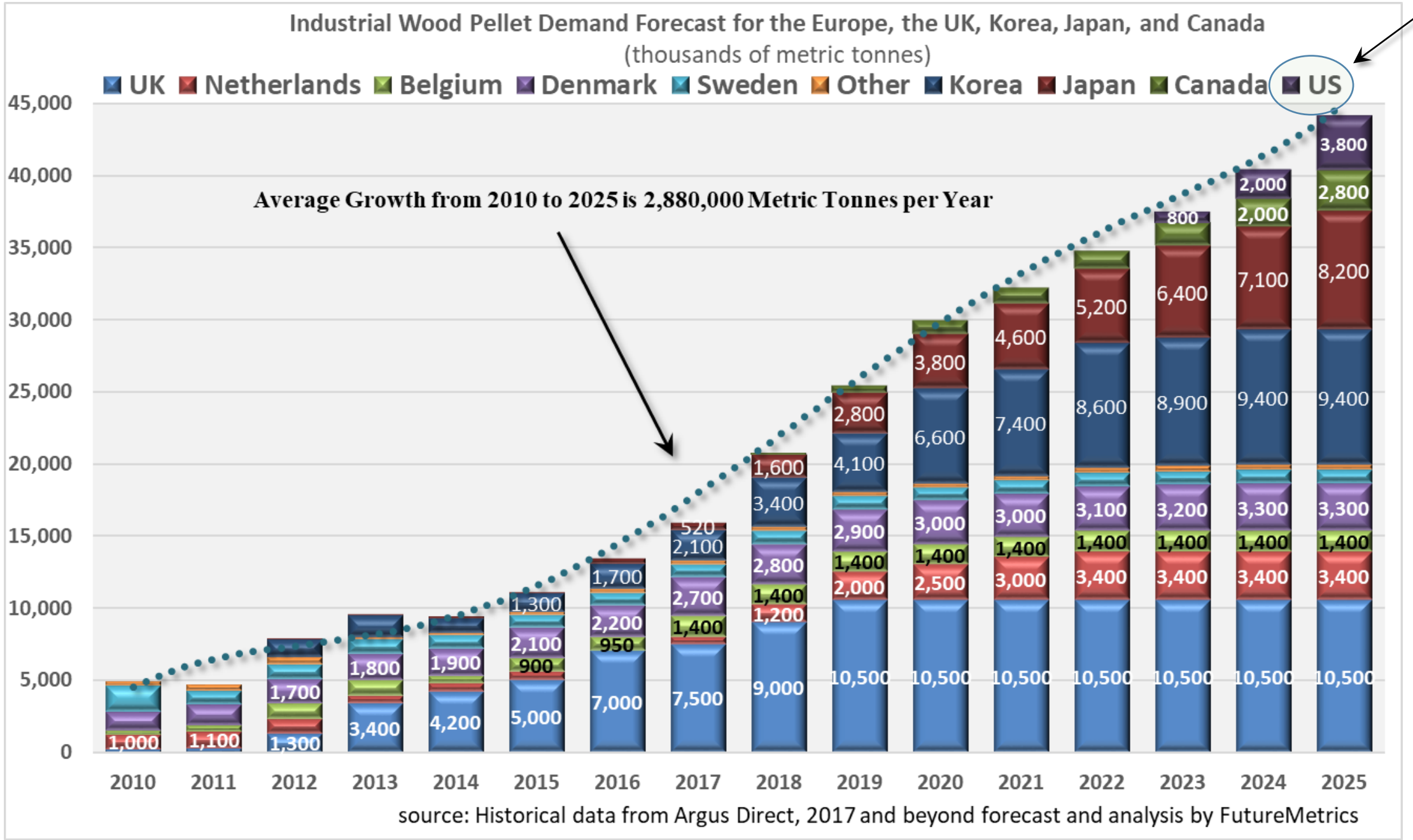
(2) Premium heating pellets used in pellet stoves and pellet fueled central heating systems.



