

Waste to Energy and Social Acceptance

Everbright International Zheru Shao



GREEN WORLD

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- **Introduction of UNECE International PPP forum in Hongkong**
 - **Status and treatment of waste in the world**
 - **WtE Technology**
 - **Experience in improving the efficiency of WtE projects**
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The grand occasion of “the UNECE International PPP forum” in Hongkong



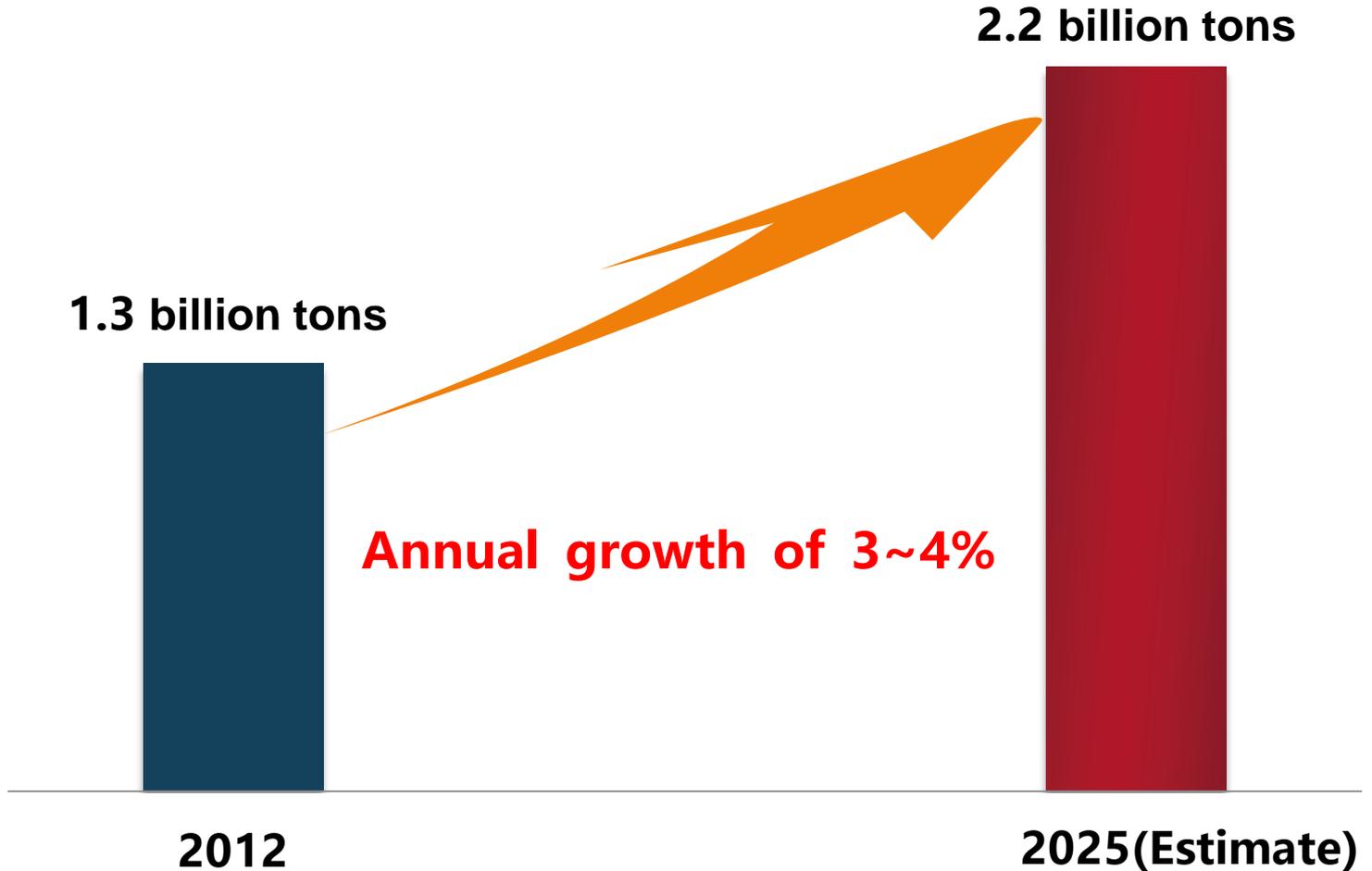
May 9, 2017. Mr. Chen Xiaoping, CEO of China Everbright International, as the representative of the private sector to participated the HongKong High Level Debate — **“the UNECE International PPP forum”** .



- Mr. Chen Xiaoping also presented as “the best practice guideline on PPPs in WtE projects” expert team leader to moderate the forum in May 10th, 2017.
- **The UN “People first PPP” model** is the best solution for the Developing Countries who is seeking WtE for waste solutions.
- The international expert team, leading by Mr. Chen Xiaoping, is currently working on the “ UNECE Guidelines”.

Waste in the world

1. Waste production of the world announced by UN



Waste in the world

The environmental problems caused by municipal solid waste have attracted worldwide attention, if improper treatment will cause:

Waste siege

Damage the environment

Pollute the atmosphere, soil, ground water

Occupy massive amount of soil resources

Endanger human life, property and safety



Waste siege



Waste siege



Scavenging in the waste for living



Scavenging in the waste for living



Environment and Atmosphere Pollutions



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Environment and Atmosphere Pollutions



Water system Pollutions



Water system Pollutions

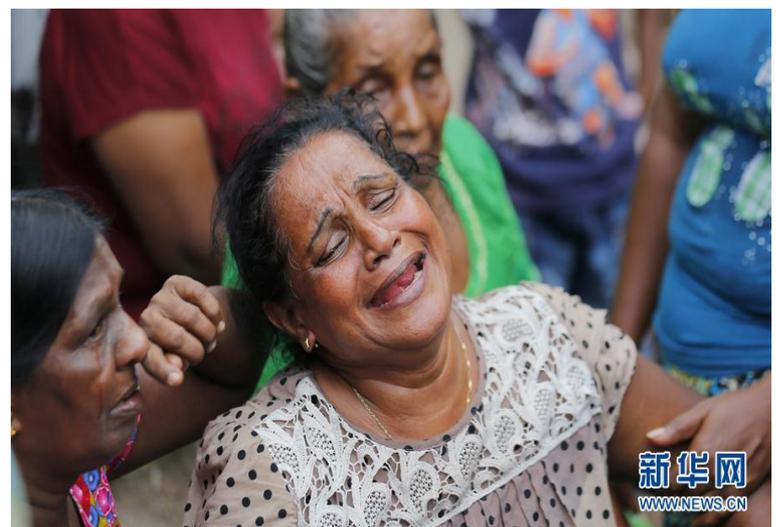


Waste Mountain



Waste Mountain fire

Waste mountain collapsed and triggered a fire in Colombo, capital of Sri Lanka, surrounding multiple houses were damaged and hundreds of people were homeless. The collapse cause a consequence of 30 people die, including 6 children, reported by Sri Lankan military in April 17th this year.



