



Efficiency/Power Enhancement &  
Life Extension Program for  
Multibrand Turbines

**Any** age  
make  
turbine

Trust us to  
bring it to life



## Efficiency Enhancement Solutions

**ANY** age  
make  
turbine  
Trust us to  
bring it to life

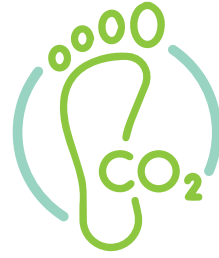
- Upto **15%** efficiency improvement of existing Turbines
- ROI under **2 years**
- Life extension upto **100,000 hours**
- Increase in span between **2 Overhauls**
- No modification in civil and Turbine housing
- Reduced carbon emission

Efficiency improvement / Life extension projects are becoming more popular with cost savings being a major factor. An improvement program is cost effective compared to a new turbine with a cost difference of over 25% .

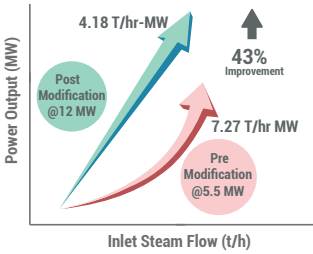
Factors considered by customers:

- Change in the process/enhancement / Power/grid
- Age of turbine
- Consuming more steam/MW

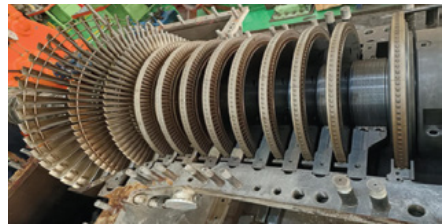
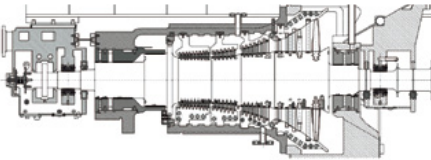
# Turbine Efficiency Enhancement Case Studies



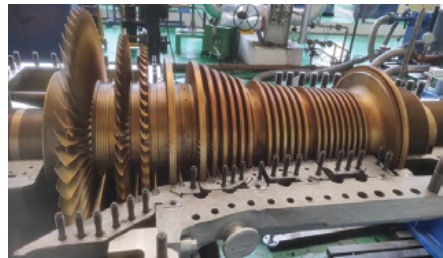
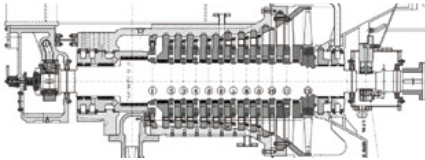
## 1 Make: European Conversion of impulse to reaction Sector: Waste to energy



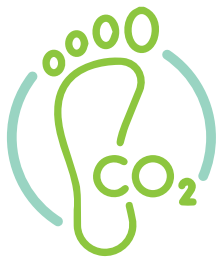
	Inlet			Bleed - 1			Bleed - 2			Exhaust			Power(MW)
	P	T	F	P	T	F	P	T	F	P	T	F	
OEM	65	450	40.00	-	-	-	-	-	-	0.08	-	-	5500
Triveni	65	450	50.25	6	-	4.11	1.29	-	4.28	0.081	-	41.86	12000



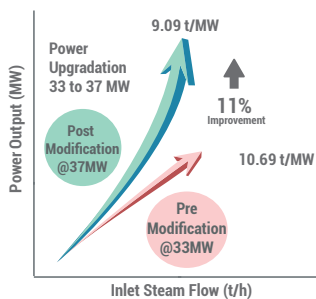
OEM DESIGN (IMPULSE - 12 STAGES)



TRIVENI DESIGN (REACTION - 26 STAGES)