Heating Pellet Markets



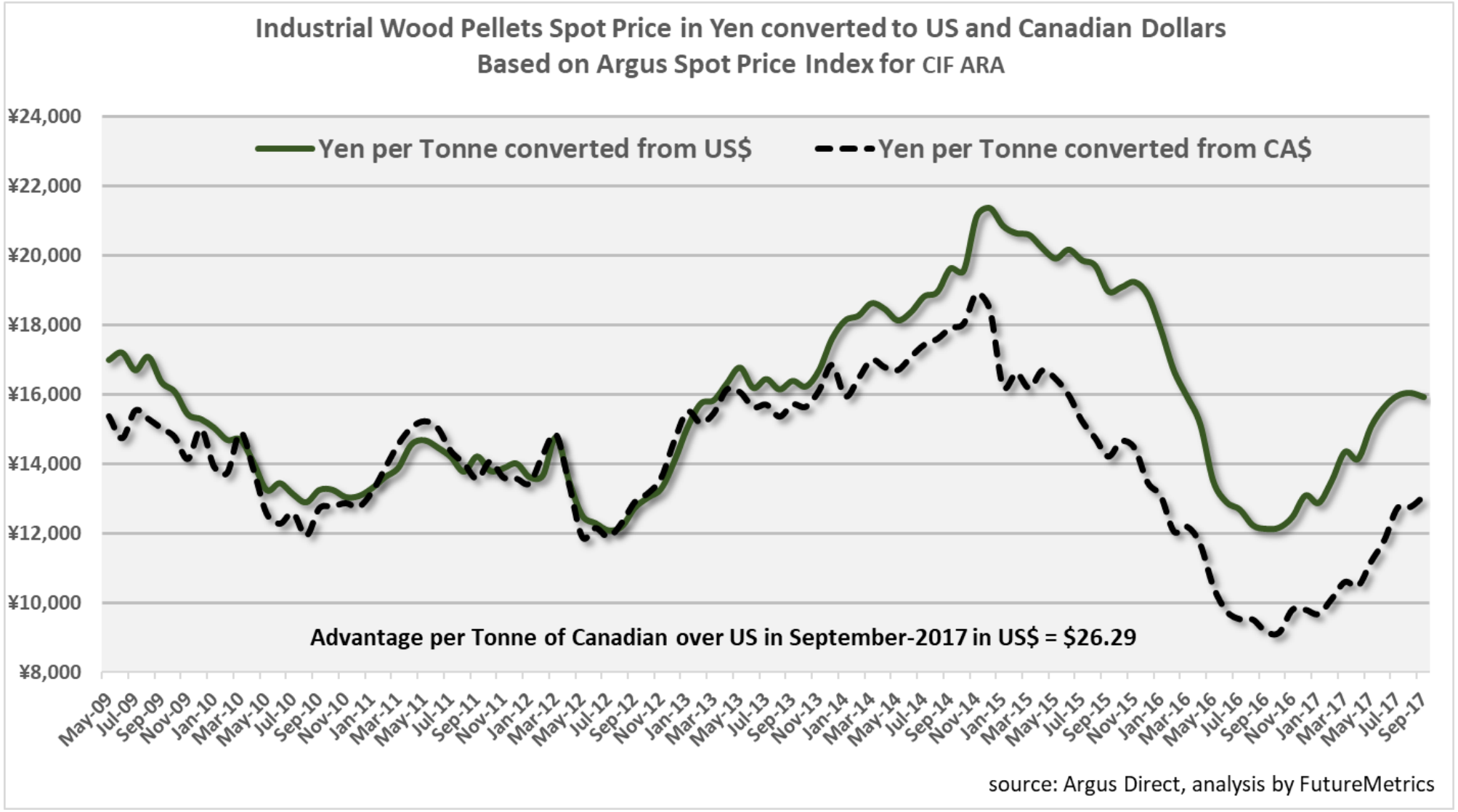
Industrial Pellet Markets



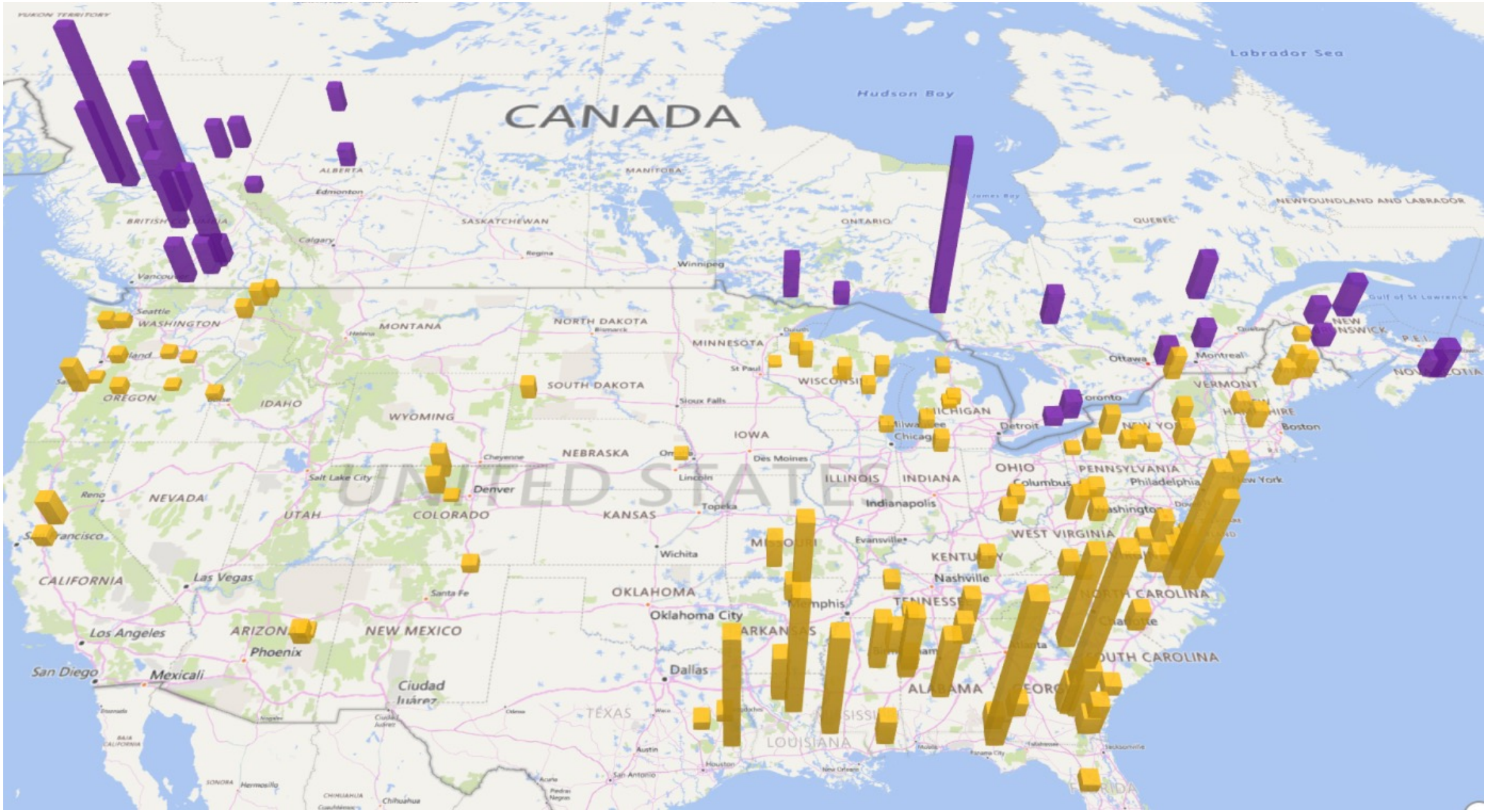
The US and Canada dominate the trade in industrial wood pellets into Europe, the UK, and Japan. Vietnam dominates the trade into S. Korea.

	Net Imports by Region (major import and export countries) - negative indicates net exports				
Region	**2013**	**2014**	**2015**	**2016**	**2017 (forecast)**
Europe and UK	4,866,320	5,655,327	6,669,874	7,407,511	8,570,000
Canada	-1,615,638	-1,607,239	-1,597,847	-2,252,201	-2,320,000
US	-2,730,078	-3,835,747	-4,368,301	-4,537,378	-5,220,000
Japan	79,052	92,539	232,060	346,518	670,000
S. Korea	484,668	1,849,639	1,469,184	1,716,346	2,530,000
Vietnam	-157,226	-742,794	-1,022,809	-1,254,955	-1,490,000
		source: Argus Direct, September 2017, Analysis and 2017 forecast by FutureMetrics			

Exchange rates have favored Canadian Producers in recent years…



US and Canadian Wood Pellet Mills – height of bar represents nameplate capacity



Source: Nameplate capacity as reported by Biomass Magazine, Sept. 2017, Analysis by FutureMetrics

Canadian Potential for Co-firing or Full-firing Wood Pellets

Mandating the cessation of the use of coal for power generation and the carbon tax at $50/tonne form a foundation…

For Alberta, which remains highly dependent on coal for power generation, a solution that leverages its existing coal assets makes a lot of sense.

Alberta's Electricity Generation - 2015

As of December 2015

Generation	Gigawatt Hour (GWh)	Generation Share By Fuel
Coal	41,378	51%
Natural Gas	32,215	39%
Hydro	1,745	2%
Wind	3,816	5%
Biomass	2,149	3%
Others*	318	0%
Total	**81,621**	**100%**

*Others include fuel oil and waste heat

Source: Alberta Utilities Commission (AUC)

Alberta's Coal-fired Power Fleet				
	Capacity (MW)	Year Completed	Age	Age in 2030
Battle River				
3	150	1969	47	61
4	150	1975	41	55
5	370	1981	35	49
Genesee				
1	410	1989	27	41
2	410	1994	22	36
3	495	2005	11	25
HR Milner 1	150	1972	44	58
Keephills				
1	406	1983	33	47
2	409	1983	33	47
3	495	2011	5	19
Sheerness				
1	380	1986	30	44
2	380	1990	26	40
Sundance				
1	280	1970	46	60
2	80	1973	43	57
3	406	1976	40	54
4	392	1977	39	53
5	392	1978	38	52
6	392	1980	36	50
Averages ==>	**341.5**		**33**	**47**

By 2030 most of Alberta's coal fleet will be over 50 years old.

