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Project Management – Technology – Operating – Consulting Excellence

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IRON & STEEL MAKING INDUSTRIES

ENERGY SAVING POTENTIALS

Typical Energy Balance Electric Arc Furnace

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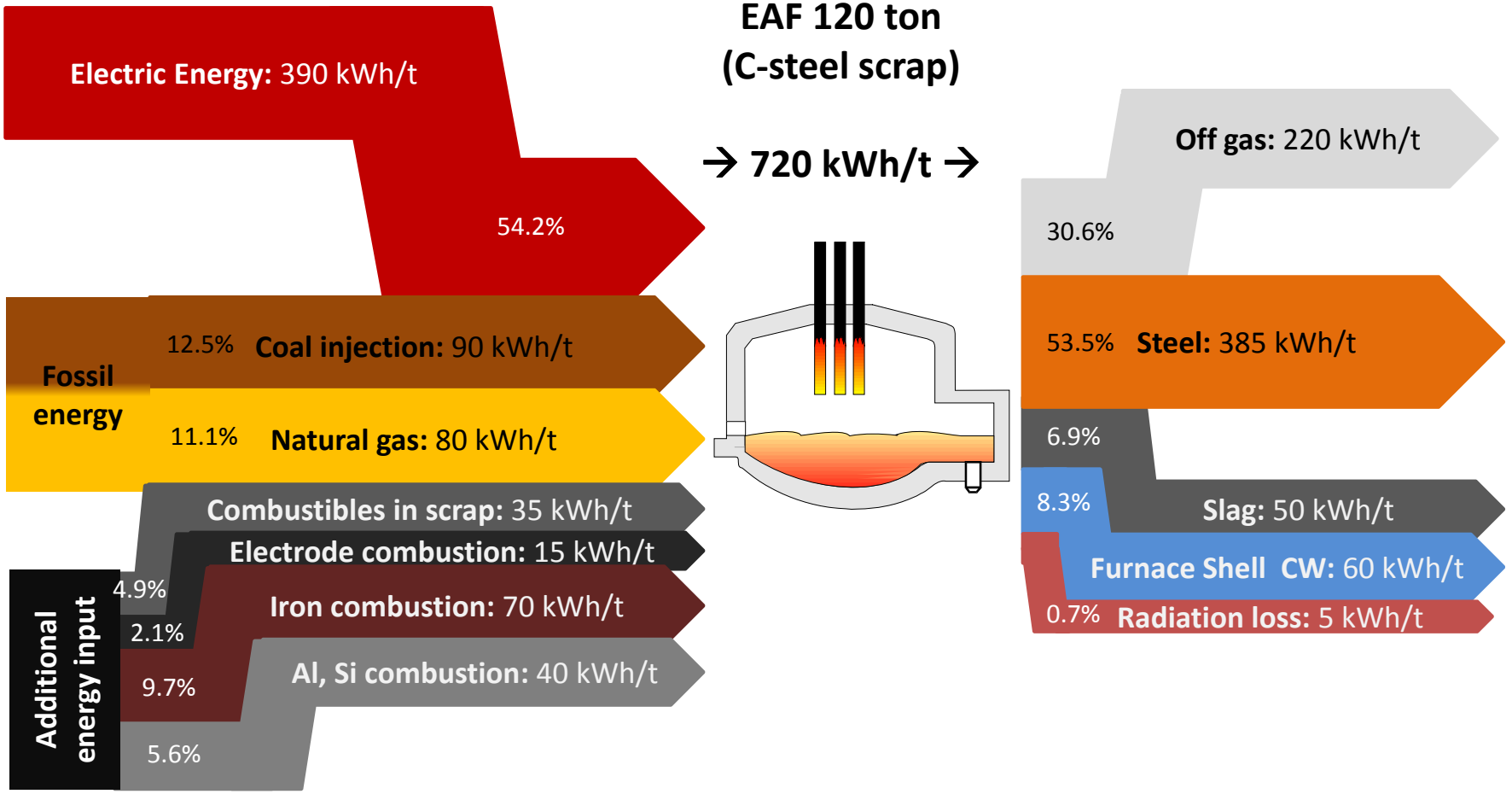

