



# Assomineraria

San Donato, 18 October 2017



# Biomass and Waste-to-Energy

# Waste to Energy Energy from Waste Trash to Energy

Energetic use of Municipal Solid Waste by incineration

- **Electric Power** from STG
- **Heat** steam or hot water as district heating or process heat for industrial use



# Waste disposal

in 2016 3,36 Million t MSW disposed every day, in 2025 6,07 Mt/day +80% expected

source: Worldbank

66 % open landfill



Uncontrolled dumpsites, no groundwater protection, no gas recovery system  
no / very low gate fee

17 % sanitary landfill



Sanitary landfill with plastic liner, ground water monitoring, enclosure, gas recovery system, gate fee required

17 % Waste to Energy

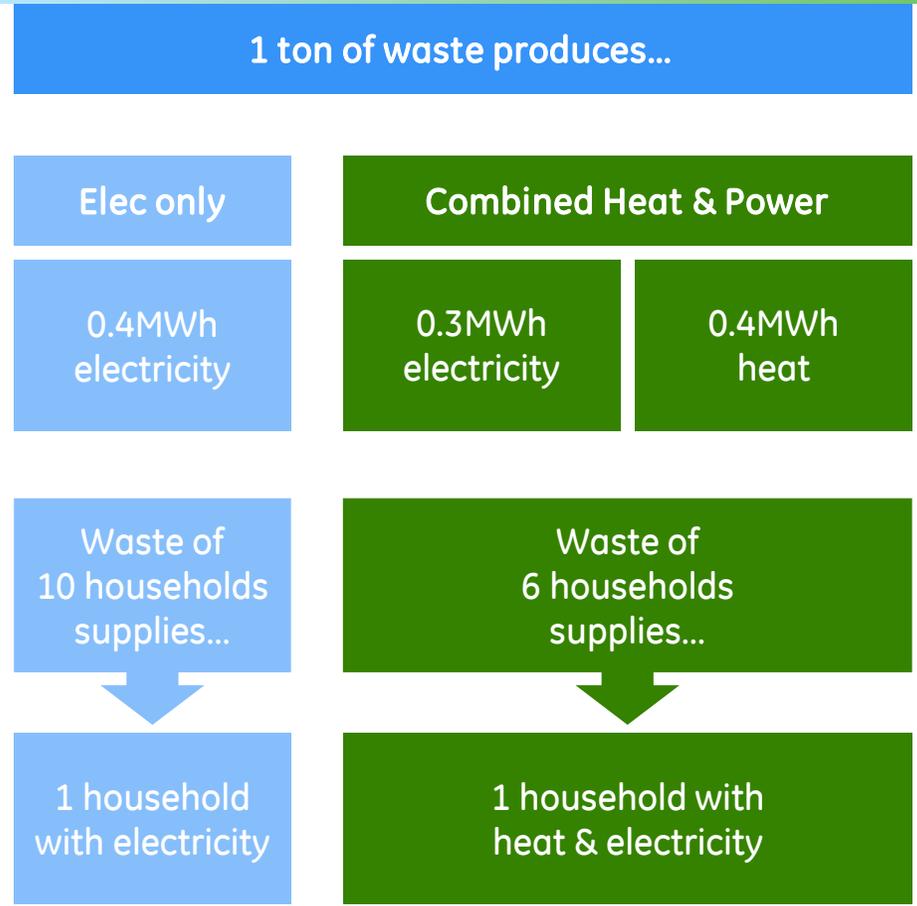


Waste to Energy plant with air quality control system, gate fee required



# Why Waste-to-Energy?

- Maximum reduction of pollutants in waste not leaving a burden for future generations
- Maximum volume reduction of waste protection of land resources
- Efficient energy production at low emission rates
- Substitution of fossil fuels
- Eliminates methane emissions from landfills reducing of greenhouse effect
- Enable efficient metal recovery component of a sustainable recycling economy



*Assumptions:  
1.2 ton of waste/household/a  
consumption 5 MWh/household/a (70% is heating related)  
Source: Ecoprog 2016 & Eurostat*