2、 Waste is a misplaced treasure



On the waste mountains, a crowd of people are Scavenging available resources for living. Someone has made a fortune by collecting waste, **it means there is a lot of treasure hidden in the waste.**

3 Waste must be classified

Through the waste classification, different wastes will be treated separately: recycled first, then WtE system for non-recyclable wastes .

Waste classification not only can recycle resources, but also decrease the amount of waste and reduced emissions.



4 Building a WTE plant :

One ton of waste can generate energy



Three households monthly electricity consumptions



Waste is misplaced renewable resources, is “oil”, is “treasure” !

5 The treatment of waste

Harmless treatments: Landfill, Composting and WtE.

① Landfill :

Sanitary landfill has been widely used in many countries . **But it occupies large areas, pollutes environment, and is easy to explode as well as great maintenance cost.** So far many cities have no proper landfill sites.

Proportion of sanitary landfill in different countries %

Country	USA	JP	Ger	FR	NL	BE	CH	DK	AT	SE	AU	CHN
Landfill%	70	32	72	85	50	62	15	32	65	75	62	65





A methane explosion in landfill site

Harmless treatments: Landfill, Composting, WtE.

② Composting:

High cost

Complex process

Low efficiency



③ Waste to Energy :

- WtE is the final treatment for waste, it is

NON-HAZARDOUS

REDUCTION

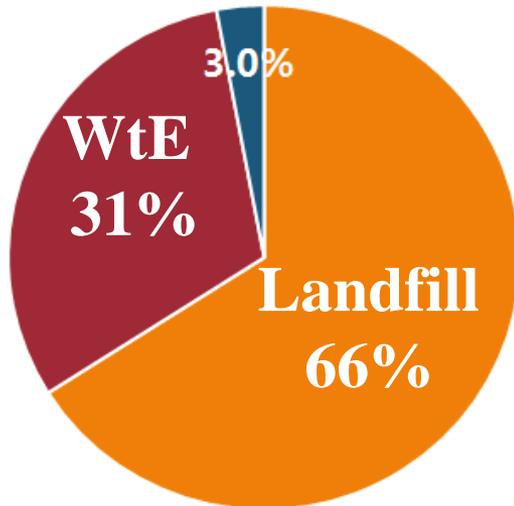
RESOURCE UTILIZATION

WtE has the advantages of **reaching the emission standard, not causing secondary pollution, less land occupation.**

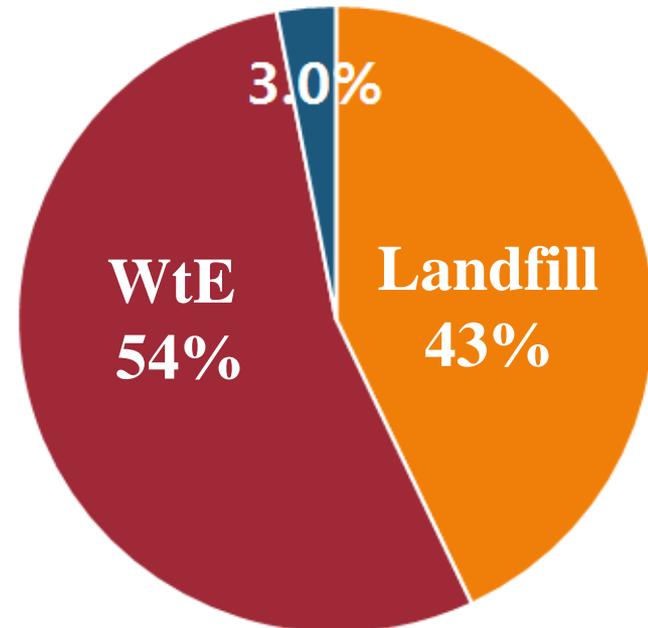
- The proportion of WtE in China is increasing.

The proportion of waste treatment **in 2020**

The proportion of waste treatment **in 2015**



“12th Five-Year” Planning



“13th Five-Year” Planning

③ Waste to Energy :

- Although WtE has many advantages, but:
- **Public acceptance:** Opponents deem the WtE will cause secondary pollution, especially **dioxins**, which is harmful to public health.
- **NIMBY:** Some people are not opposed to build WtE, but not in my backyard.
- **Affordable investment cost**
Developed countries: **880\$/T**
China : **228\$/T**



The public is against the WtE projects.



The Hangzhou, China, government plans to build a WtE project at JiuFeng, which has been strongly opposed by the public:

- The government organizes the public to visit the Nanjing, Changzhou, Suzhou WtE plants in China, the public learn more about the WtE plants' operation, management processes and pollutant emission controls;
- The public has held discussions and exchanges with residents around the WtE plants, recognizes the WtE plants do not pollute the surrounding environment;
- After the visit, **the public invites Everbright to build the 3000t/d WtE plant at JiuFeng .**



How to break NIMBY——

Government-led, Public participation, Enterprise self-discipline

① Government-led

- The government should establish “credibility” :
- Establish whole-process, long-term **regulation and law-enforcement systems**;
- **To benefit the public by allocating quality civil services resources**, such as medical care, education and retirement, in order to push forward the development of the local economy;
- The government strengthen publicity that the benefits from WtE for **environmental protection, social efficiency and economic development**;
- The government organizes the public to visit WtE plants for learning.



② Public participation

- To respect the public's right to know, participate in and supervise the WtE projects, and obtain the real approval of the public;
- **To organize side visit** and let the public to dispel their concerns by what they see, hear and feel at the sites;
- **To improve communication mechanism** by establishing smooth communication and feedback channels;
- Each WtE plant from Everbright has set up environmental education base, receiving visitors from the public nearly one hundred thousand people annually.