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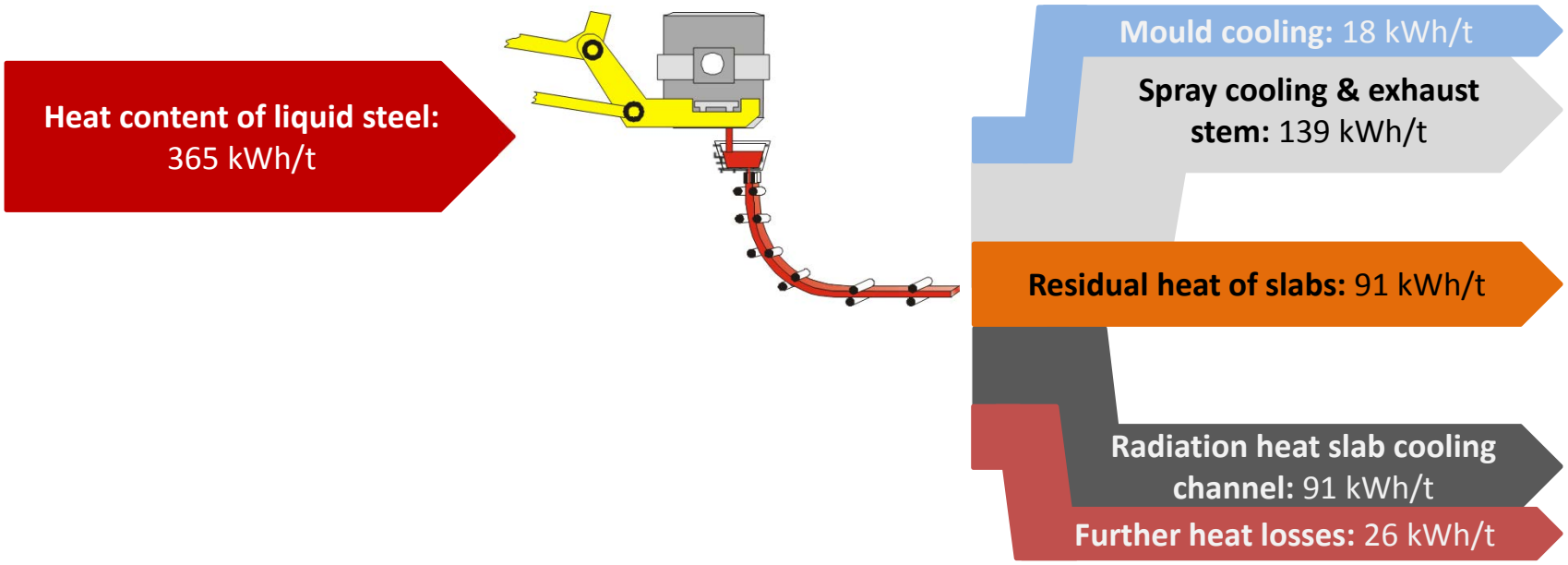
ENERGY SAVING POTENTIALS

Typical Energy Balance Billet/Bloom/Beam Blank CCM



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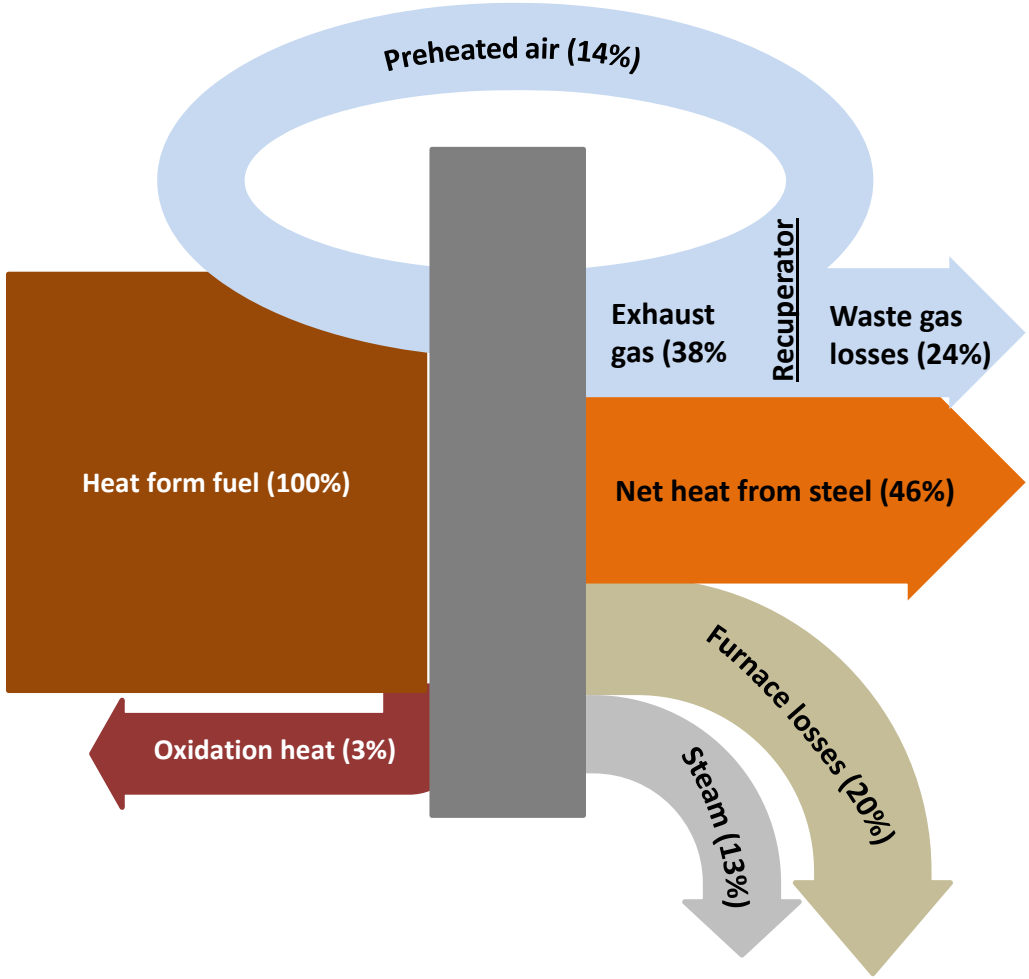
ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
Typical Energy Balance Reheating Furnace



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ENERGY SAVING POTENTIALS - Technologies & Measures (samples), to adjust according to individual plant findings