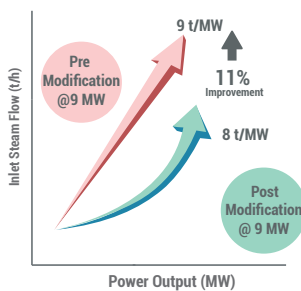


**2 Make: European, 37MW Sector: Oil & Gas**



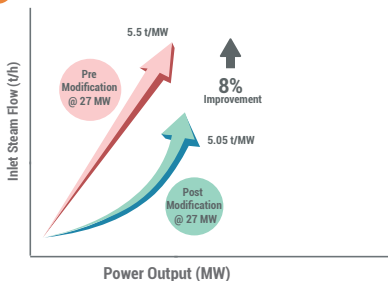
Inlet			Ext. 1		Ext. 2		Exhaust	
P	T	F	P	F	P	F	P	F
106.00	505	352.75	41	158.1	12.75	164.68	0.08	29.97
103.95	505	354.7	41	140	12.5	154	0.117	60.7

**3 Make: European, 9MW Sector: Chemical**



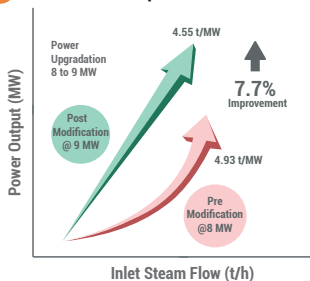
Inlet			Exhaust	
P	T	F	P	F
43.2	440	81	4	81
43	440	72.5	4	72.5

**4 Make: European, 27MW Sector: Chemical**



Inlet			Extraction		Exhaust	
P	T	F	P	F	P	F
70	485	121	16	35	0.113	86
70	485	111	16	35	0.113	76

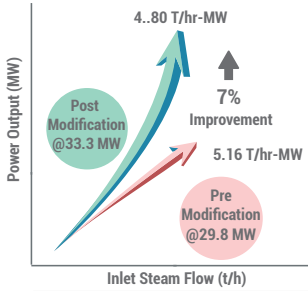
**5 Make: European, 9MW Sector: Steel**



Inlet			Extraction		Exhaust	
P	T	F	P	F	P	F
42	410	37	5.1	4	0.098	33
42	410	41	5.1	4	0.098	37



## 6 Make: China Sector: Textile



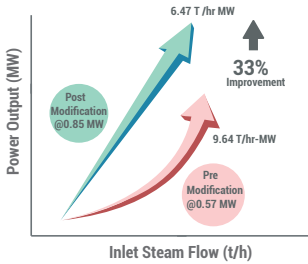
	Inlet			Extraction			HP Bleed			LP Bleed			Exhaust			Power(MW)
	P	T	F	P	T	F	P	T	F	P	T	F	P	T	F	
OEM	86.3	515	154	6.87	222.3	67.01	30.8	389.7	14.67	1.39	109	7.7	0.17	56	-	29.82
Triveni	86.3	515	160	6.87	219.5	55	25.61	366.9	15	1.77	119	9.6	0.0883	43.4	77.86	33.3

## 7 Make: India

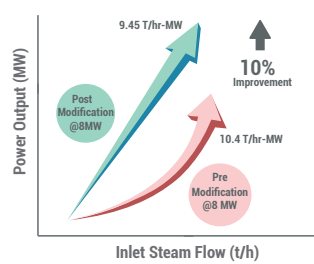
## Sector: Agrochemical

## 8 Make: USA

## Sector: Textile

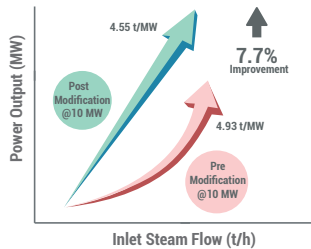


	Inlet			Exhaust			Power (MW)
	P	T	F	P	T	F	
OEM	40	360	5.5	0.2	-	5.5	0.57
Triveni	40	360	5.5	0.2	-	5.5	0.87



	Inlet			Exhaust			Power(MW)
	P	T	F	P	T	F	
OEM	20.626	350	83.26	1.99	-	83.26	8
Triveni	20.626	350	75.6	1.99	-	75.6	8

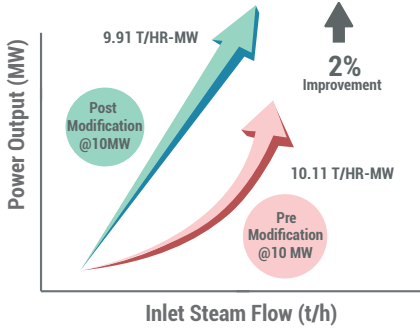
## 9 Make: India Deration of 24 MW to 10MW Sector: Steel



