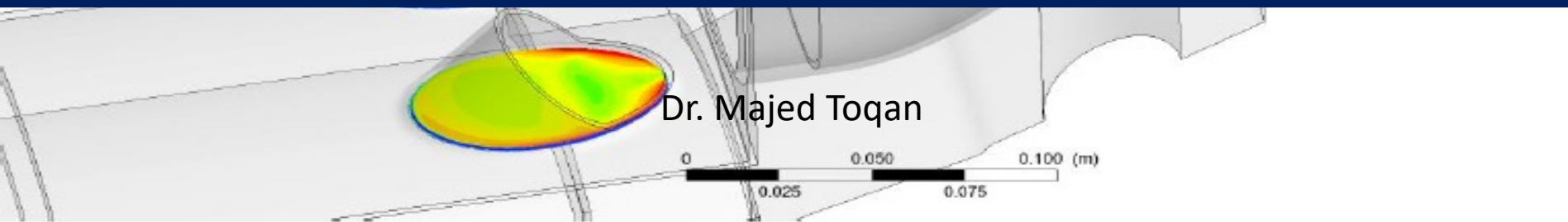


Advanced Technology Development LLC – Green Energy Solutions



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Company Brief
January 2024

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A company focused on the development and implementation of high-tech green technology solutions to industries around the world.

Established in 2014 in the UAE, Advanced Technology Development LLC is a developer of green energy projects with special emphasis on brown field projects increasing their efficiency, reliability and reducing their carbon emissions.

To achieve its objectives, ATD applies its state-of-the-art green technology solutions to reduce the operation and maintenance costs of power plants by half or more as well as reducing the carbon emissions from the concerned plants

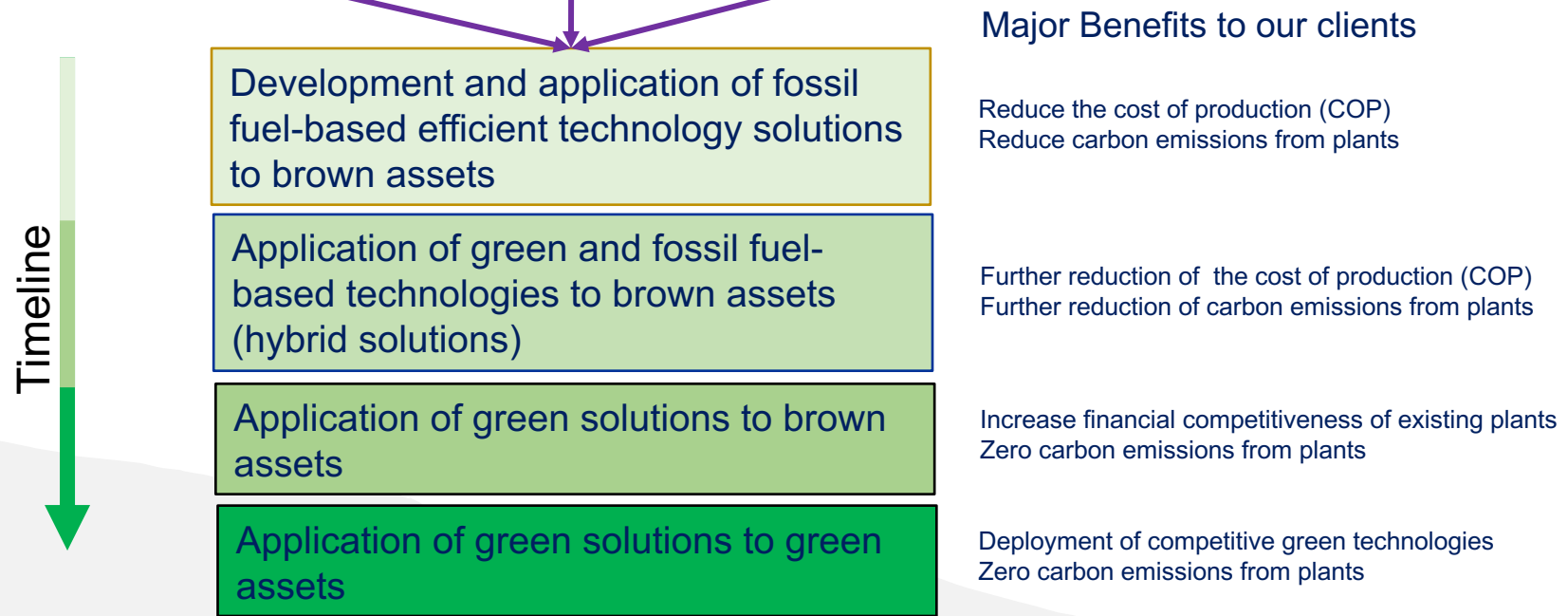
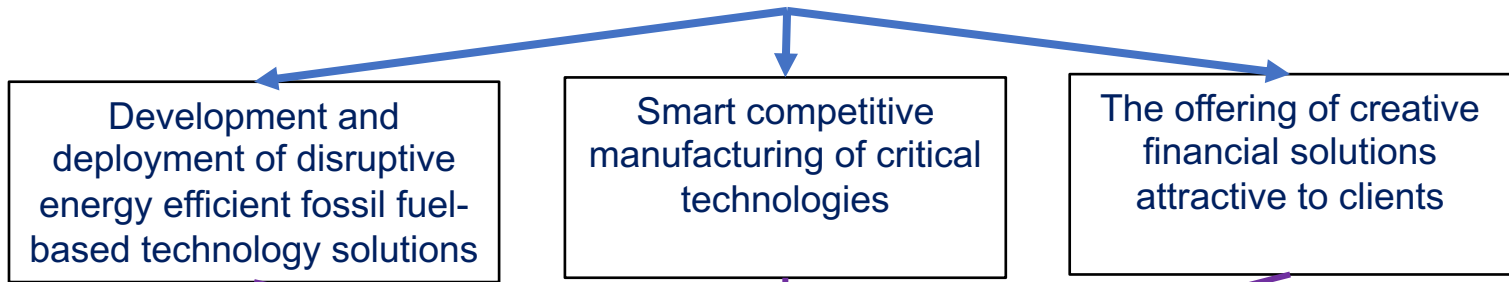
ATD expanded its offering by manufacturing key components and systems by developing its own designs and establishing strategic partnerships with manufacturing facilities in Egypt to produce critical high-end power plants components such as burner systems, steam turbine parts and boiler components (superheater & reheater panels, etc.)