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Technology or Measure	Potential Energy Saving	Increase in productivity	Potential CO_2 emission reduction	Cost (estimate)
EAF controls	▪ Electric energy consumption ≤ 14% ▪ Natural gas consumption ≤ 6%		▪ ≤ 34 Kton Co_2 p.a.	
Improved process control	▪ Electricity savings ≤ 30 kWh/t-steel	▪ Increase ≤ 12% ▪ Electrode consumption - ≤ 25%	▪ ≤ 18 kg Co_2/t-steel	
Oxyfuel burner / lancing	▪ Energy savings 2-3 kWh/t-steel per minute heating time reduction		▪ ≤ 24 kg Co_2/t-steel	▪ Retrofit CAPEX ≤ 5 USD/t
Hot DRI/HBI charging	▪ Melting energy savings ≤ 150 kWh/t-steel (DRI/HBI ≤ 600 °C)			
Foamy slag practices	▪ Net energy saving ≤ 8 kWh/t-steel		▪ ≤ 11 kg Co_2/t-steel	▪ Retrofit CAPEX ≤ 16 USD/t
Bottom stirring gas injection	▪ Electricity savings from 12 – 24 kWh/t-steel		▪ ≤ 12 kg Co_2/t-steel	▪ Retrofit CAPEX ≤ 1 USD/t
CONSTEEL	▪ Electricity savings ≤ 60 kWh/t-steel	▪ Increase ≤ 33%	▪ ≤ 36 kg Co_2/t-steel	▪ Retrofit CAPEX ≤ 8 USD/t
Shaft Furnace (QUANTUM)	▪ Electricity savings ≤ 280 kWh/t-steel	▪ Increase ≤ 35% ▪ Electrode consumption - ≤ 30%		▪ Retrofit CAPEX ≤ 10 USD/t

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WHP (Waste Heat to Power) ZERO-EMISSION ELECTRICITY

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Temperature Classification	Waste Heat Source	Characteristics	Commercial Waste Heat to Power Technologies
HIGH >650 °C / 1200 °F	➢ Furnaces ✓ Steel electric arc ✓ Steel heating ✓ Basic oxygen ✓ Aluminium reverberators ✓ Copper reverberators ✓ Nickel refining ✓ Copper refining ✓ Glass melting ➢ Iron cupolas ➢ Coke ovens ➢ Fume incinerators ➢ Hydrogen plants	➢ High quality heat ➢ High heat transfer ➢ High power-generation efficiencies ➢ Chemical and mechanical contaminants	➢ Waste heat boilers and steam turbines
MEDIUM 350 - 650 °C / 500 - 1200 °F	➢ Prime mover exhaust streams ✓ Gas turbine ✓ Reciprocating engine ➢ Heat-treating furnaces ➢ Ovens ✓ Drying ✓ Baking ✓ Curing ➢ Cement kilns	➢ Medium power-generation efficiencies ➢ Chemical and mechanical contaminants (some streams such as cement kilns)	➢ Waste heat boilers and steam turbines (>260 °C / 500 °F) ➢ Organic Rankine cycle (<430 °C / 800 °F) ➢ Kalina cycle (<540 °C / 1,000 °F)
LOW <260 °C / 500 °F	➢ Boilers ➢ Ethylene furnaces ➢ Steam condensate ➢ Cooling Water ✓ Furnace doors ✓ Annealing furnaces ✓ Air compressors ✓ IC engines ✓ Refrigeration condensers ➢ Low-temperature ovens ➢ Hot process liquids or solids	➢ Energy contained in numerous small sources ➢ Low power-generation efficiencies ➢ Recovery of combustion streams limited due to acid concentration if temperatures reduced below 120 °C / 250 °F	➢ Organic Rankine cycle (>150 °C / 300 °F gaseous streams, 80 °C / 175 °F liquid streams) ➢ Kalina cycle (95 °C / 200 °F)

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WTE (Waste to Energy) Application Fields

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Field of Application	Temperature Range		
	Low (>100 °C / 212 °F)	Medium (<200 °C / 392 °F)	High (>2100 °C / 392 °F)
Geothermal	01 – 20 MW		
Waste Heat	0.2 – 20 MW		
Biomass & Waste to Energy			0.2 – 15 MW
CSP Solar			0.2 – 15 MW