	Inlet			Bleed - 1			Bleed - 2			Exhaust			Power(MW)
	P	T	F	P	T	F	P	T	F	P	T	F	
OEM	64	485	50	3.2	-	3	1.2	-	1.5	0.18	-	44.5	10000
Triveni	64	485	40.14	-	-	-	3.84	-	4.34	0.18	-	35.8	10000

10 Make: Japan

Sector: Sugar



\* During operation customer could not go beyond 6.6 MW

	Inlet			Exhaust			Power(KW)
	P	T	F	P	T	F	
OEM	21	350	101.1	1.5	-	101.1	10000
Triveni	22	350	99.1	1.5	-	99.1	10000



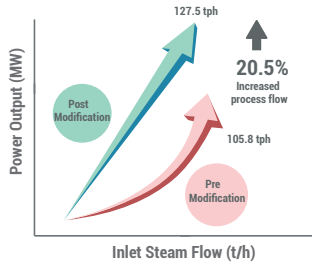
BEFORE



AFTER

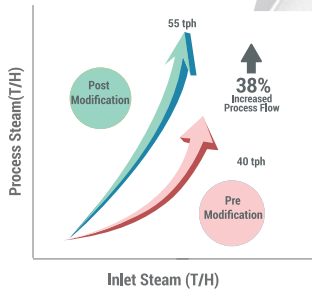
# Condensing to back pressure Case Studies

## 1 Make: India



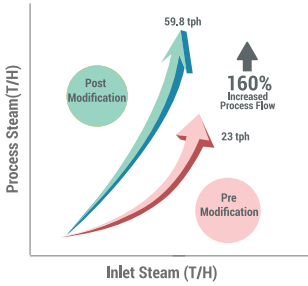
	Inlet			Bleed			Extraction			Exhaust		
	P	T	F	P	T	F	P	T	F	P	T	F
OEM	63	480	157.5	8.5	-	21	2.75	-	105.8	0.1	-	30.7
Triveni	63	480	157.5	8.5	-	30	2.5	-	127.5	-	-	-

## 2 Make: European



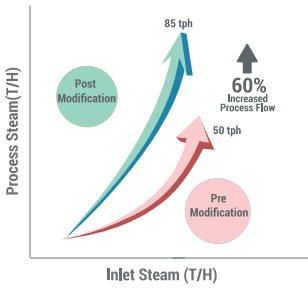
	Inlet			Bleed			Extraction			Exhaust		
	P	T	F	P	T	F	P	T	F	P	T	F
44	420	55	9	-	5	2.5	-	40	0.2	-	10	
44	420	55	-	-	-	2.5	126	55	-	-	-	

### 3 Make: Japanese



Inlet			Bleed			Extraction		
P	T	F	P	T	F	P	T	F
87	515	48	3	130	23	0.1	42	25
87	515	59.8	3	151	59.8	-	-	-

### 4 Make: Russian



OEM ROTOR WITH 17 STAGES (CONDENSING DESIGN)



TRIVENI ROTOR WITH 9 STAGES (BACK PRESSURE DESIGN)



Inlet			Bleed			Extraction			Exhaust		
P	T	F	P	T	F	P	T	F	P	T	F
35	435	112	13	-	50	1.2	-	40	0.1	-	22
35	445	112	13	-	85	5	-	12	-	-	-



AS RECEIVED CONDITION



FINAL CONDITION



# Geothermal

Geothermal turbines often encounter blade erosion and cavity formation due to impurities in the steam, causing reduced efficiency, shorter turbine lifespan, and unexpected breakdowns.

## **Case Study: Revitalize 16MW turbine Geothermal sector** **Client Overview**

Our client, a key player in geothermal energy, faced ongoing erosion and corrosion issues with their American-made 16 MW geothermal turbine, severely affecting rotor material lifespan and performance.