**Conservation of Resources**  
as coal, oil, gas

*Based on energy content of European waste (10MJ/Kg):*

- 1 t lignite = 1 t waste
  - 1 t wood = 1.5 t waste
  - 1 t coal = 3 t waste
  - 1 t oil = 4 t waste
- Source: Ecoprog 2016*

**Climate protection** by eliminating Methane from landfill as well as replacing fossil fuels



# Myths versus Reality



Waste-to-Energy pollutes



**Waste-to-Energy technology improved significantly over the decades.** Currently, subject to strict emission regulations, Waste-to-Energy plants have one of the lowest emission rates among industrial sectors.



Waste-to-Energy hinders recycling



**Waste-to-Energy is an integral part of waste management and there is still a lot of room for growth of recycling rates in some Member States.** Waste that cannot be recycled should be incinerated rather than landfilled so that it does not pollute the environment.



Waste-to-Energy is no better than landfilling



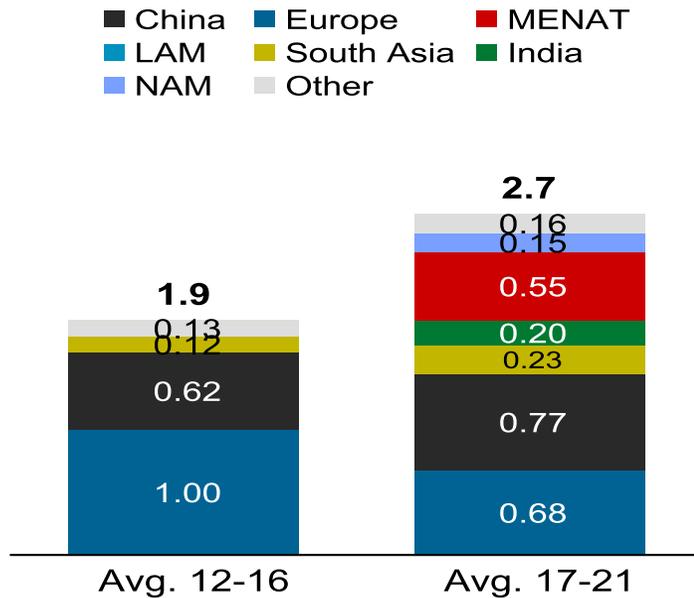
**Unlike landfilling, Waste-to-Energy does not emit methane.** Instead, it removes pollutants from the eco-cycle safely and it recovers the energy contained in waste. Hence, it lowers demand for fossil fuels while being a stable source of energy.