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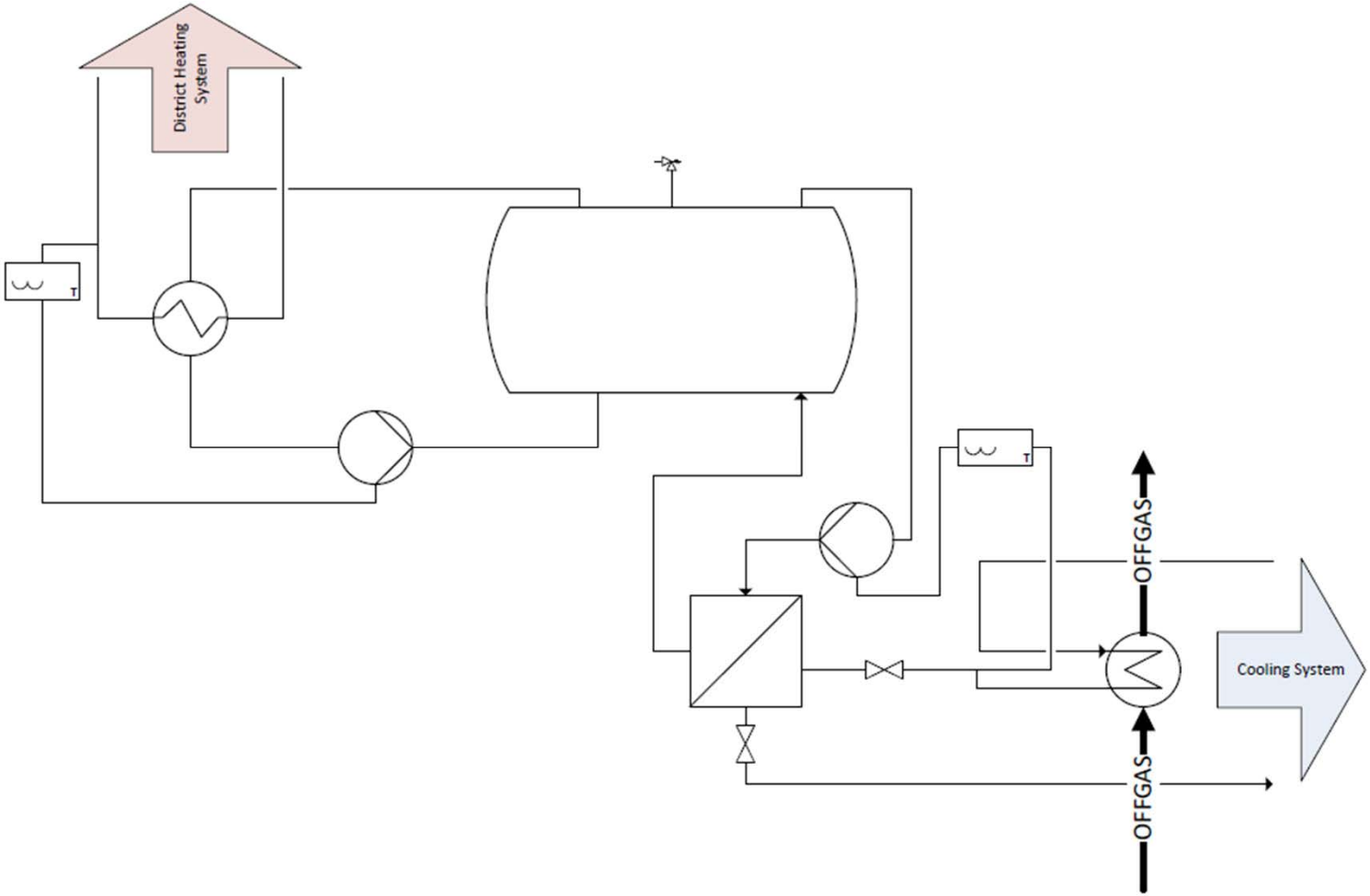
ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
SAMPLE DISTRICT HEATING & COOLING SYSTEM



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ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
SAMPLE Organic Rankine Cycle (ORC) power system

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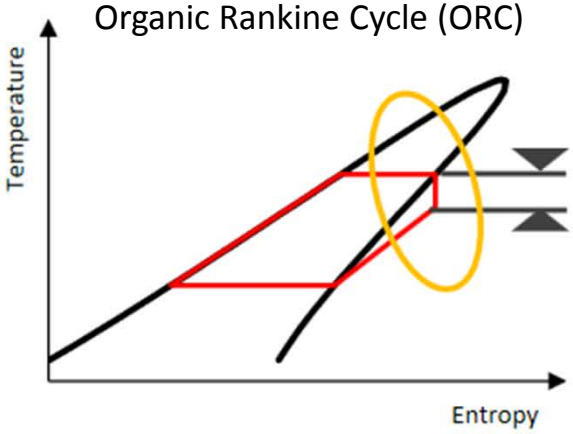
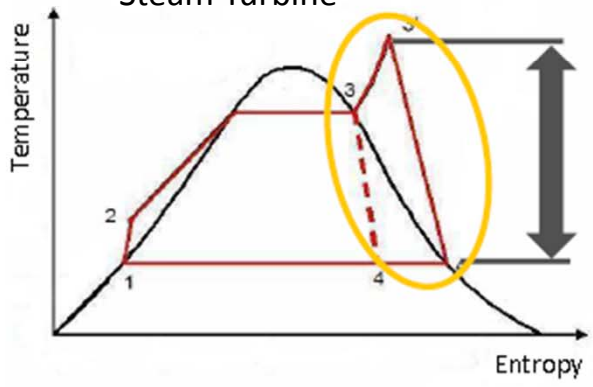
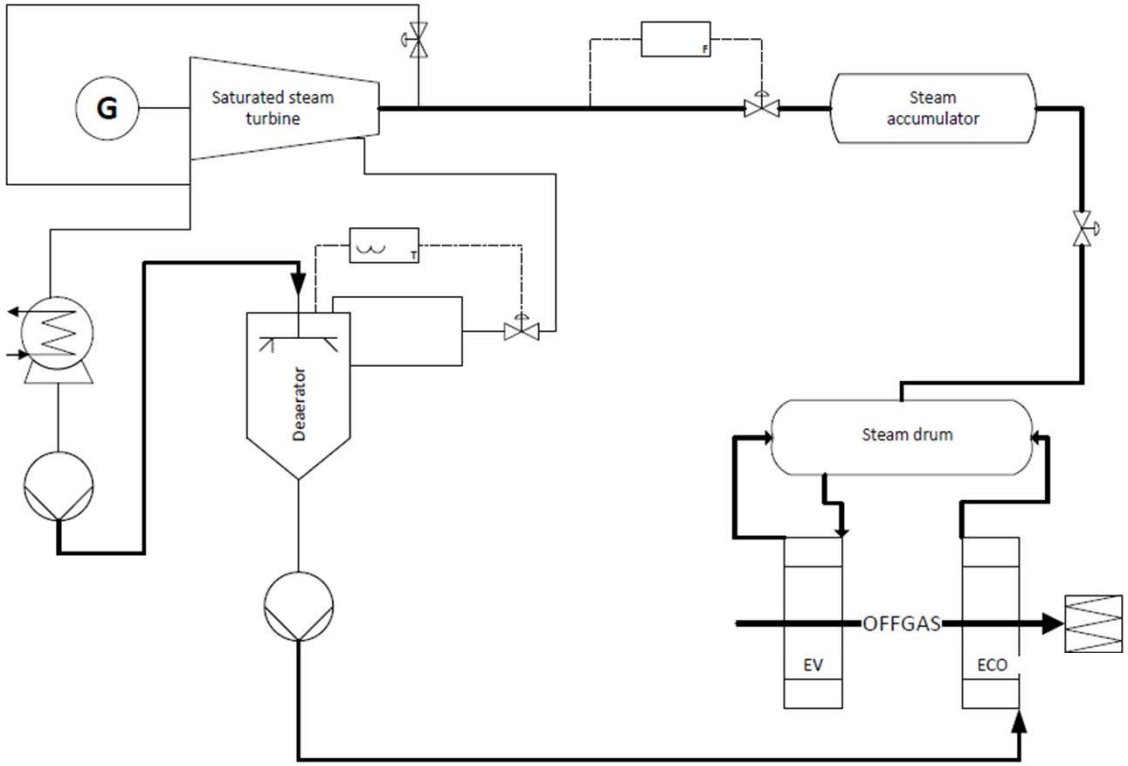
Organic Rankine Cycle (ORC)