③ Enterprise self-discipline



The core values proposed by Everbright CEO Mr. Chen Xiaoping

The enterprise is not only the creator of wealth

But also the undertaker of environment and social responsibility

- According to the core values, **protect the environment, emission controls, and secondary pollution prevention becomes the primary goal of Everbright WtE project.**
- At present, all WtE project from Everbright has published **the live pollutants emission value on the internet, and also take the supervision from the government and the public.**

③ Enterprise self-discipline

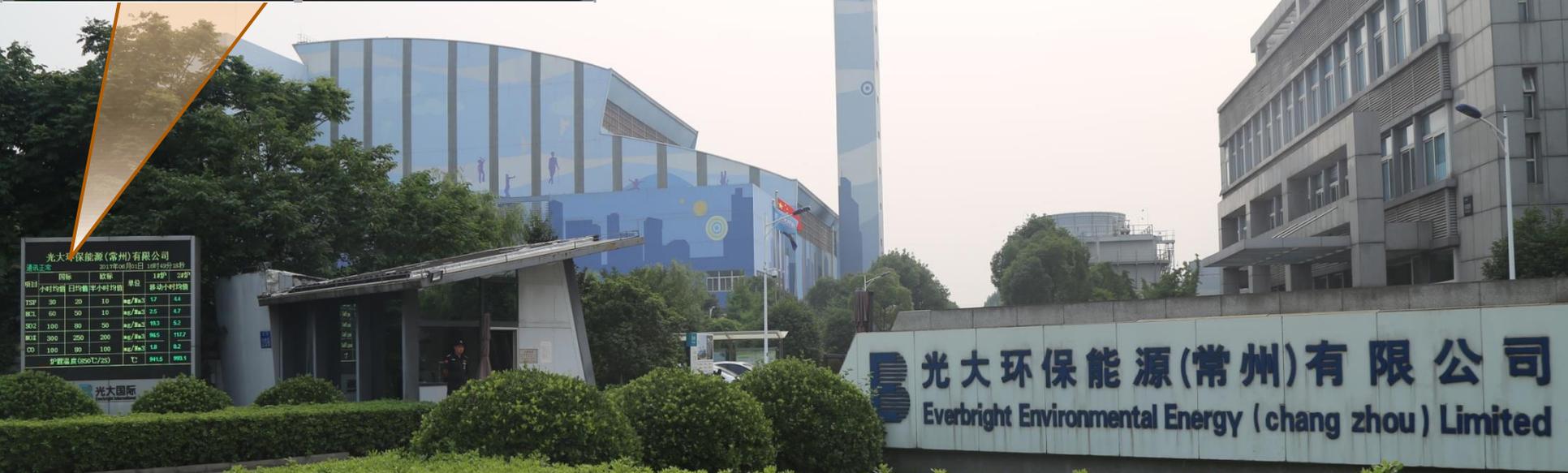
- WtE plants of Everbright aim to protect the environment, to ensure “**safe disposal and pollutant discharge under certain standard**” by high-standard designs, constructions and operations;
- WtE plants of Everbright implement the EU 2010 standard, some plants implement "**ultra-low emission**" standards;
- Everbright has released the live emission value on the internet. Emission values also link to the local environmental protection departments, which has taken the initiative to accept the supervision of the government and the public, to integrate into the society, create employment, and provide public welfare.

光大环保能源(苏州)有限公司												
2017年06月01日 17时41分00秒												
项目	指标		单位	移动小时均值								
	小时均值	日均值		1#炉	2#炉	3#炉	4#炉	5#炉	6#炉	7#炉	8#炉	
TSP	30	20	10	mg/m ³	2.1	1.6	0.8	3.5	2.1	1.1	1.8	1.3
HC1	80	50	10	mg/m ³	4.6	2.4	4.3	2.8	3.8	2.3	0.6	1.7
SO2	100	80	80	mg/m ³	14.0	8.4	23.3	0.9	1.6	0.2	6.1	7.7
NOX	300	250	200	mg/m ³	83.2	97.3	115.7	116.0	134.0	128.0	88.8	123.9
CO	100	80	100	mg/m ³	6.3	6.0	5.9	30.8	0.4	8.2	3.5	8.3
炉膛温度 (850℃/25)				℃	1192.6	1170.5	1070.9	1122.1	1028.9	1100.1	1059.3	1094.4



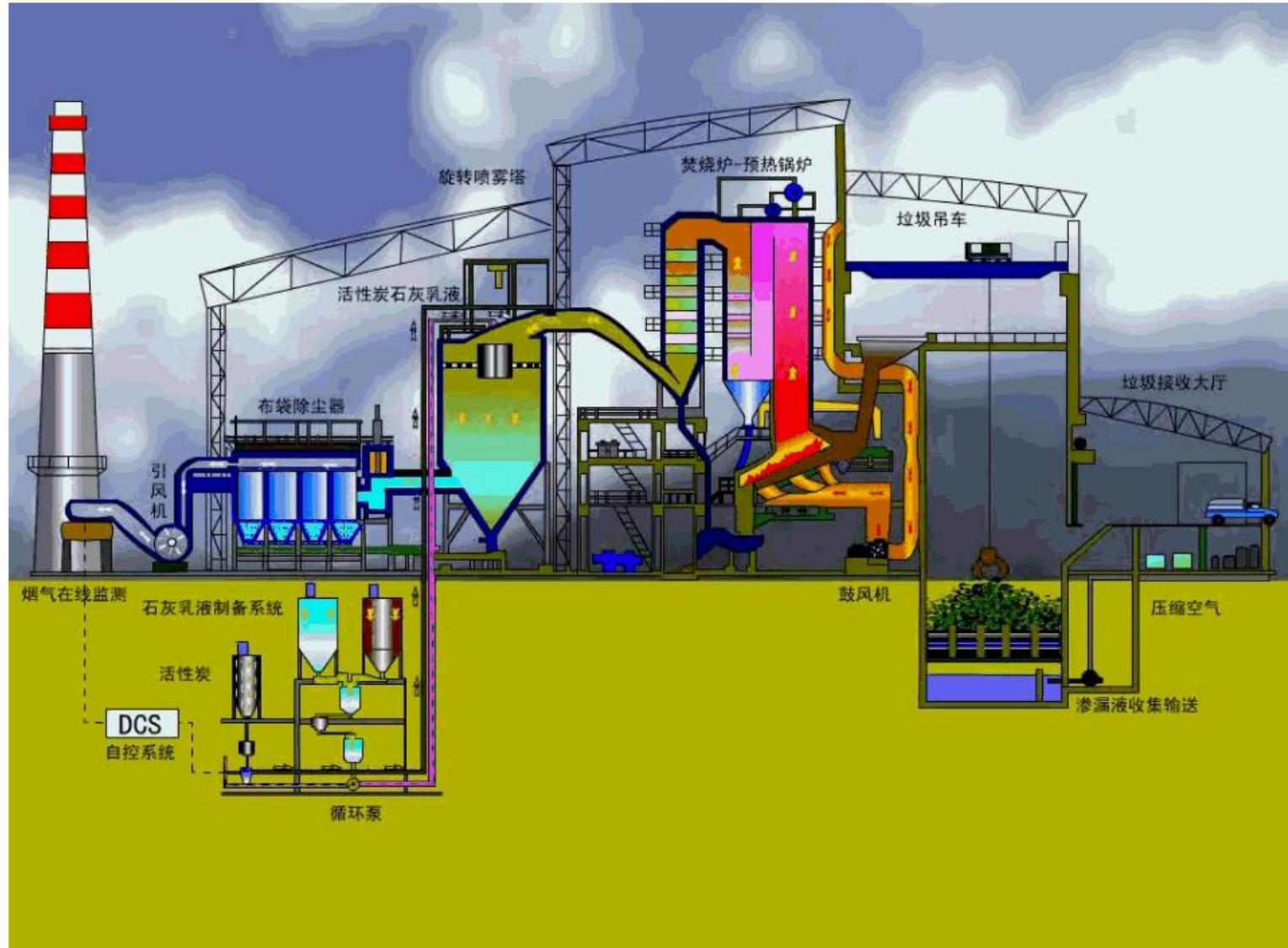
光大环保能源(常州)有限公司
 通讯正常 2017年06月01日 16时49分18秒