Source: ESWET Handbook

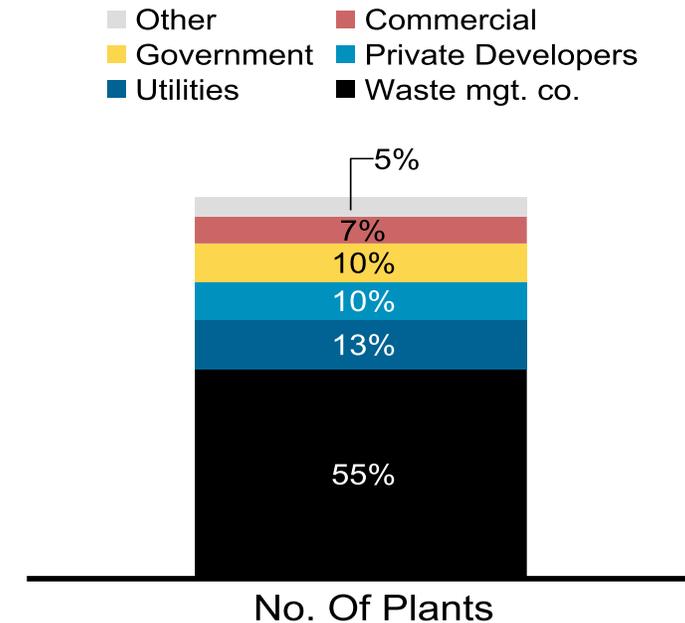


# Waste-to-Energy market overview

Market value - \$Billion per year



Type of customers - %



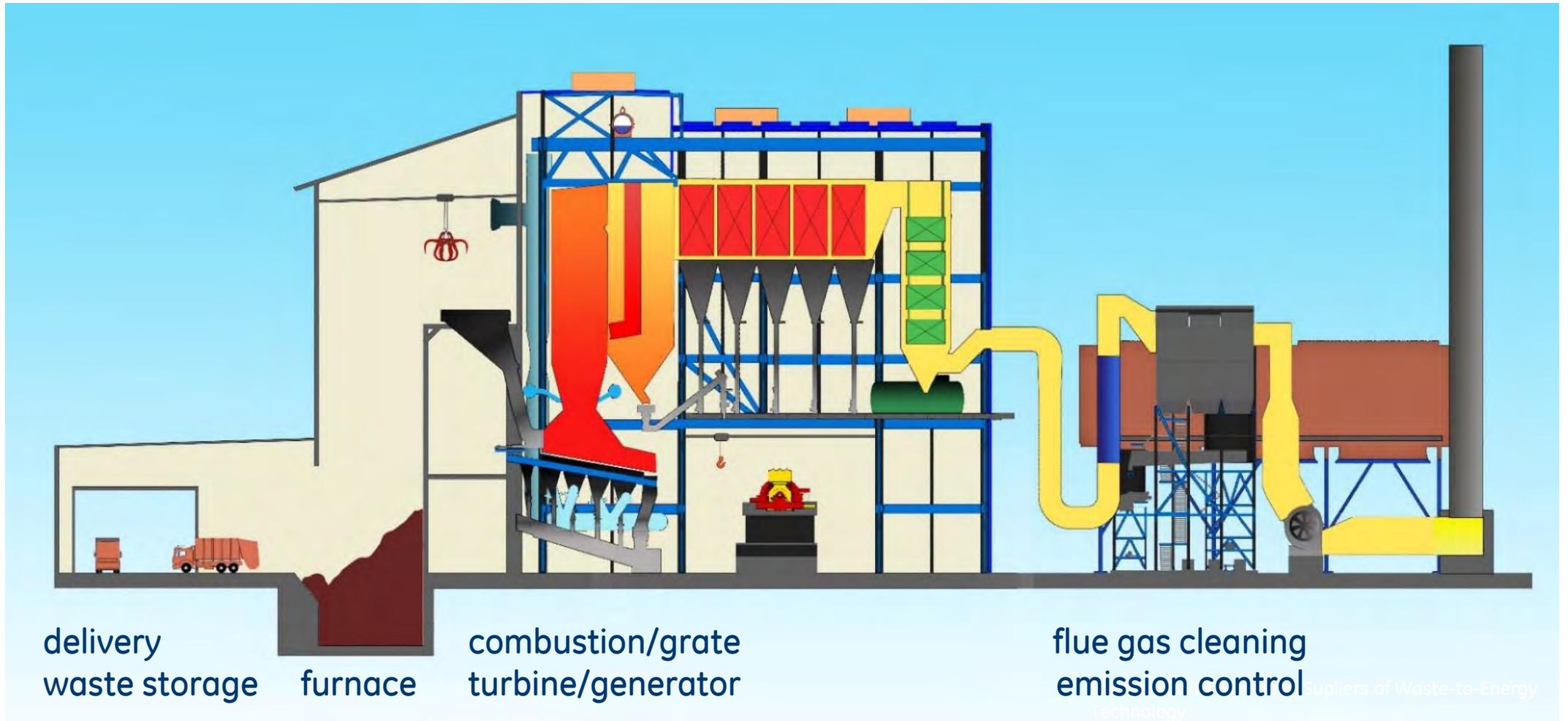
- ❑ Market expected to be at average of \$2.7 B per year – entitlement in EPC scope
- ❑ Europe, MENAT, India & South Asia account for ~60% of total market value

- ❑ Waste mgt. operators accounts (i.e. Veolia) for 55% of total customer
- ❑ Chinese Waste operators have been acquired EU operator aboard