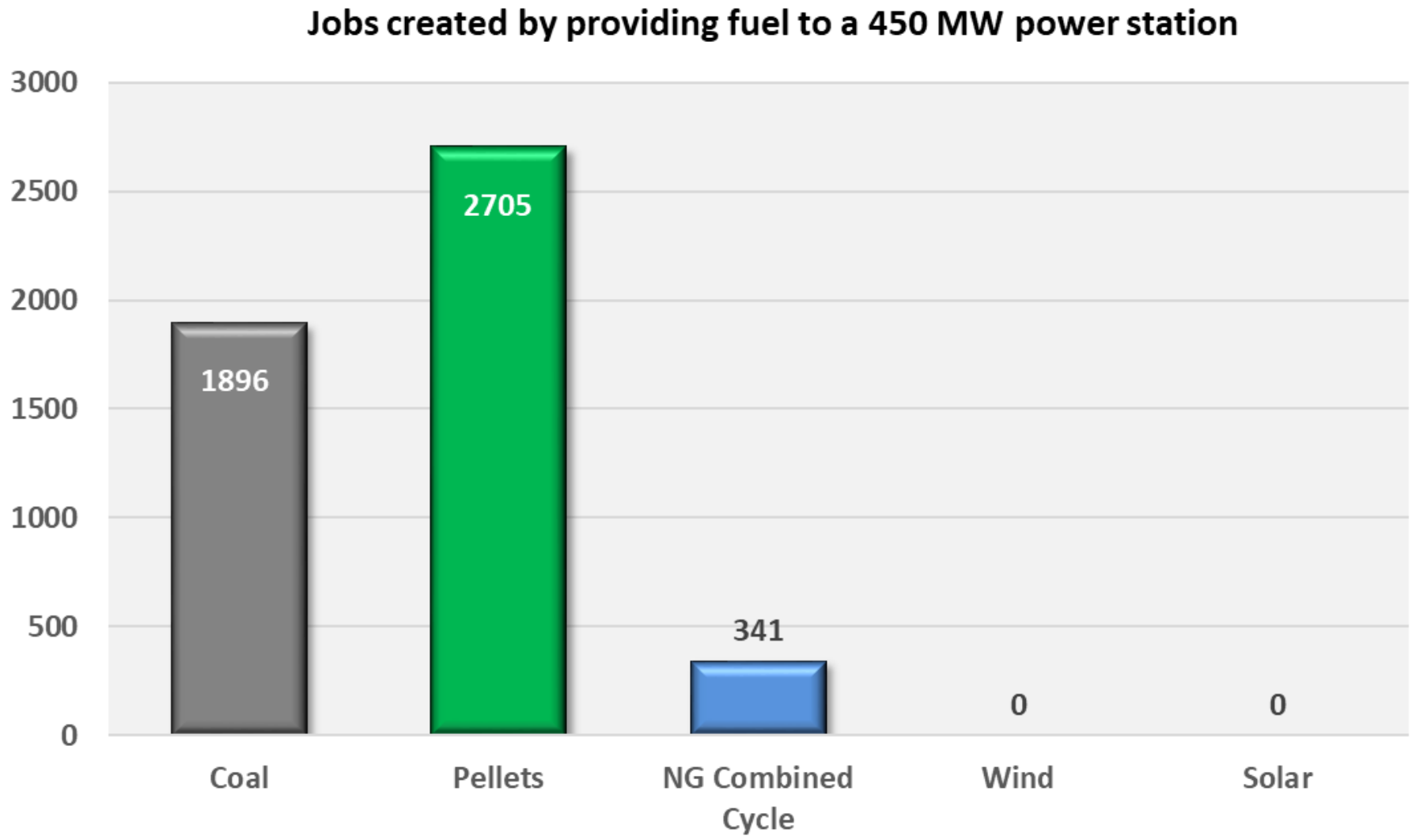
But a few plants will be relatively young.

New Brunswick, Nova Scotia, and Saskatchewan also have coal fueled power plants that provide critical baseload power.

New Brunswick Power's 450 MW coal fueled station in Belledune is 23 years old and is far from being ready to retire.

Nova Scotia Power's coal fueled Trenton station is a key supplier of power to Nova Scotia. Coal is imported from the US. Pellets would be Canadian made.

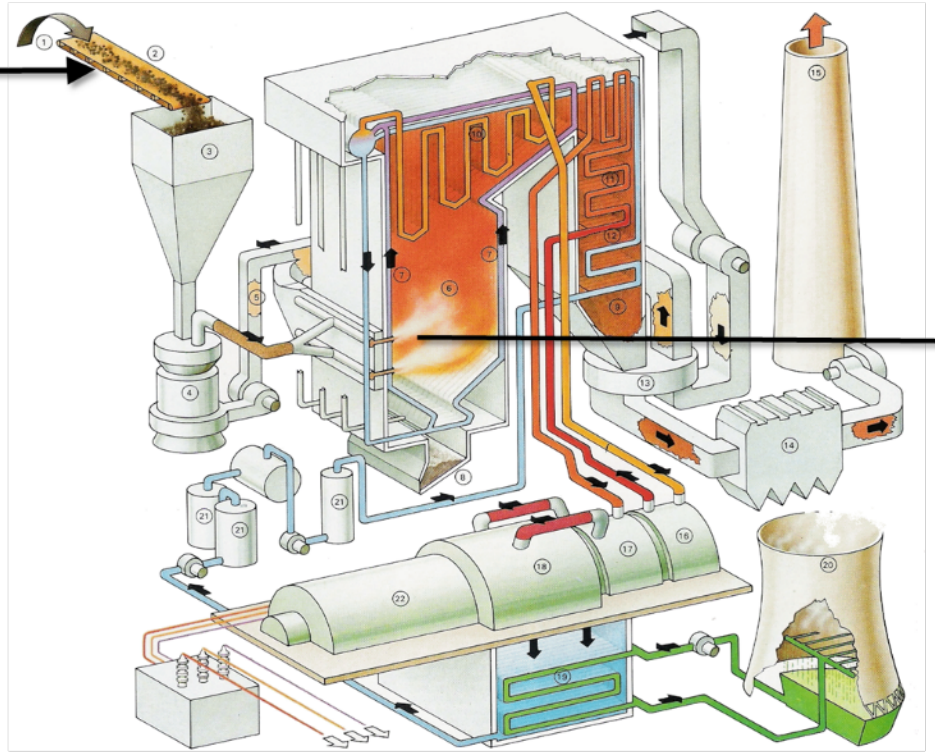
This is a job sustaining and job creating solution for complying with carbon reduction policy.