Steam Turbine





generally in the range **200 kW – 10 MW electrical output**
e.g. recovery at Elbe – Feralpi ≤720 kWh/tls / pay-back 5-6 years
Average consumption EAF:

- 360 – 400 kWh/tls (hot DRI)
- <400 – 550 kWh/tls (cold DRI, scrap)

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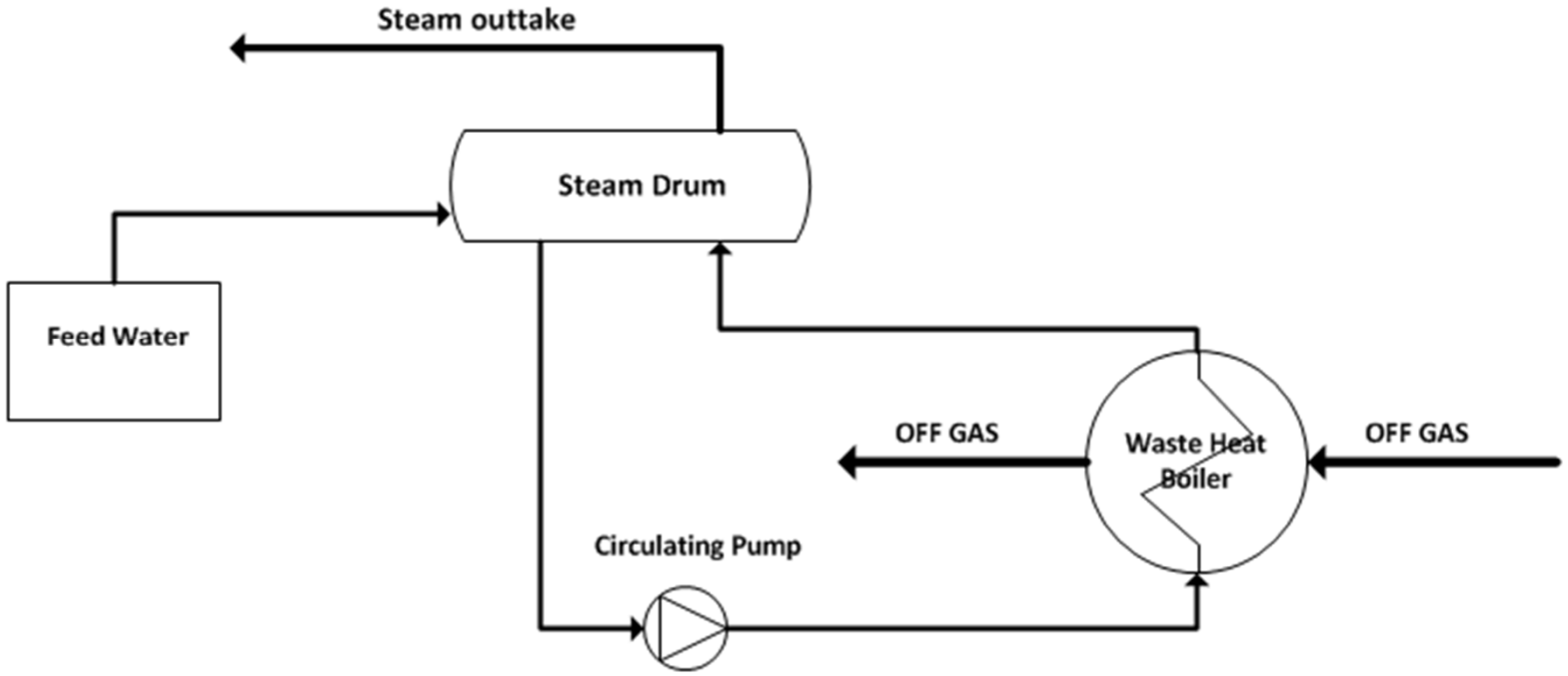
ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
SAMPLE STEAM GENERATION (simplified scheme)