# Waste-to-Energy plant

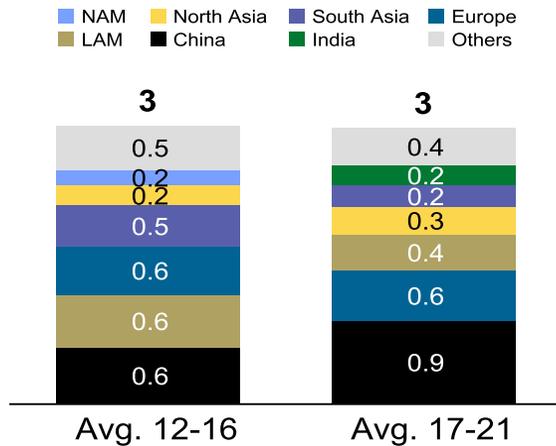
Convert waste into valuable power



# Biomass market overview

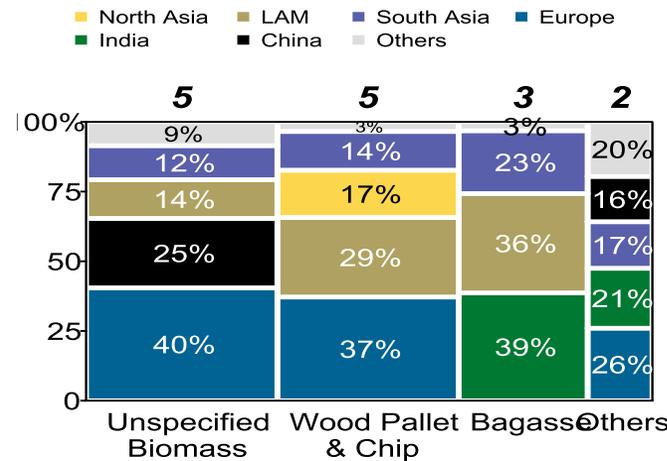
Annual new orders expects at ~3GW with wood chip and bagasse fuel >55% of total GW