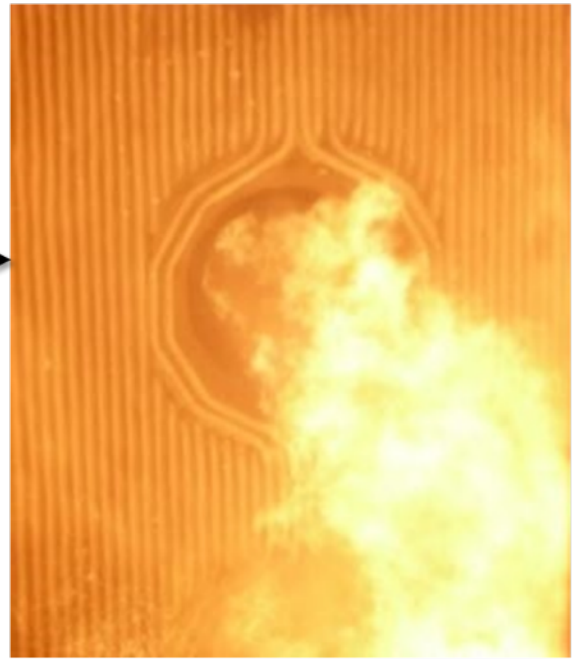


Analysis on pellet jobs by FutureMetrics. Data on coal employment from "U.S. Coal Exports: National and State Economic Contributions", Ernst & Young, May, 2013. NG jobs based on percentage of NG that goes to the power sector and data from employment in NG extraction and transport. Total jobs includes direct, indirect, and induced jobs calculated with IMPLAN. Analysis by FutureMetrics

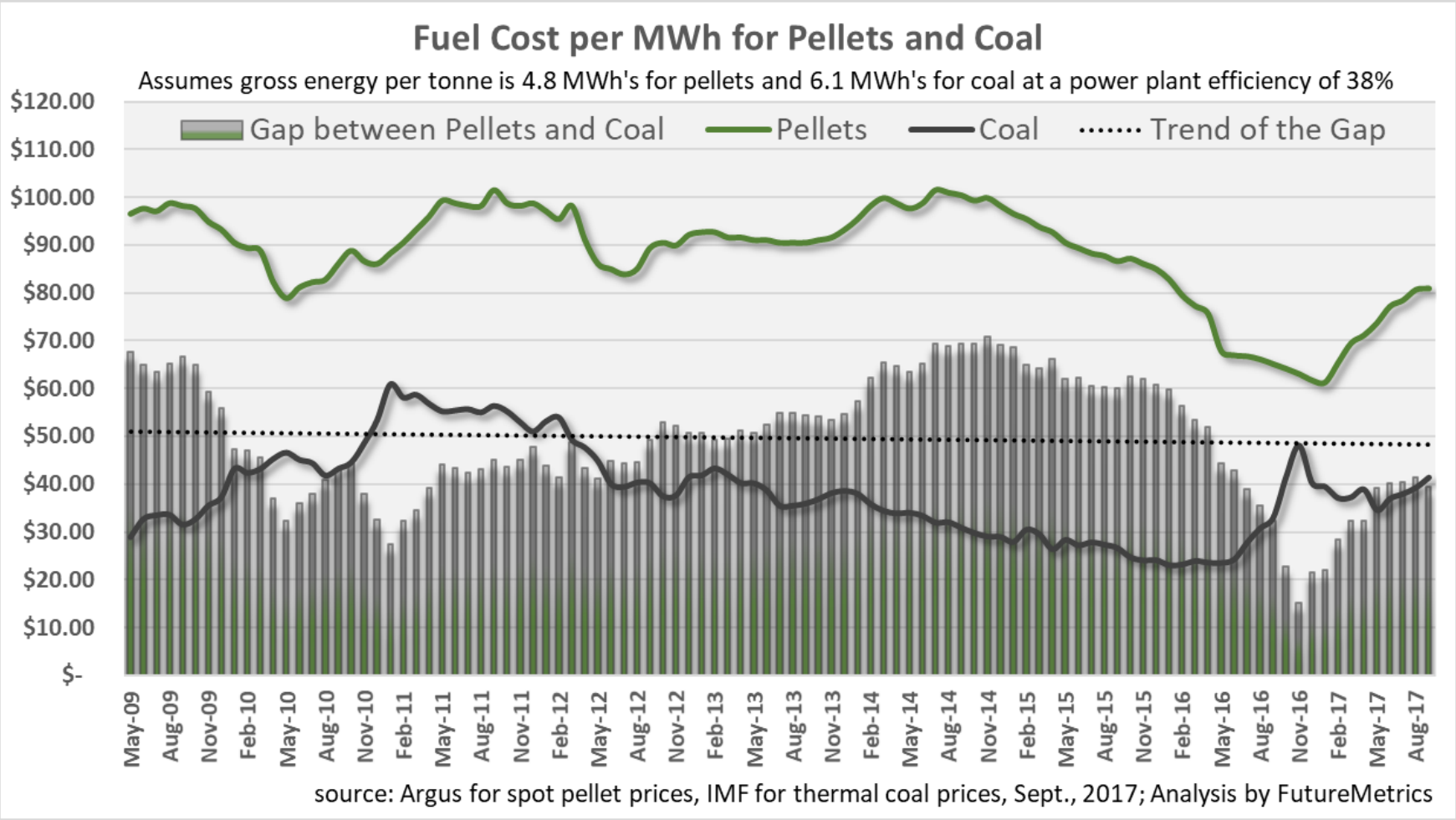
With relatively low cost modifications, the power station will have no loss of uptime and no de-rate.

Wood pellets are used in large power boilers that rely on pulverized coal. Wood pellets pulverize and can substitute for coal. If properly modified, there is no lost of power output or reliability.