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ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
HRSG (heat recovery steam generator)

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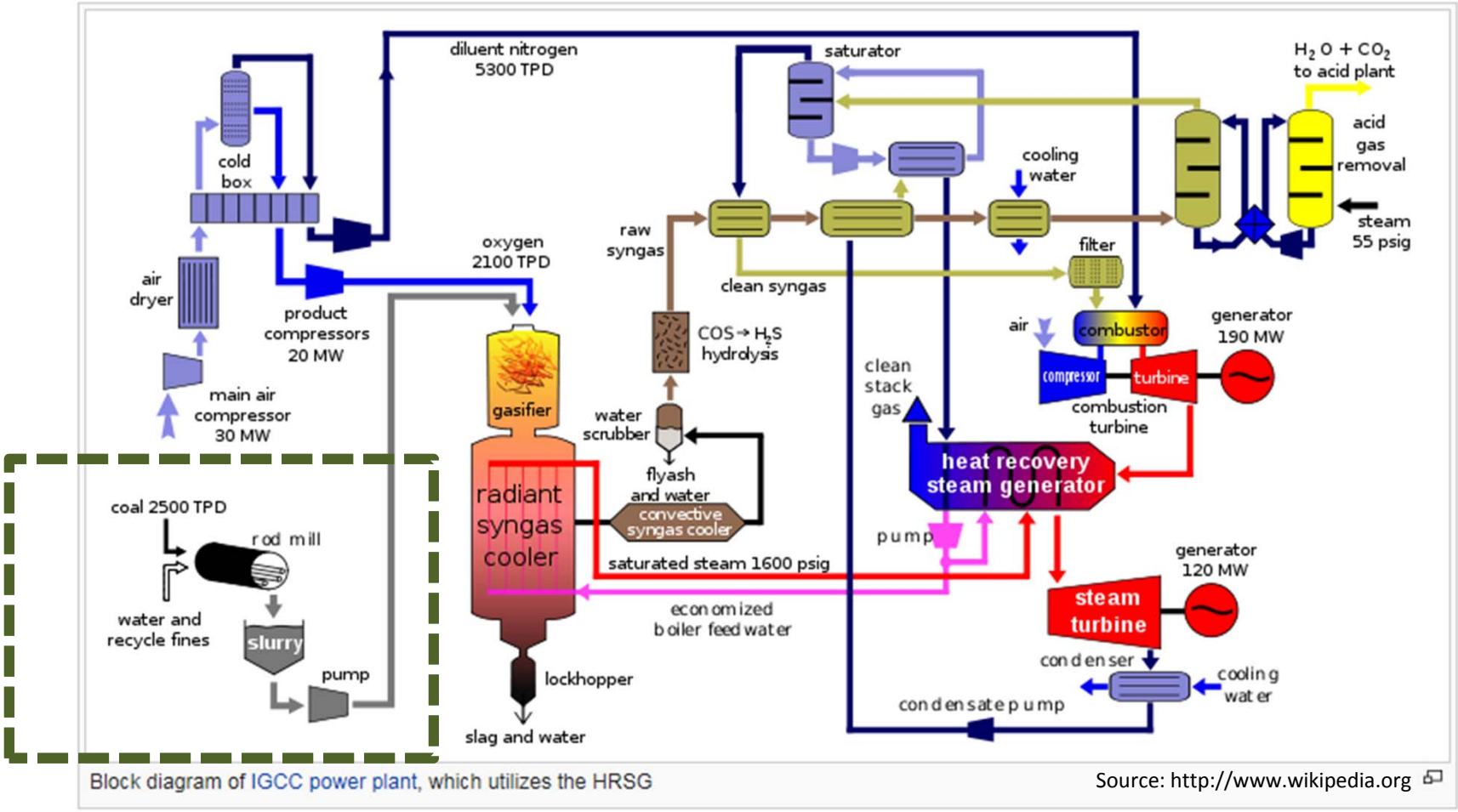

Block diagram of IGCC power plant, which utilizes the HRSG

Source: http://www.wikipedia.org

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ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
Iron & Steel Production life cycle (simplified)