### Market Forecast – GW per Year



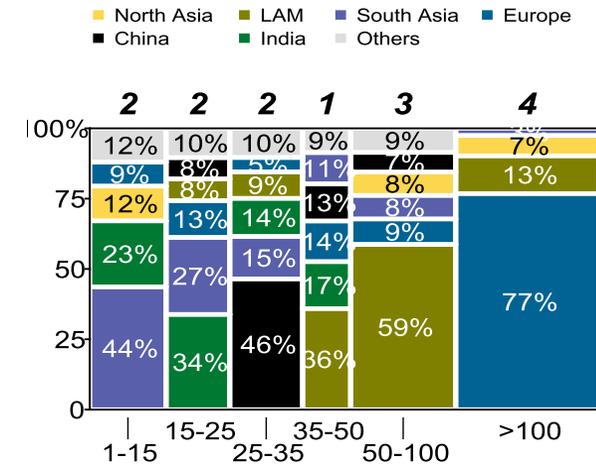
### Feedstock allocation % of GW

Total GW ('17-'21) = 15 GW



### Unit Size - % of GW

Total GW ('17-'21) = 15 GW



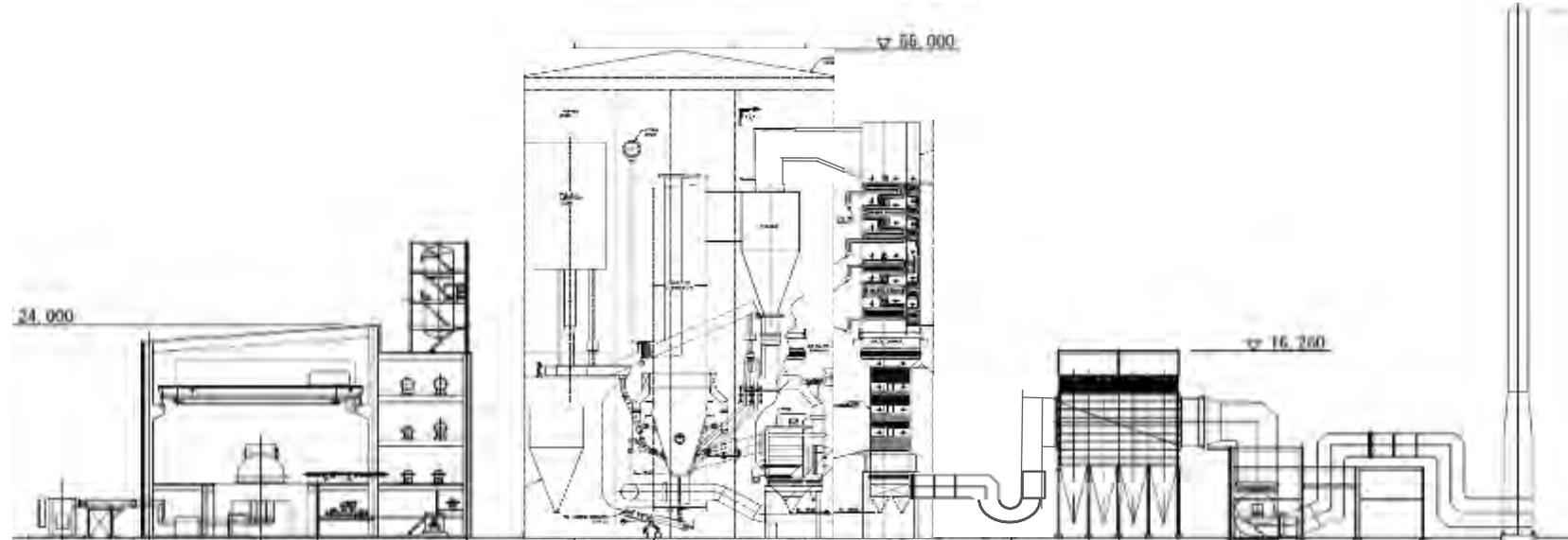
- ❑ **China and South Asia** has large biomass targets, but **might not materialize**
- ❑ **Europe and North Asia** have an established **supply chain** and **high feed-in-tariffs**

- ❑ **Wood & bagasse** accounts for **32% & 23% of total GW**
- ❑ **Wood** from NAM can be **shipped globally** to fulfill demand in EU and North Asia, bagasse mostly **used locally as captive power** in LAM, South Asia, and India

- ❑ Unit size <35MW concentrate in **China, South Asia & India**
- ❑ Unit size >50MW mainly locate in **LAM, North Asia & Europe**
- ❑ Unit size >50MW account for **50% of total GW**



# Biomass plant



**Steam Turbine & Generator**

**Boiler**

**AQCS**

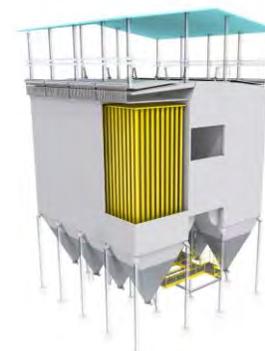
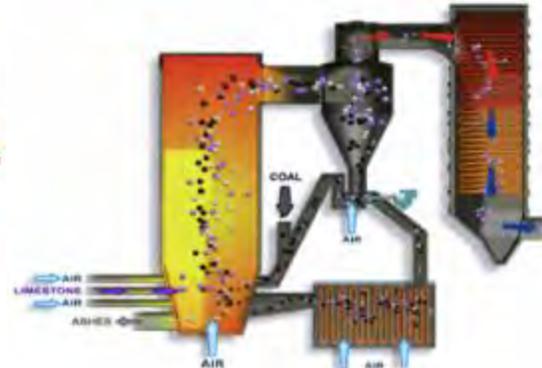
**Stack**

Double casing reheat STG

Circulating Fluidized Bed (CFB)

NID (Option)