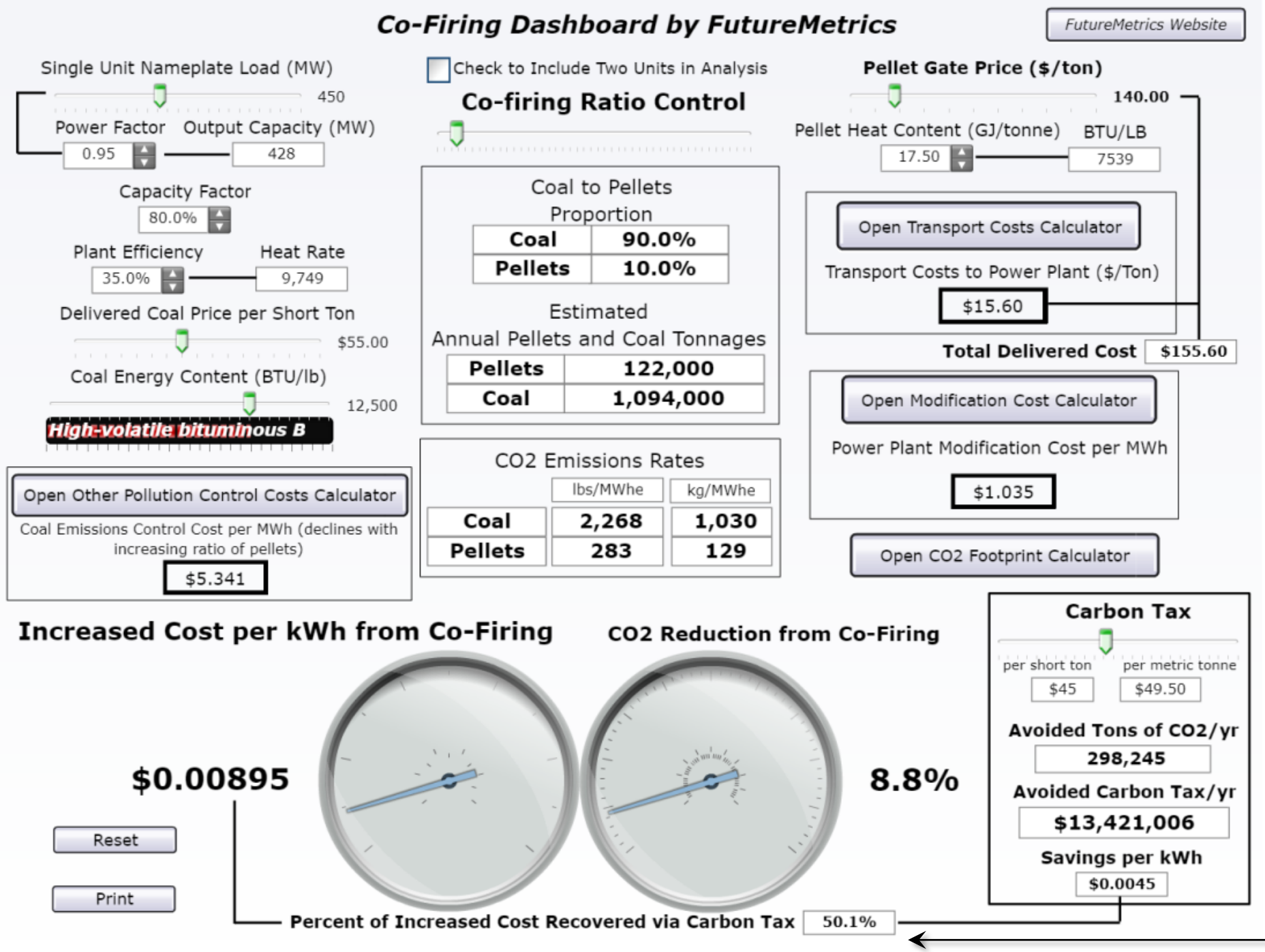




The cost of power generated from pellets in modified or converted coal power plants is higher than the cost of power generated from coal.



BUT if the external cost of carbon emissions are considered, then policy has to close the gap.



At a 10% co-firing ratio, the increased cost of generation is less than a penny per kWh.

Dashboard is free to use at www.FutureMetrics.com

Avoiding a $50/tonne carbon tax recovers about 50% of the increased cost generation.

Any scheme that increases the cost of generation must have the support of policy.

In the countries that are co-firing or full-firing, governmental policies aimed at lowering overall carbon emissions include subsidies to the generators and/or the ability to avoid penalties such as carbon taxes.

The “avoided” Canadian carbon tax covers about half of the estimated increased cost of generation for a coal plant using pellets.

For example, the UK has a “contract for difference” scheme.

The generator gets the current wholesale power rate and the CfD policy makes up the difference.

The net revenue per MWh is at the guaranteed rate.

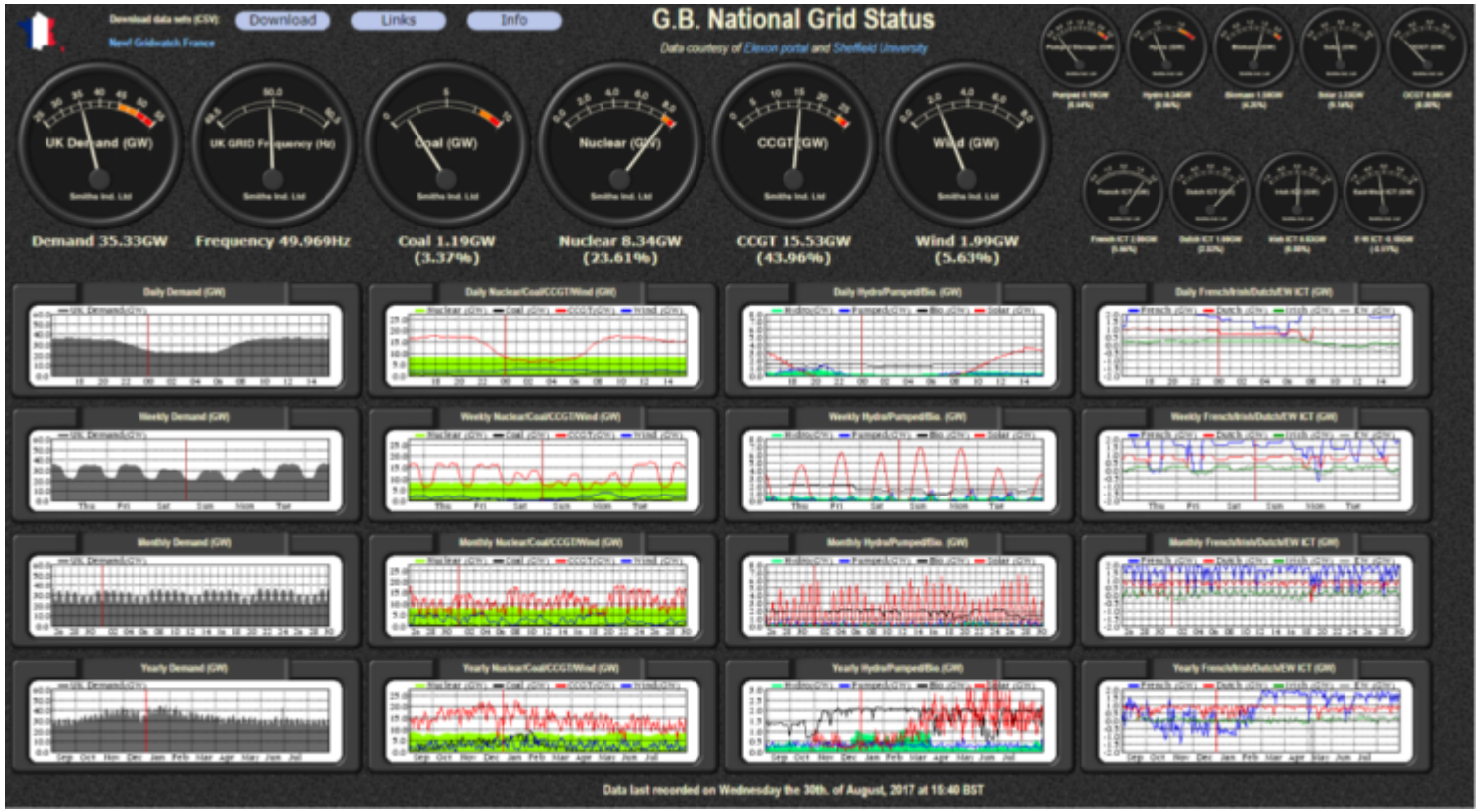
As the next few slides show, this supports a significant level of low carbon reliable baseload generation from pellets.