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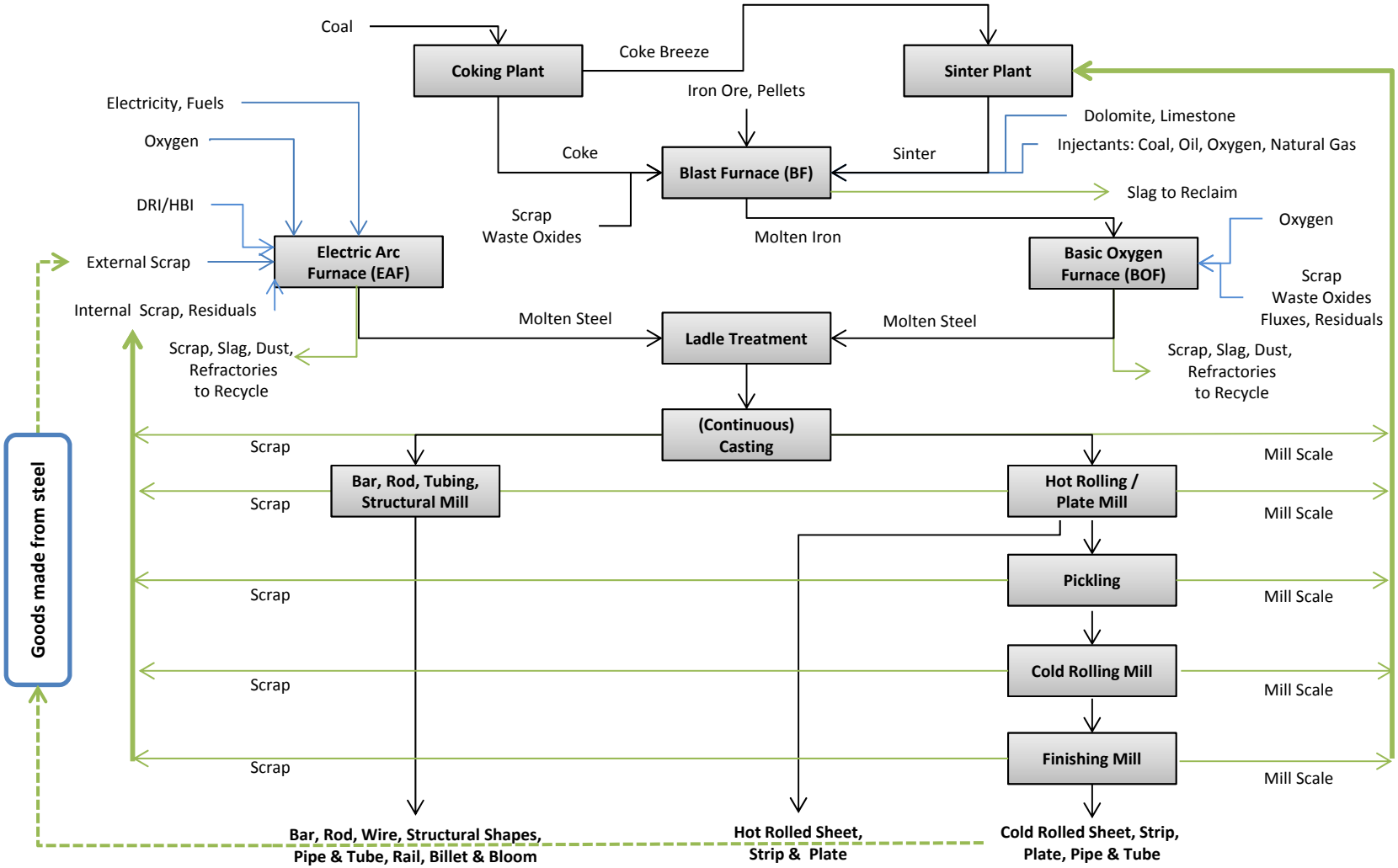

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ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
Iron & Steel Production life cycle (simplified)

Possibilities of by-products usage in the metals industry (different kinds of raw material),

- ✓ road construction and building industries (ballast/fill materials, steel slag asphalt),
- ✓ binder material and production of cement, agriculture and animal husbandry (soil improvers and horse riding surfaces),
- ✓ electronics industry (ferrites),
- ✓ chemical industries (different kinds of raw materials and fertilizer products);

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ENERGY SAVING POTENTIALS - Technologies & Measures (samples),
Samples on implemented Energy Savings - Excerpt

Enterprise	Investment	Savings	Source
Tenaris Dalmine Plant	▪ EUR 3.8 mill. (2007-2008) – e.g. high efficiency & frequency controlled motors, energy waste, heat recovery, CHP power plant, etc.	▪ 14% reduction in electricity ▪ 6% reduction in natural gas (JUN08-JUL09 vs JUN05-JUL06)	www.worldsteel.org
Essar Hazira Plant	▪ Investment in HBI Cooling system	▪ Water consumption reduction 0.68 m^3/ton MAY08 compared to 0.92 ^{3}/ton FEB08, savings: 250,000 USD	www.worldsteel.org
HADEED	▪ Upgrading natural gas quality	▪ Specific consumption savings: 0.97 MBTU/MT equivalent to 8.48% of original gas consumption	www.worldsteel.org
ThyssenKrupp German HRM	▪ Advanced burner technology, secondary de-dusting systems	▪ Specific dust & NOx emission reduction from 1985 to 2005 (2 kg/ton → 0.5 kg/ton crude steel produced)	www.worldsteel.org
Usage of slag in different industries like road making, cement, etc.		▪ Production cost of 01 ton Portland Cement generates about 1.2 ton CO_2, usage of BF slag containing 50 wt.-% GGBS generates 0.54 ton CO_2 ▪ Market price BF granulated slag: 75-79USD/ton; 65 EUR/m^3, BOF 38-40 EUR/ton	www.euroslag.com