项目	国标		欧标	单位	1#炉	2#炉
	小时均值	日均值	半小时均值		移动小时均值	
TSP	30	20	10	mg/m ³	1.7	4.4
HCL	60	50	10	mg/m ³	2.5	4.7
SO2	100	80	50	mg/m ³	19.3	5.2
NOX	300	250	200	mg/m ³	96.5	117.7
CO	100	80	100	mg/m ³	1.8	0.2
炉膛温度(850℃/2S)				℃	941.5	993.1



The WtE project located in the city centre

WtE Technology of Everbright



Three focus point of WtE plant

- How to build a WtE project ?

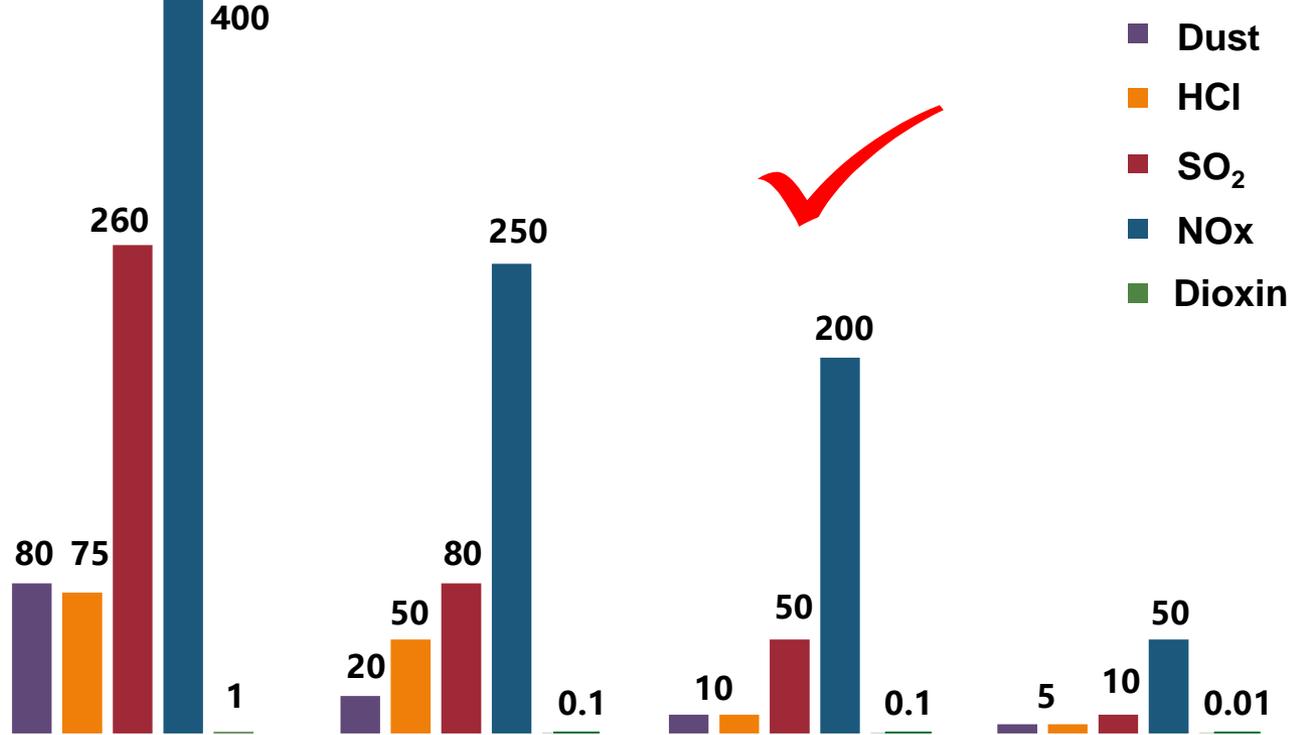
High starting point, strict standard, clean emission, more efficient, safer and less investment

- Three main points to build a WtE plant:



- 1 Clean emissions, reduce secondary pollutions
- 2 Increase generation benefits and reduce generation costs
- 3 Safety and reliability