	Installed Capacity (GW)	Output (TWh)	Capacity Factor
Nuclear	9.5	16.6	81%
Pellets	2.2	3.5	79%
Hydro	1.1	0.4	19%
Wind	15.5	9.3	28%
Solar	12.4	4	16%
Natural Gas	28.4	27.7	45%
Coal	14	1.3	4%

source: Electric Insights Quarterly Q2 2017

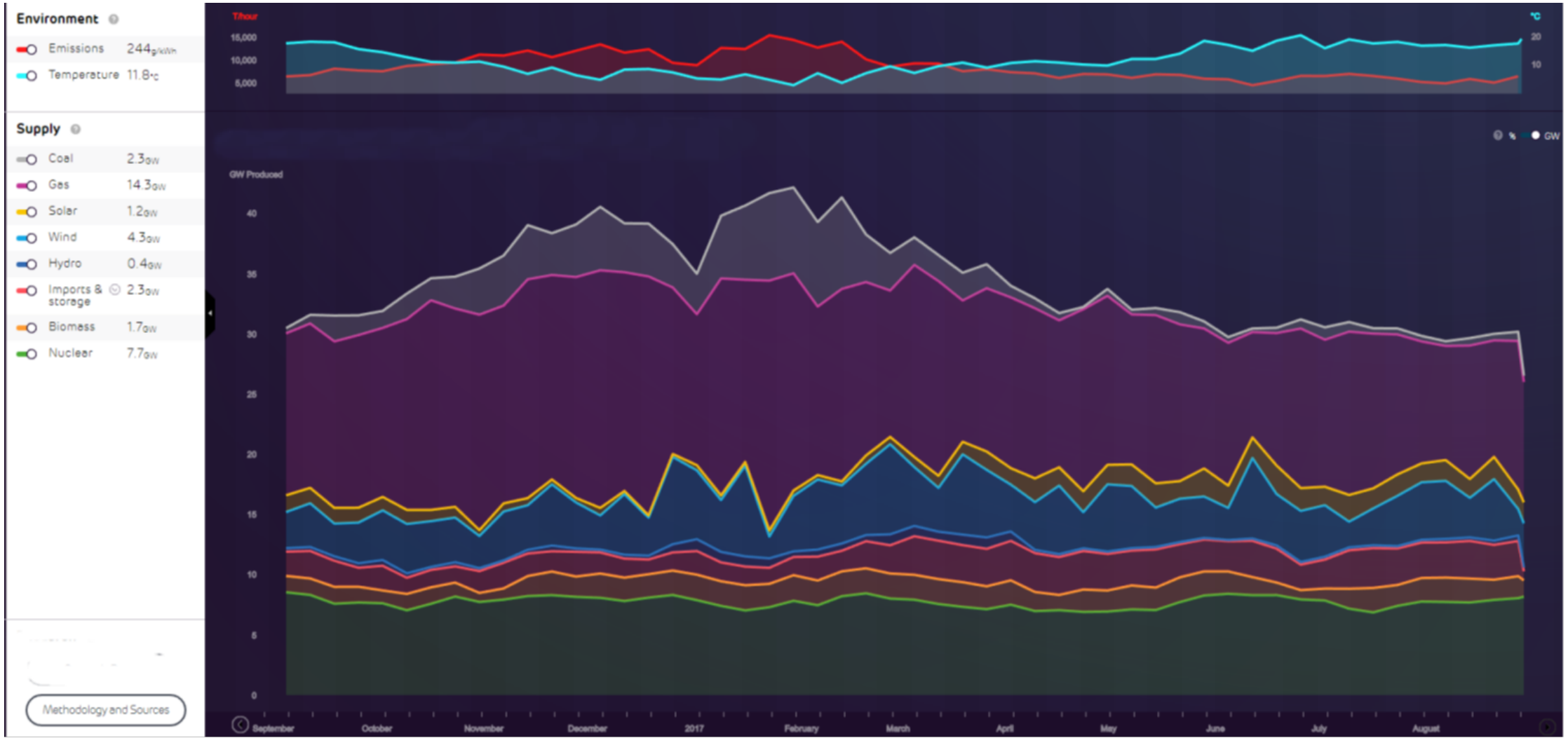
In Q2, 2017, power from pellets in the UK produced 3.5 tWh's of power at a capacity factor similar to nuclear.

Check out the current UK production in real time at http://www.gridwatch.templar.co.uk/



The power generated from pellets is shown in the orange line second from the bottom. The baseload from nuclear, pellets, and imported power form the foundation upon which the intermittency and variability of wind and solar sit.

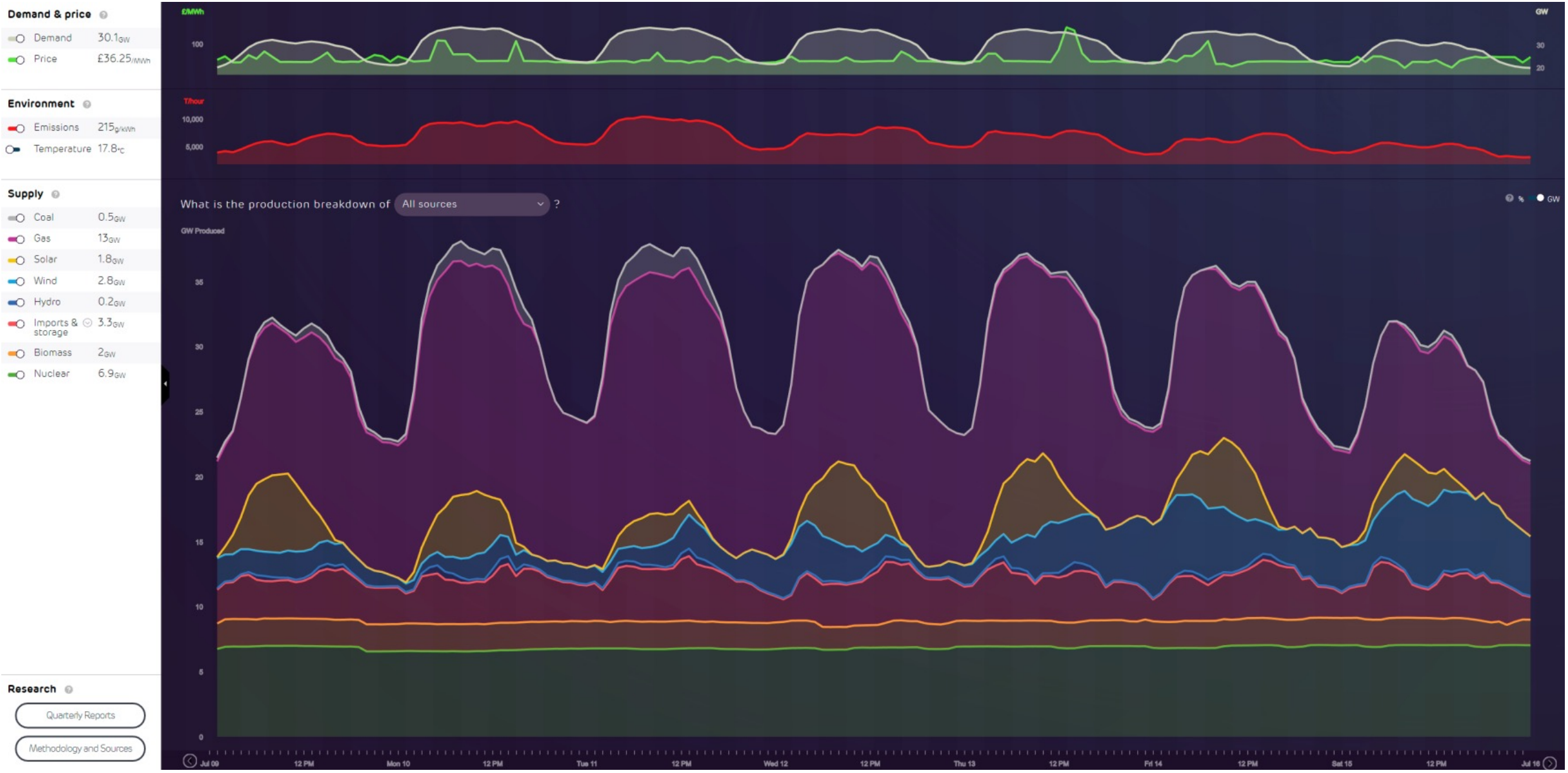
Source: Electric Insights http://electricinsights.co.uk/#/homepage?&_k=9d4yww