### **Client Challenges**

The client faced a triad of formidable issues:

- (i) Frequent Erosion in Blade Tenons
- (ii) Cavity Formation in High-Pressure Gland Areas
- (iii) Rotor Material Enhancement

Solutions:

- 1. Integral Shroud Design
- 2. Enhanced Rotor Material
- 3. Precision Shot Peening

### **Benefits**

Prolonged Turbine Lifespan  
Augmented Reliability  
Heightened Plant Efficiency  
Enhanced Availability:



**New design rotor**

# Utility Turbines

Health  
assessment

High-Speed  
Balancing

Modernization  
of control  
system

Replace of  
rotor & stator  
rotor blades

Overhauling

Supply of  
spare parts

## Enhancing the life of steam turbines

Upto 970 MW across all brands

### Case Study

#### Repair and High-Speed Balancing of a 250 MW Turbine's IP-LP Rotor

##### Challenge

- Facing critical situation during annual turbine overhaul
- Three rows of rotor blades damaged
- Extended outage
- Threat to plant's productivity

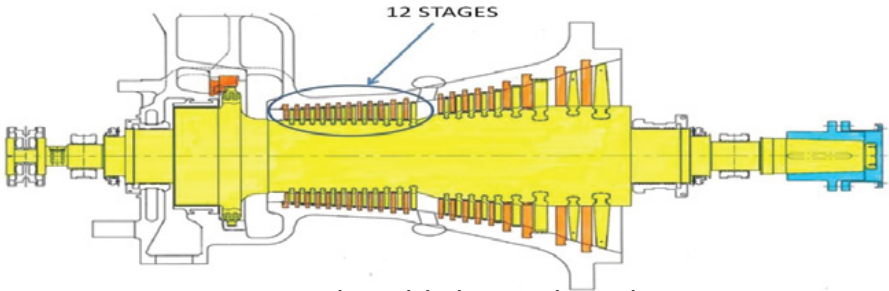
##### Solution

- Repair and restoration
- Blade replacement
- Balancing
- Successful commissioning
- Efficiency and quality assurance

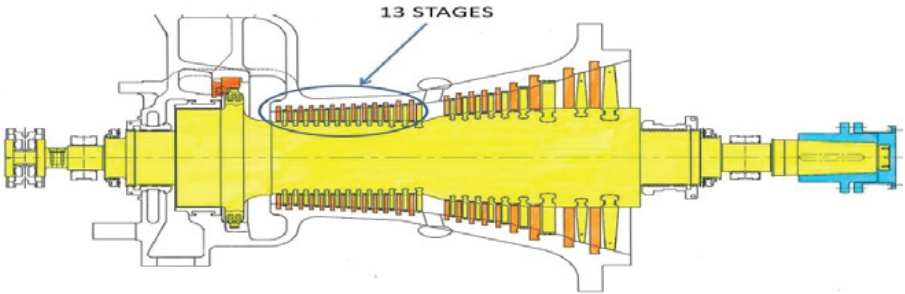
##### Conclusion

- Restoration of client's 250 MW turbine to optimal functionality
- Meeting OEM standards
- Ensuring efficiency
- Minimizing downtime during critical maintenance and repair projects

# Efficiency Enhancement In Pictures

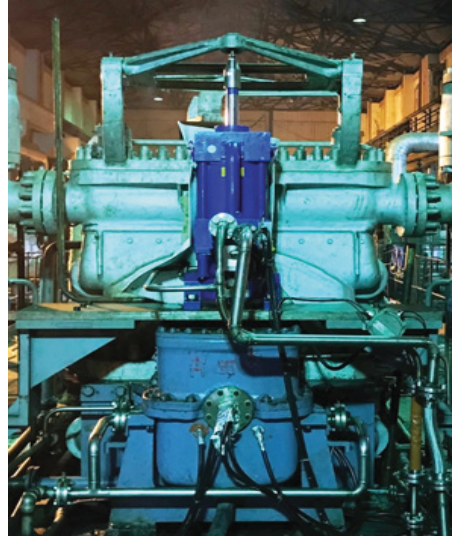
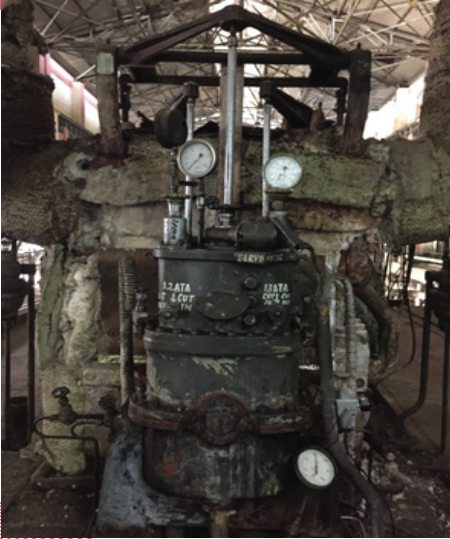
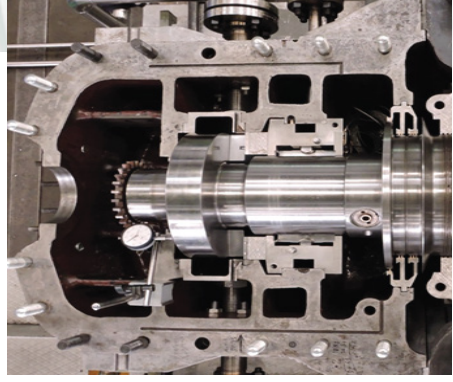