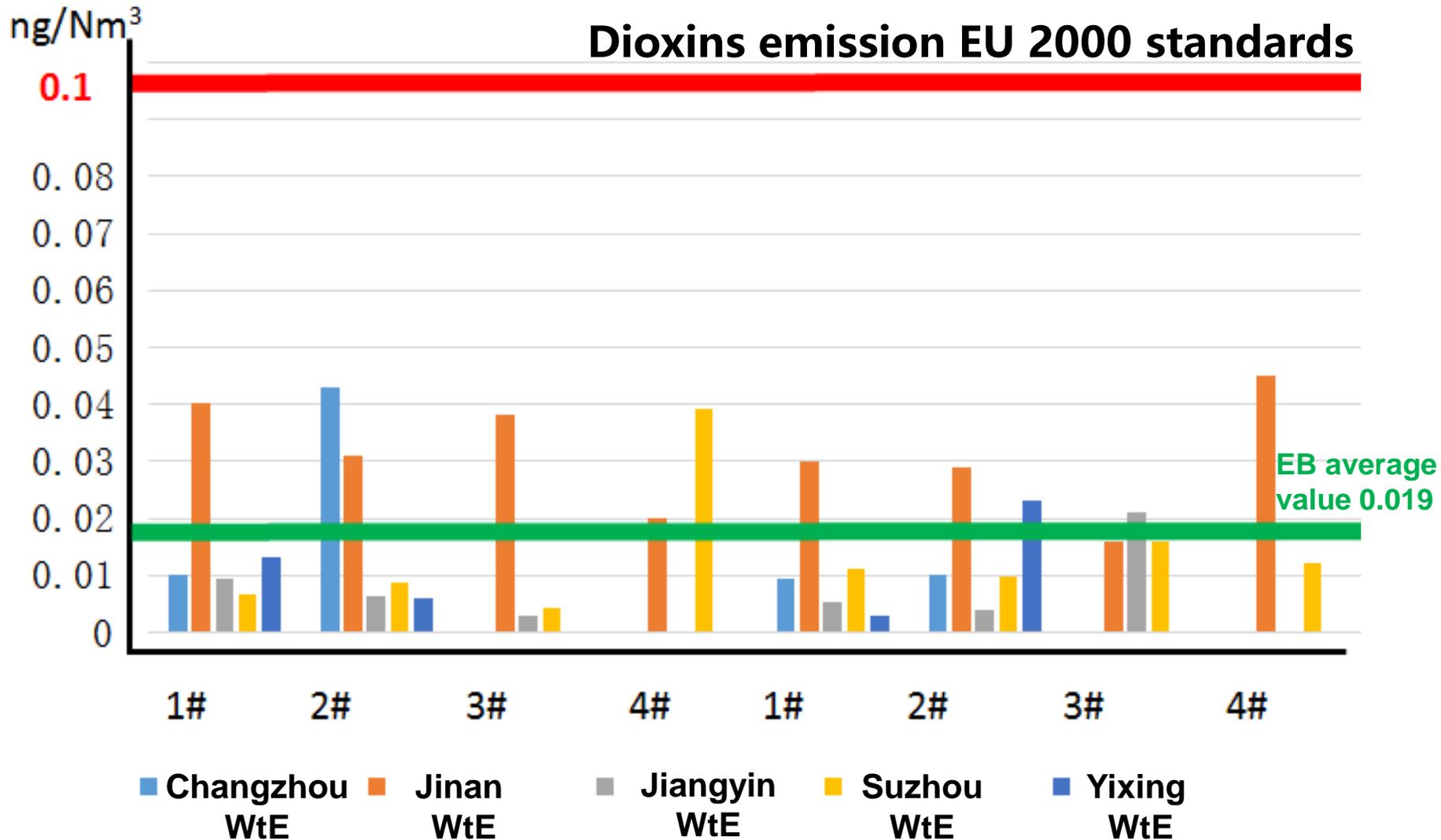
1 Clean emissions, reduce secondary pollution, **Everbright implements the EU 2010 standard**



Pollutant	China 2001 standard	China 2014 standard	EU 2010	Ultra-low emission	Unit
Dust	80	20	10	5	(mg/Nm ³)
HCl	75	50	10	5	(mg/Nm ³)
SO ₂	260	80	50	10	(mg/Nm ³)
NO _x	400	250	200	50	(mg/Nm ³)
Dioxins	1	0.1	0.1	0.01	(ngTEQ/Nm ³)

Since Everbright built the first WtE plant in 2004 which implemented the EU 2010 standard, at present Everbright has more than ten years and dozens of plants operating experience, such as Hangzhou, Suzhou, Nanjing and other WtE plants have reached ultra-low emissions.

■ Test data of **actual** emissions of dioxins in WtE plants of EB(2014)



All data were examined by Tsinghua University.