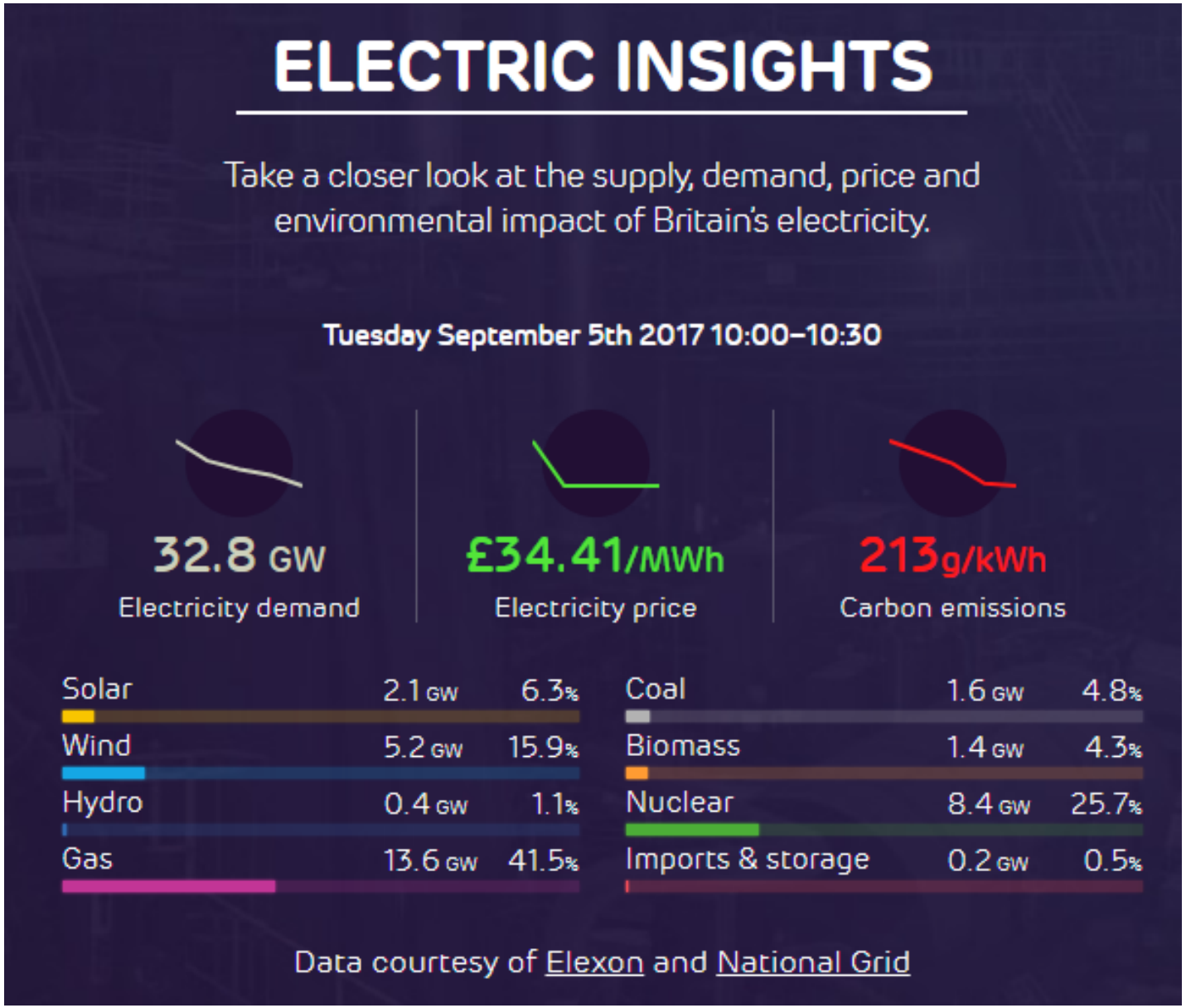
One year of data.

Next slide shows one week.

Over one week in the UK we can see how wind and solar fluctuate dramatically. The grid needs steady baseload low carbon power.



A snapshot of the UK grid on Sept. 5, 2017 at 10am



Wind, solar, pellets, and hydro peaked at a 51.5% share of demand on June 7th at 1 PM, with a combined output of 19.1 GW. Net carbon emissions went below 100 g/kWh.