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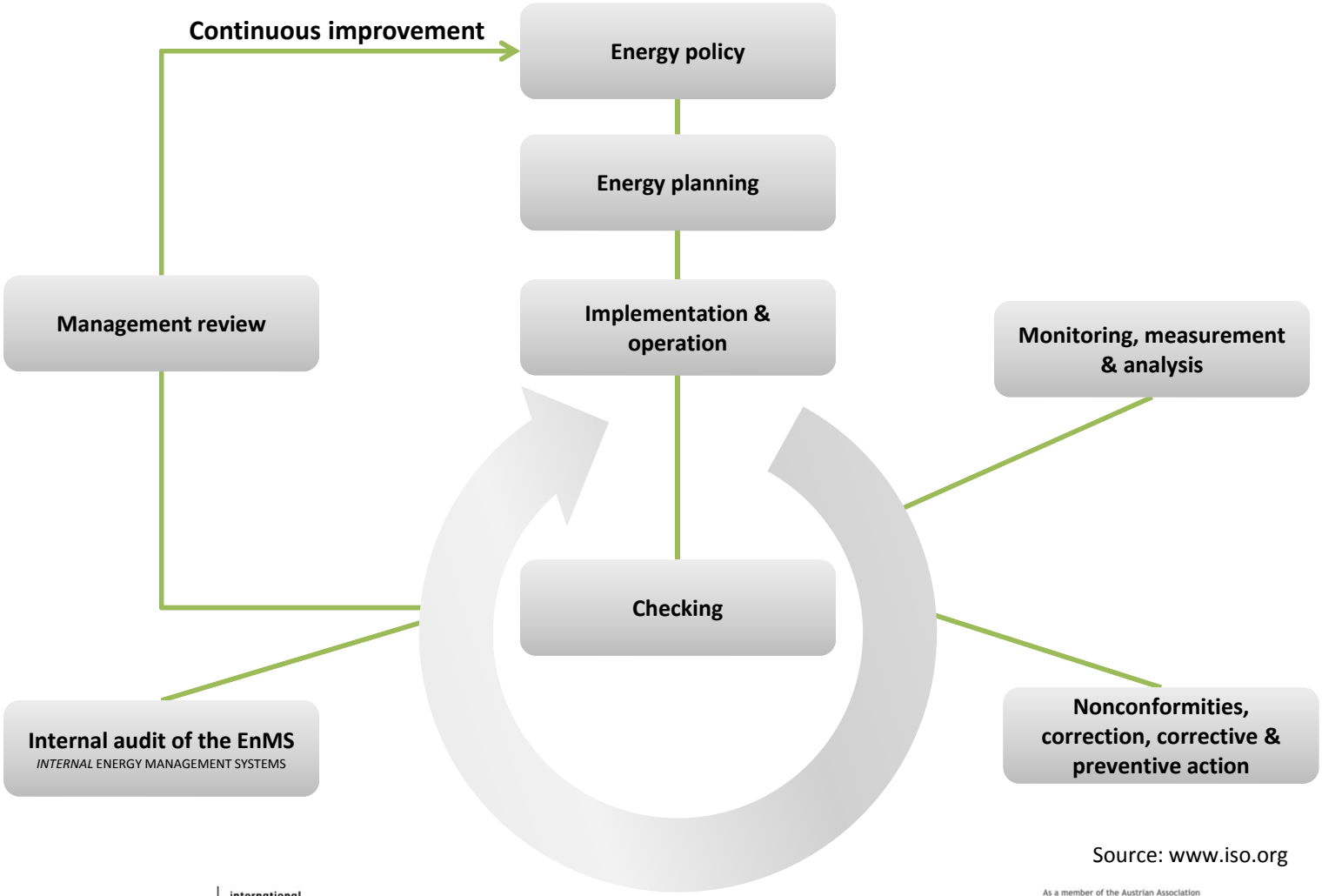
ENERGY SAVING POTENTIALS - Technologies & Measures,
ISO 50001 Energy Management System Model (**P**lan – **D**o – **C**heck – **A**ct)



Source: www.iso.org

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ENERGY SAVING POTENTIALS - Technologies & Measures,
Basic program energy saving audit & implementation

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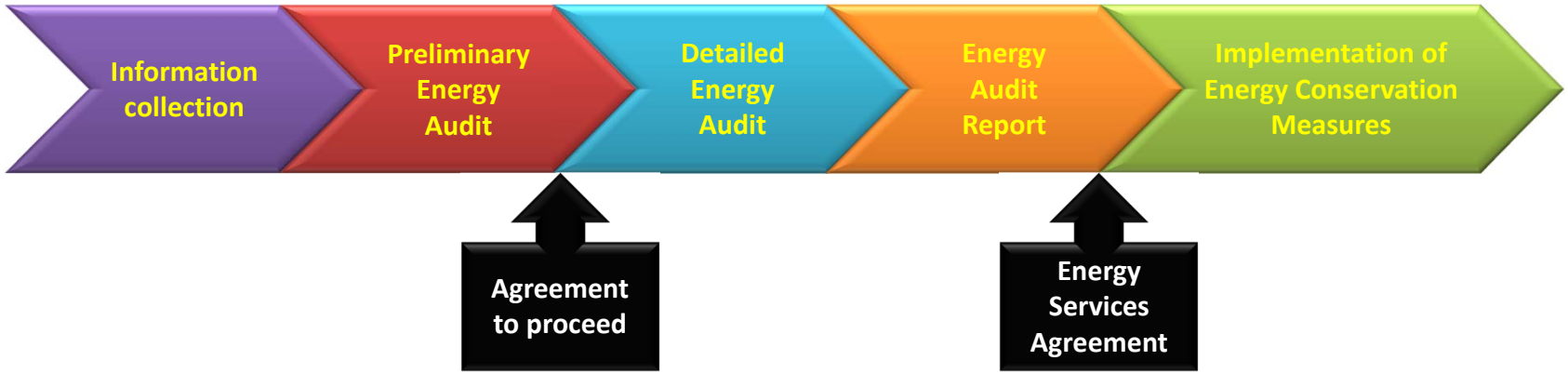

In cooperation with

BOKU

University of Natural Resources and Life Sciences, Vienna

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ENERGY SAVING POTENTIALS - Technologies & Measures

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