2 Increase generation benefits and reduce generation costs

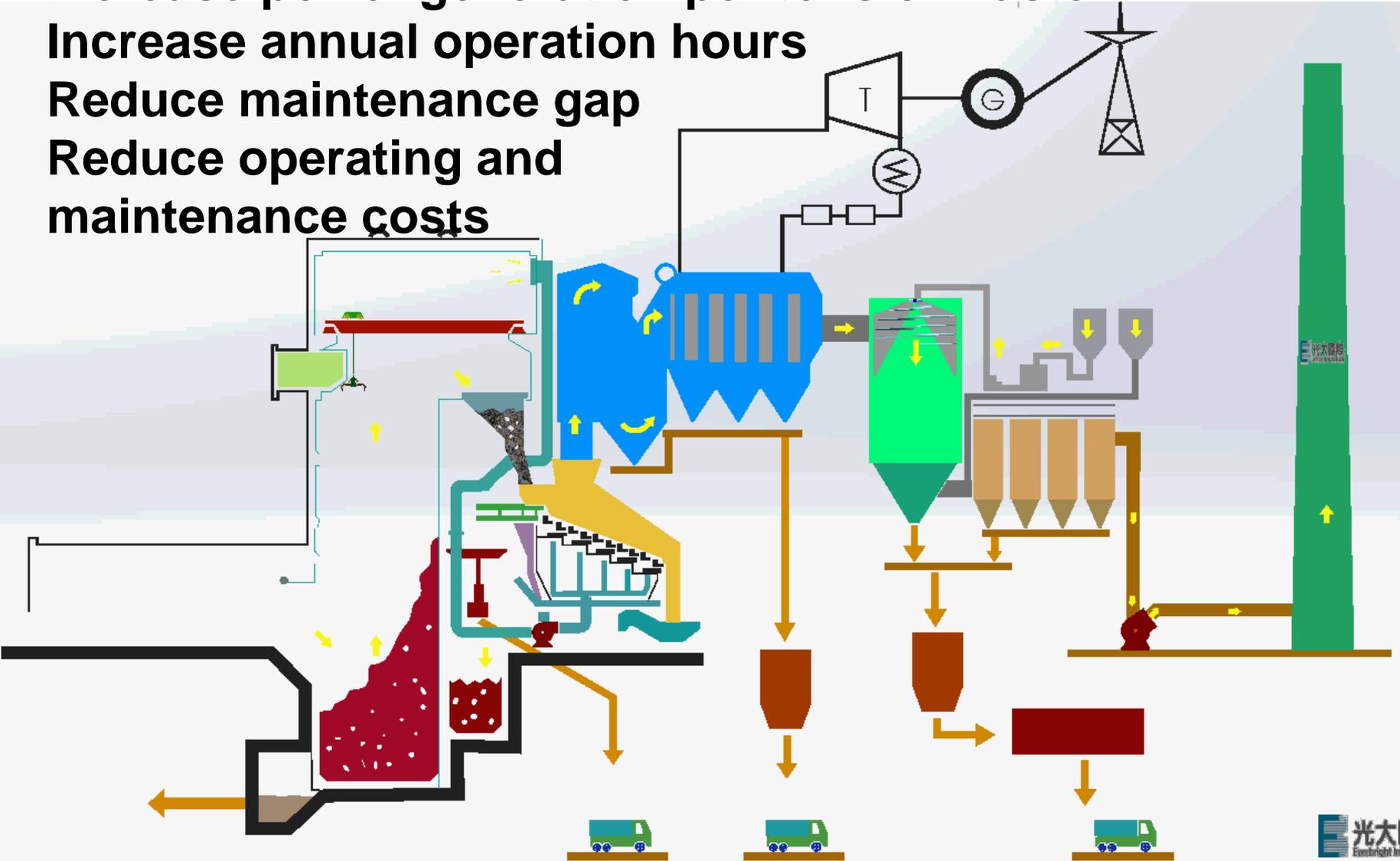
Increase thermal efficiency

Increase power generation per tons of waste

Increase annual operation hours

Reduce maintenance gap

Reduce operating and maintenance costs

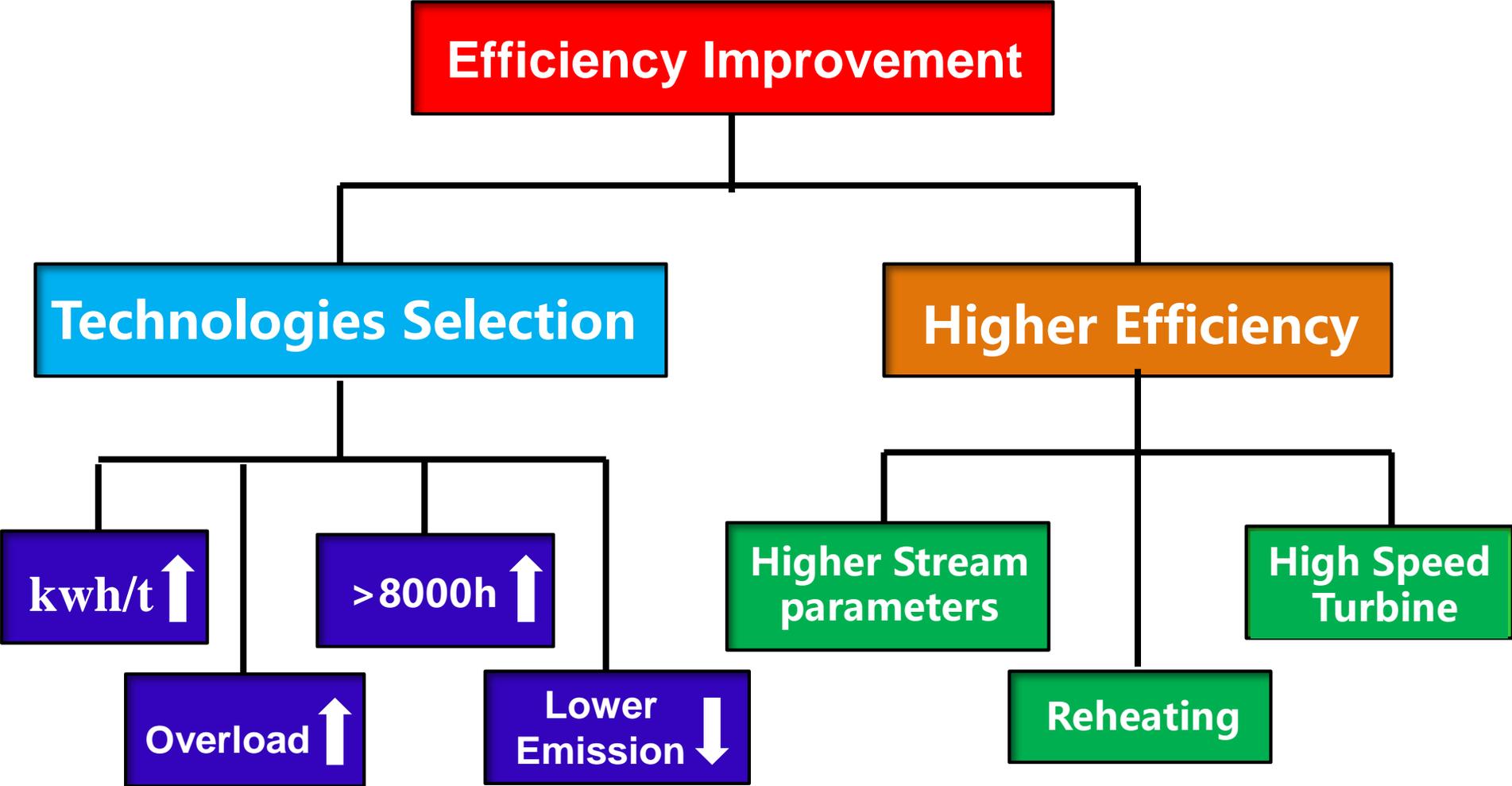


3、 Safety and reliability

Cleaner, more efficient, safer and less investment



Experience in improving the efficiency of WTE plants



Experience in improving the efficiency of WtE plants



Nanjing WtE Plant Phase I Project (4×500t/d): Operating since June 2014

Phase II Project (3×750t/d): Operating since March 2017

■ Wujiang WtE project has been operated for seven months, the highest power generation per tons of waste is 608kwh/t