Fabric Filter



# GE's Industry Leadership In Steam Power

**Steam Fossil  
Power Plant**



**30%**  
of the world's fossil  
steam turbine

**Biomass &  
Waste-to-Energy**



**30%**  
of the world's boilers

**Nuclear Turbine  
Island**



**50%**  
of the world's  
nuclear turbine

**Environmental  
Controls Systems**

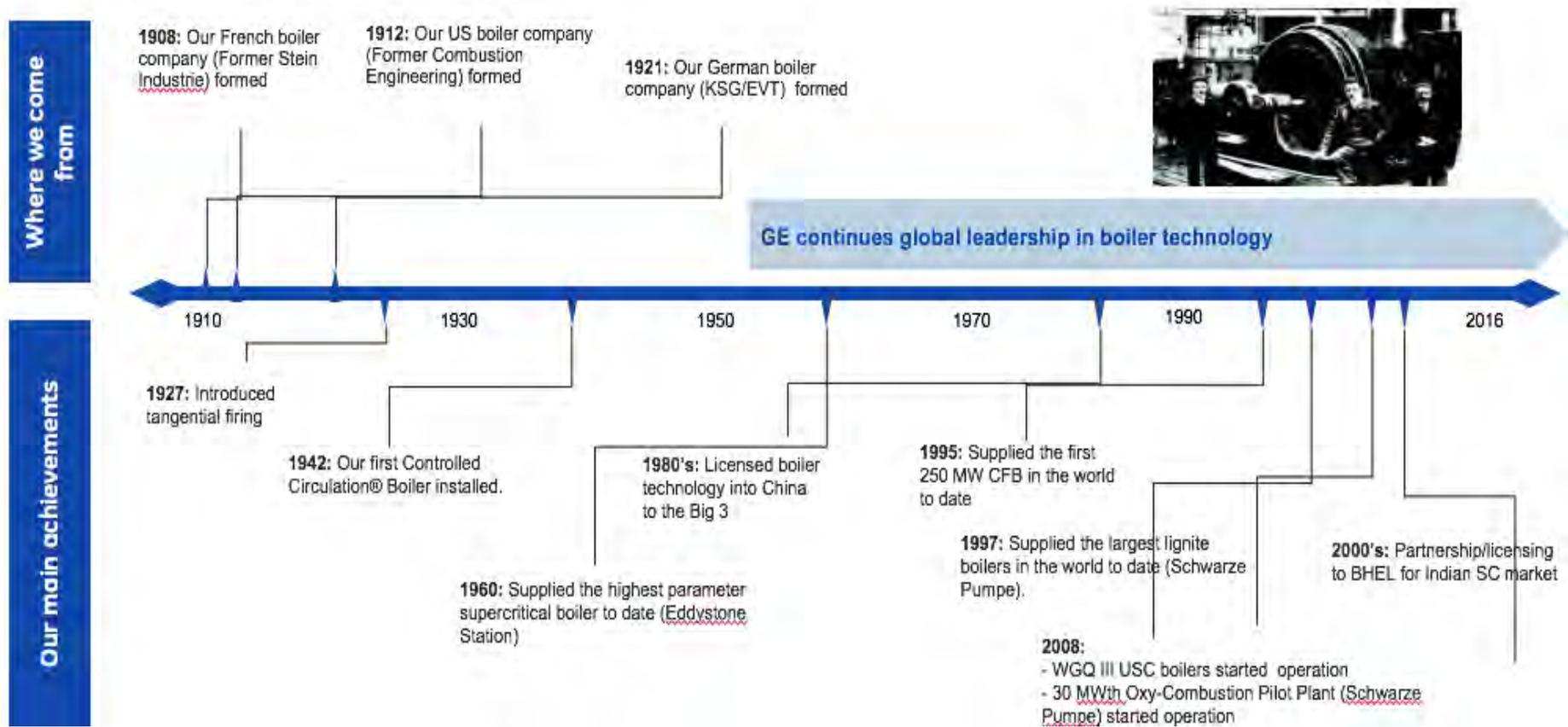


**>100 yrs**  
of expertise put to  
work for customers

**100+ years of expertise put to work for customers every day**

# Boiler experience

GE brings 100 + years of Boiler experience (30% Global Share)