OEM Design: Original Steam Flow path

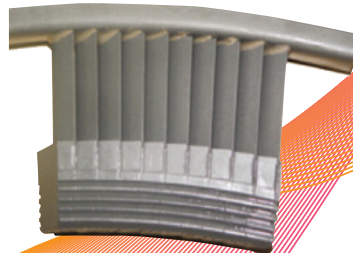
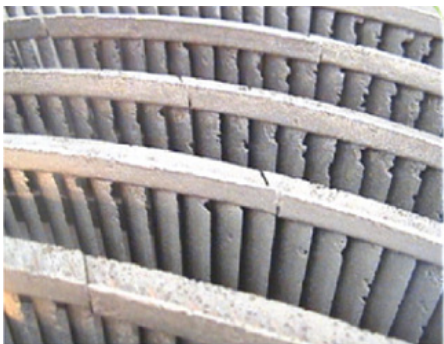
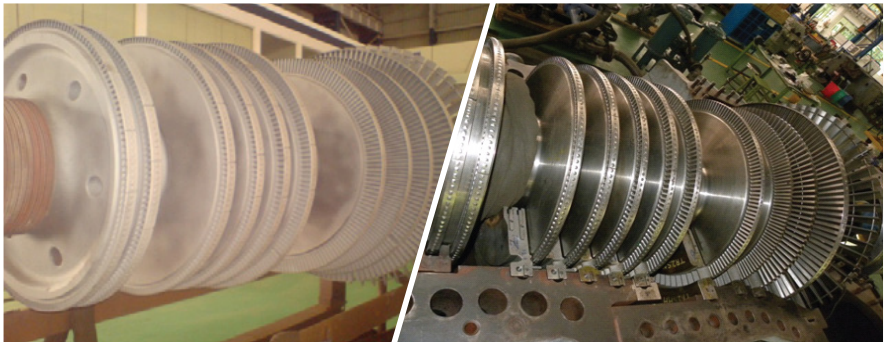


New Design: Original Steam Flow path









# Efficiency Enhancement / Life Extension

- Retain Existing Housing / Casing
- No civil modification
- Upgraded steam flow path
- New rotor with high efficient blades

On requests from customers we initially started supporting them on other makes of turbines. Today we have positioned ourselves on top of the pyramid to focus on efficiency improvement / life extension programs. The advantage are multi fold including never having to discard a turbine and change parameters to achieve the new requirements.

## Our portfolio includes:

- Overhauling
- Long Term Service Agreement
- Health Survey & Condition Assessment
- Reverse/Re-Engineering
- High Speed Balancing
- Efficiency Enhancement
- Automation
- Triveni Touch: Remote Monitoring
- Renovation & Modernization

**Any** age  
make  
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Trust us to  
bring it to life



# Triveni Turbines is one of the leading Manufacturers of **Steam Turbine** in the world



Leading **OEM** of Steam Turbines globally

Manufacturing capacity of **350+** Turbines/year

About **6000+** installations in over **80+** countries

**16 GWe** of installed power

**AS9100D** Aerospace standard certification

**Gold standard** in refurbishing



# Triveni REFURB™

Embracing cultures. Enhancing the future

VISIT  
WEBSITE



DOWNLOAD  
BROCHURES



## Global Network

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MANUFACTURING FACILITY

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