■ Operation data of 3×750t/d Phase II project in Nanjing

1. Construction period: From Jan 2015 to Feb 2016, **total of 13 months**

2. 72+24 hour assessment test: From March 25 to 28,2017

3. Operating dataset :

1) Design LHV : **1800 kcal/kg**

2) Capacity : 750t/d

3) 100%MCR : 40bar/400°C 73t/h

Max MCR : 80t/h

4) Ignition loss : **1.7-1.8 < 3%**

5) Power generation per tons of waste : **570kwh/t**

Highest power generation per tons of waste : **600kwh/t**

6) Power consumption rate : **9.6%**

Ca(OH)₂ consumption : 12kg/t_{waste}

Activated carbon consumption : 0.4kg/t_{waste}

7) flue gas emission values :

	Unit	Design value	Actual operation value
Dust	mg/Nm ³	10	0.28
HCL	mg/Nm ³	10	5.5
HF	mg/Nm ³	1	0.1
SO ₂	mg/Nm ³	50	9.8
NOx	mg/Nm ³	200	150
Dioxins	Ng/ Nm ³	0.1	-

The Development history of Everbright high efficiency system

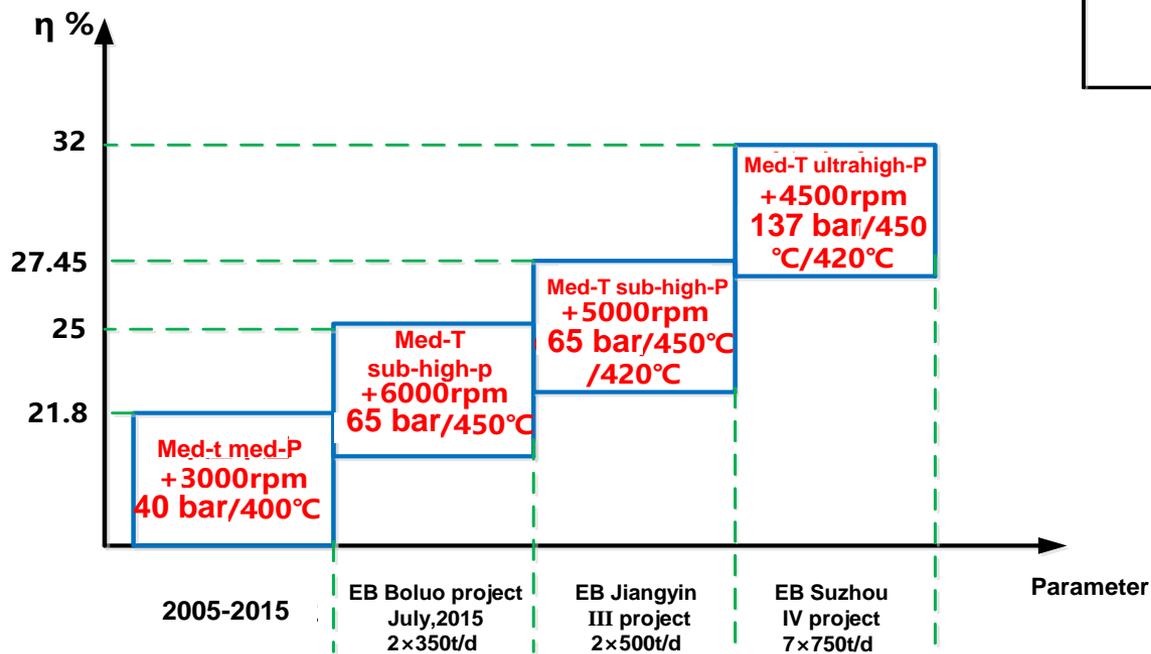


Fig1 Variation tendency chart between cycle thermal efficiency versus steam parameter

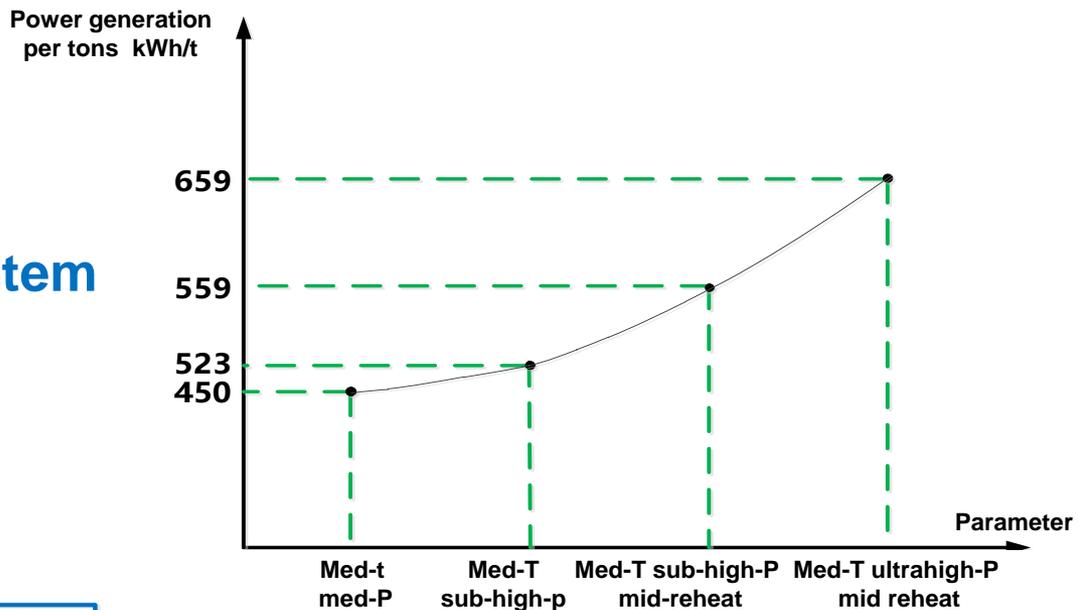


Fig2 Waste Design LHV=1800kcal/kg Diagram between power generation per tons versus stream parameter LHV