**Largest boiler installed base worldwide: 1600 Units / 385 GW**



# Boiler Types – relevant applications

Boiler Type	Output	Fuel
<p><b>Two Pass</b></p> <div>   </div> <p>Coal-Fired      Oil-Fired</p>	<p>100 MW      1,350 MW *</p> <p>* Oil-fired : up to 1,000 MW</p>	<ul style="list-style-type: none"> <li>▪ Coal</li> <li>▪ Oil</li> </ul>
<p><b>Tower</b></p> <div>   </div> <p>Hard Coal-Fired      Lignite-Fired</p>	<p>100 MW      1,350 MW *</p> <p>* Lignite Tower: up to 1,100 MW</p>	<ul style="list-style-type: none"> <li>▪ Coal</li> <li>▪ Lignite</li> </ul>
<p><b>CFB</b></p> <div>  </div>	<p>50 MW      660 MW *</p> <p>* Up to 660MW for lignite, higher for hard coal</p>	<ul style="list-style-type: none"> <li>▪ Coal</li> <li>▪ Lignite</li> <li>▪ Biomass</li> <li>▪ Petcoke, HFO</li> </ul>
<p><b>Grate</b></p> <div>  </div>	<p>5 MW      100+ MW *</p> <p>Modular design</p>	<ul style="list-style-type: none"> <li>▪ Municipal Waste</li> </ul>



# What are our customers asking for?



**Leading Availability and Efficiency, Lower Emissions, Better Economics**



# 4 pillars to drive customer success



Flexible offering



Technology  
advancements



Digital offering



Geographic Scale  
& financing

**GE is fully committed to provide what the customer is asking for... a partner**



# GE Power Digital applications

## Business Applications

 <b>Business Optimization</b>	Market Intelligence & Forecasting	Portfolio Management			Business Communications		Financials	
 <b>Operations Optimization</b>	Operations Evaluation	Plant Optimization				Work & Outage Optimization	Compliance Management	Financial Analysis
		<i>Efficiency</i>	<i>Flexibility</i>	<i>Availability</i>	<i>Capacity</i>	<i>Emissions</i>		
 <b>Asset Performance Management</b>	Machine & Equipment Health		Reliability Management			Maintenance Optimization		

## Enabling Platform

**PREDIX**

Mobility | Cloud Services & Applications | Security | Software Development Kit



**Predix Edge**

Optimizing Controls Applications | Edge Applications



**Cyber Security**

Baseline | Defend | Prevent

Digital Worker

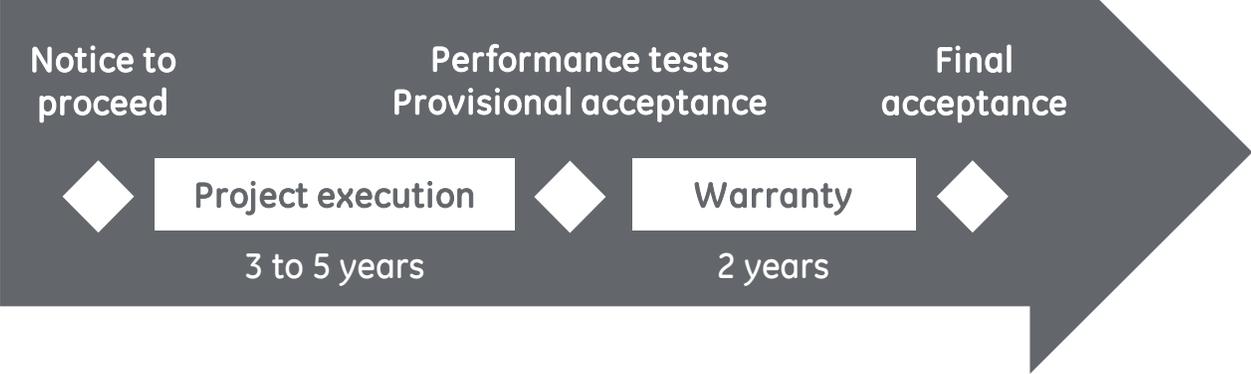


# Guarantees 4.0

## New guarantee lifecycle



### Usual lifecycle



### New Guarantee 4.0 lifecycle