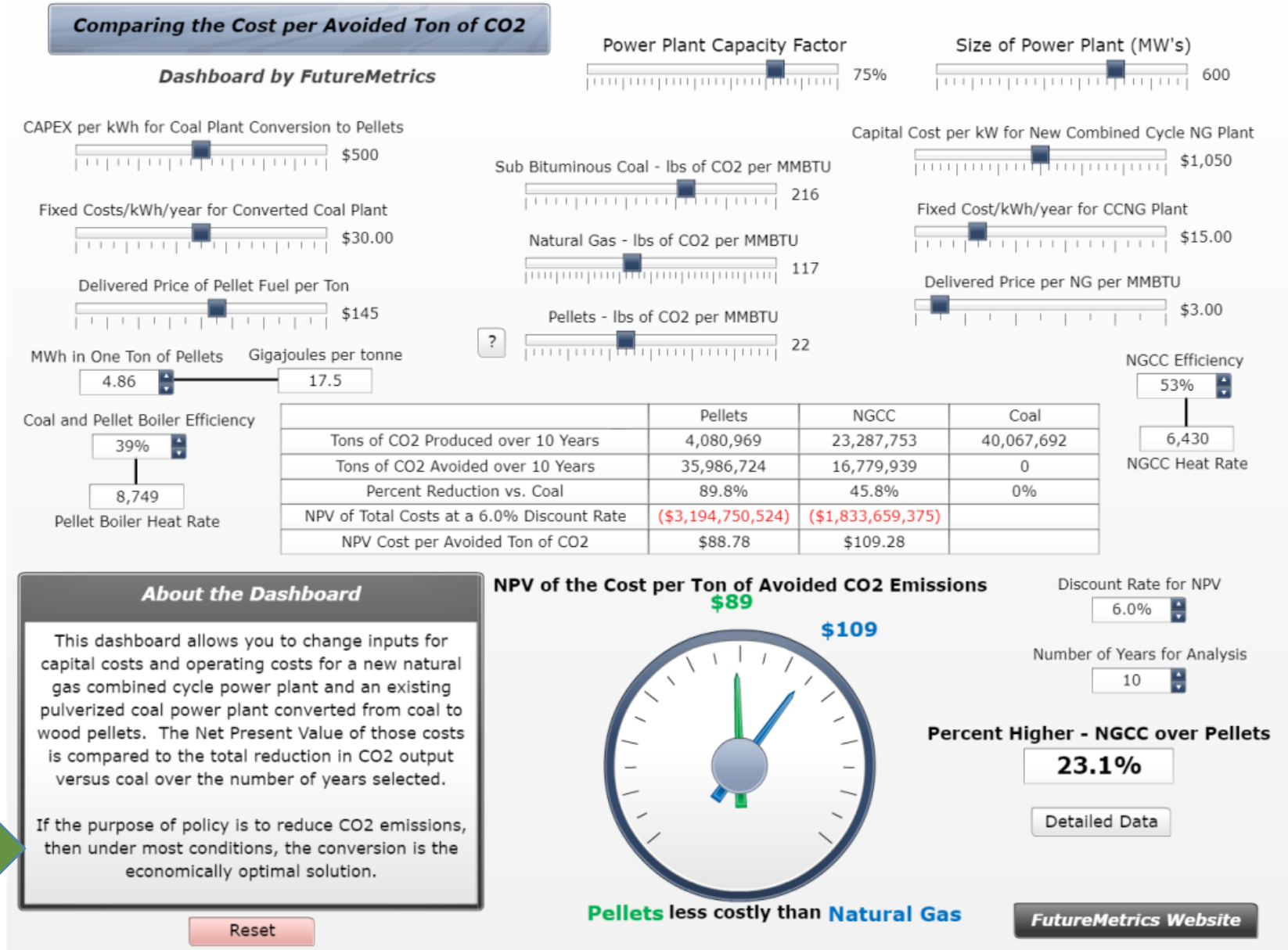
← Reliable baseload power from pellets

The substitution of wood pellets for coal either by co-firing or full conversions is a rational and pragmatic solution to moving toward a more decarbonized power sector.

Leveraging existing pulverized coal plants as part of the transition to a more decarbonized future should be part of the menu of solutions.

NO OTHER SOLUTION PROVIDES THE MOST REDUCTION IN CO_2 EMISSIONS FOR THE LOWEST COST.

The Cost per Tonne of Avoided CO_2 Emissions is Lower from a Converted Coal Plant than from a New Natural Gas Combined Cycle Plant



And as an earlier slide showed, a converted coal plant requires **8 times more jobs** to deliver the fuel than a plant running on natural gas!

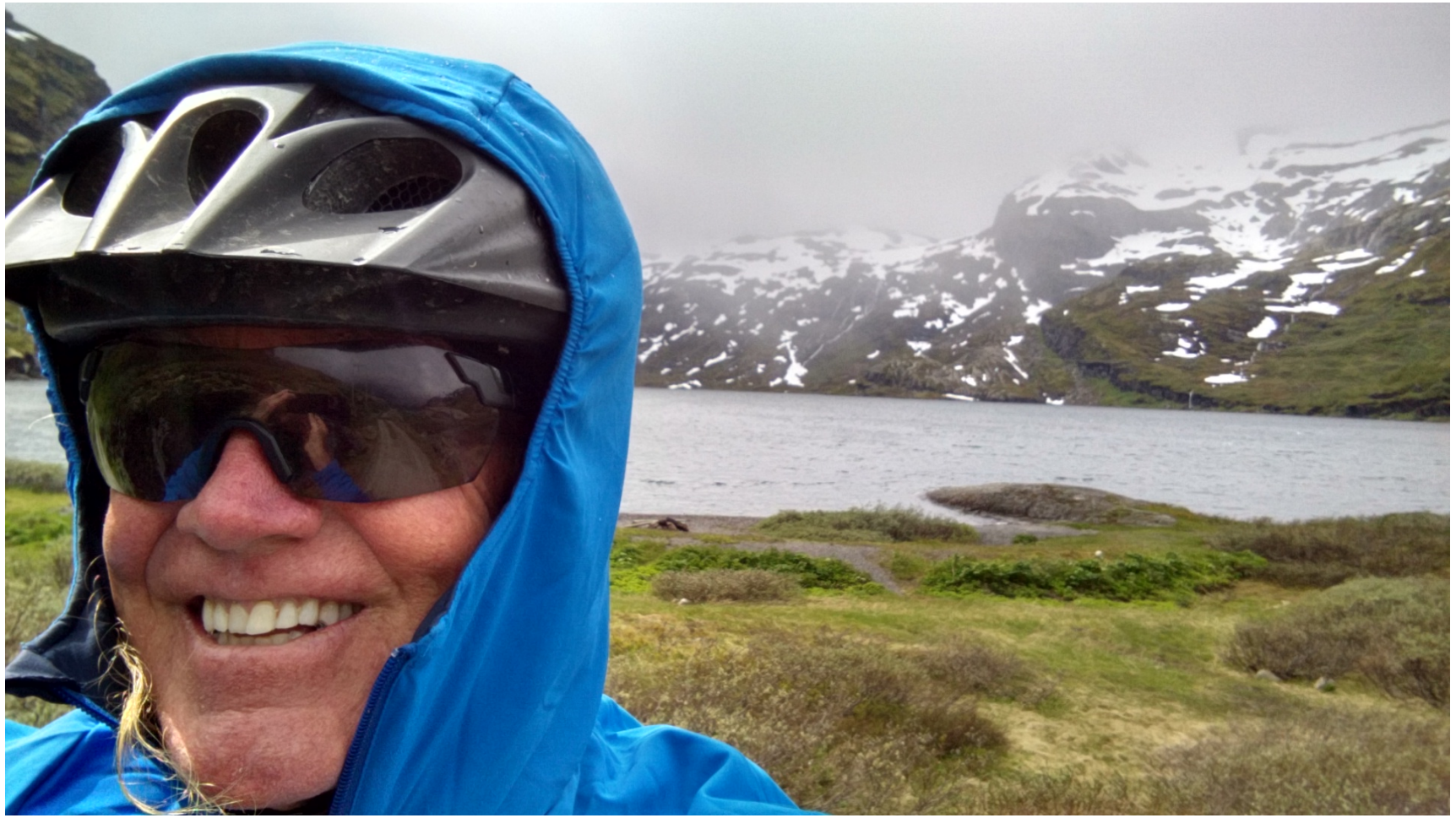
In conclusion, Canada has all the right ingredients to join the other developed nations that support the use of industrial wood pellets for power generation.

Canada is one of the world's largest producers of industrial wood pellets but almost every pellet is exported. Canada has the resources to deliver pellets to Canadian power stations.

A well-crafted federal policy would yield the lowest cost per avoided tonne of carbon emissions by supporting the use of industrial wood pellets to generate power;

power that is made from Canadian resources
by Canadian workers.

Thank you – Bill Strauss – WilliamStrauss@FutureMetrics.com



Mountain biking in
Norway in late June, 2017