Schemes benefit comparison of 2x750t/d

Plant	Unit	Conventional power plant		Medium-temperature sub-high-pressure		Medium-temperature sub-high-pressure reheating		Medium-temperature ultrahigh-pressure				Medium-temperature ultrahigh-pressure reheating			
Capacity	t/d	2×750t/d		2×750t/d		2×750t/d		2×750t/d				2×750t/d			
LHV	kcal/kg	1800		1800		1800		1800				1800			
Boiler superheated steam parameter	MPa/°C	40bar/400°C		64bar/450°C		64bar/450°C /420°C		137bar/450°C				137bar/450°C/420°C			
superheated steam flow	t/h	2×74.6t/h		2×72.2t/h		2×70.2t/h		2×75.3t/h	2×75.3t/h	2×96.9t/h	2×96.9t/h	2×76t/h	2×76t/h	2×88t/h	2×88t/h
Reheated steam flow	t/h	/		/		2×60.8t/h		/	/	/	/	2×63t/h	2×63t/h	2×72.5t/h	2×72.5t/h
Efficiency	%	81		81		81		81	81	81	81	81	81	81	81
Feed-water temperature	°C	130	130	130	130	130	130	130	130	253	253	130	130	253	253
Turbine speed	rpm	3000	5000	3000	5000	3000	5000	3000	5000	3000	5000	3000	5000	3000	5000
Power generation	MW	28.59	29.73	31.53	32.79	33.6	34.95	35.20	36.61	37.69	39.2	37.12	38.61	39.61	41.18
Cycle thermal efficiency	%	21.85	22.72	24.10	25.06	25.68	26.71	26.90	27.98	28.81	29.96	28.38	29.51	30.27	31.48
KWh per ton of waste	kWh/t	457	475	504	524	537	559	563	585	603	627	594	617	633	659
Income from the grid	Ten thousand yuan/year	12636	13141	13937	14495	14853	15447	15559	16181	16660	17326	16410	17066	17505	18205
	Increased income	0	505	1301	1858	2216	2810	2922	3545	4023	4690	3773	4430	4869	5569

Remarks :

- 1 Annual operation hours: 8000h
- 2 Power own consumption rate: 15%
- 3 Tariffis: 0.65RMB per kwh

Annual waste disposal fee: 2x750T/dx333dx80RMB/T=39.96million RMB/a
By improving the efficiency of the WtE project, the annual benefits from electric can offset the cost of annual waste disposal tipping fee(in China).

Two boiler one turbine-main-pipeline unit reheating system

Large power plant with high parameter and reheating system, one boiler with one steam turbine.

Due to the small scale power generation capacity, WtE plant uses mother-pipeline unit, two boiler with one steam turbine .

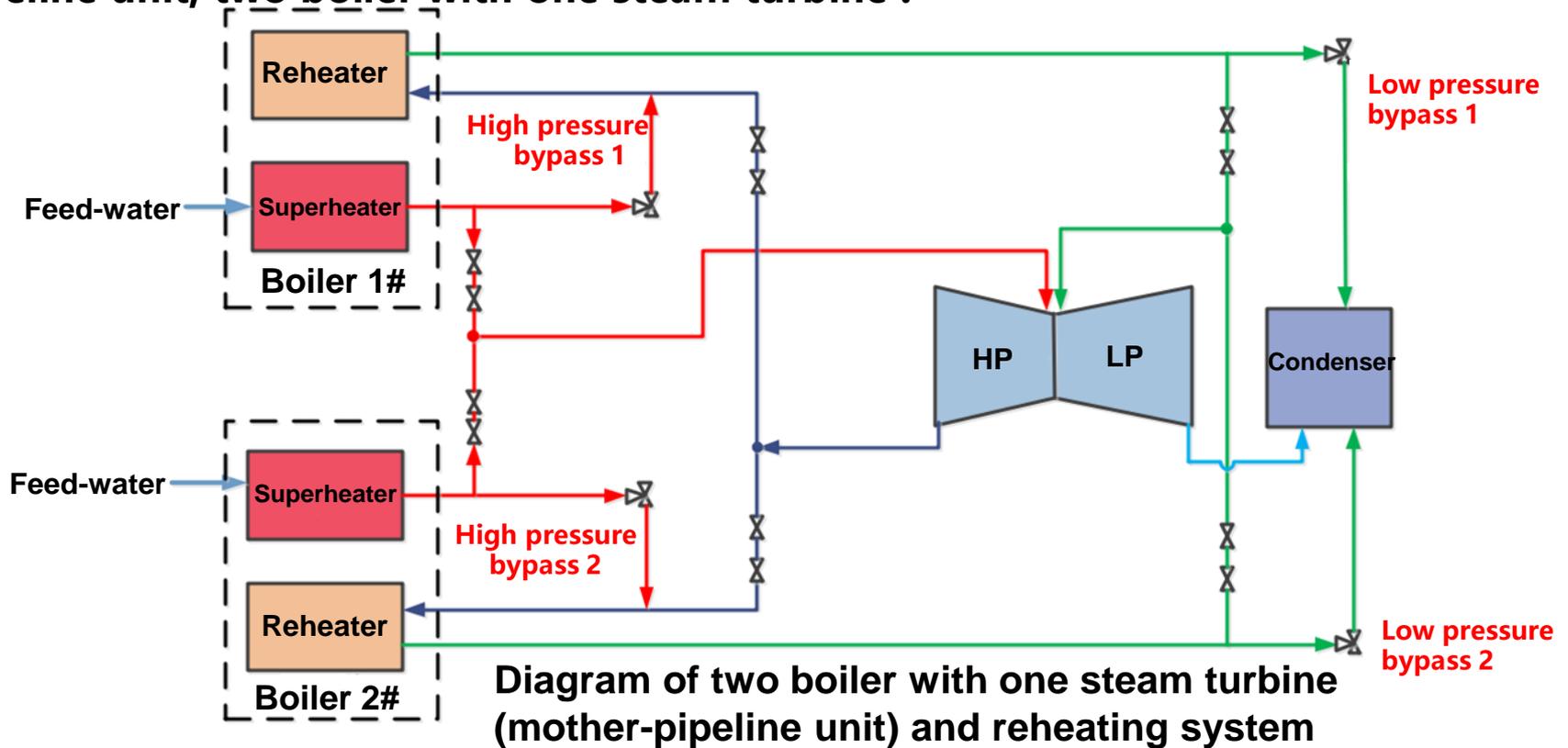


Diagram of two boiler with one steam turbine (mother-pipeline unit) and reheating system

1 Start or stop :

- Prevent reheater burning out.
- When bringing two boiler into the line, the reheating steam parameter should be controlled within the allowable deviation range.

2 Operation :

- The reheating steam temperature should be adjusted to the allowable range.
- HP exhaust should be adjusted to the flow distribution of two boiler reheater.

Recycling—cyclic utilization

The waste slag produced by WtE can be reuse after inspection.



We would like to share the technologies and management experiences of Everbright from over 70 projects whichever relate to investment, construction and operation knowledges.

**Welcome to China for Visiting
Everbright Waste to Energy Projects.**

THANK YOU !