Company Roadmap



Company mission: The company's primary business is the development & deployment of green energy solutions in power generation and industrial sectors

Three Critical verticals



Business Offering

Business Offering

To fulfill the company's strategy, three services are offered:

Power
Generation &
Industrial Plants
Performance
Improvements

Components
Development
and Application

Competitive
Manufacturing
of Key Products

1. Power Generation & Industrial Plants Performance Improvements

Egypt

Egypt – Power Plant Performance Enhancement

- The company signed a long term 12-year contract at the end of 2016 with the Ministry of Electricity in Egypt that covers the following:
 - The company assumes the responsibility of investing to upgrade and rehabilitate a 600 MWe power plant in country
 - A first major objective of the program is to increase the plant's efficiency and reduce the fuel consumption
 - A second one is to increase the plant's output relative to its current values.
 - All major overhauls during the contract period will be covered by the Company.
 - All routine and daily maintenance will be covered by the ministry
 - The plant will continue to be run and maintained by the Ministry
 - In relation to the above, the partners agree to split the fuel savings achieved every month based on formula agreed between the parties.



Achieved Fuel Savings and Carbon Emission Reduction Between 2018-2023

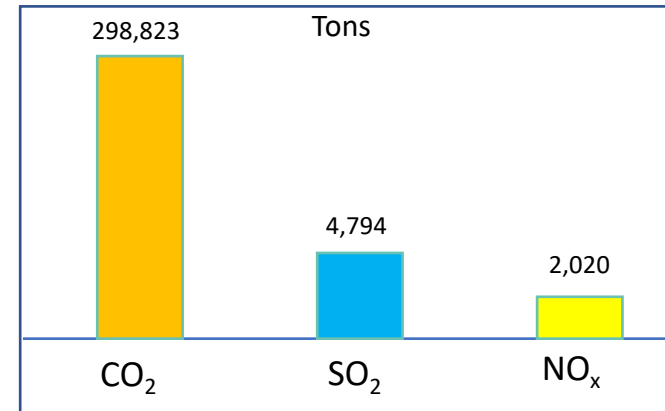
Year	Electricity Production (MWH)	Quantity of Saved Fuel (Ton)	Percentage of Saved Fuel	Mazut Fuel FOB Price Range (USD/ton)	Value of Saved Fuel (USD)	Reduction of Carbon Emissions (Ton)
2018	2,350,639	22,049	3.8%	273-393	8,674,911	67,445
2019	2,667,653	34,325	5.2%	173-357	10,840,958	106,615
2020	2,297,045	31,320	5.6%	124-233	6,715,478	97,614
2021	2,061,034	22,182	4.4%	261-402	8,448,224	69,134
2022	1,857,992	19,840	4.4%	342-583	9,238,843	61,835
2023	2,424,894	36,700	6.6%	357-425	16,910,299	114,381
Total (till end of 2023)	12,813,592	153,710	5.0%		60,828,713	518,663

Quantities of saved fuel were realized with limited burner handling and the operation of one 300 MW_e unit at a time. With an integrated AI system and higher units' utilization larger savings will be achieved

Pollutants' Emission Reductions

- Emissions from the station were extremely high prior to the ATD program. Particulate emissions were high as observed by the continuous black smoke released from the stacks of both units before the ATD intervention program.
- ATD reduced the annual tonnage of pollutants of CO₂, SO₂ and NO_x emissions by roughly 6%.
- A total of CO₂, 298,823, SO₂ 4,794 and 2,020 NO_x tons were reduced in the first three years ATD's program inception.
- This translates directly from improving the efficiency and the optimized operation of the units as a result of ATD's improvement program.
- Through the continuous improvement program being implemented by ATD, and its new burner technology, the steam boilers were able to reach higher efficiency levels while allowing further reduction in the above pollutants' emissions

Quantity of Pollutants reduced since program implementation



Value Creation from the 600 MWe Power Project



Areas of Value Creation	Annual	Project Life
Cost of Production	\$35,000,000	\$350,000,000
Fuel savings**	\$10,000,000	\$100,000,000
Increase of Production	\$18,000,000	\$180,000,000
Carbon credits**	\$500,000	\$5,000,000
Total Value Creation	\$63,500,000	\$635,000,000

Rate basis:
Cost of production 1 cent/kWh
Price of electricity 3 cent/kWh
Carbon credit 5 USD/ton

Analysis horizon:
10 years

In future projects, company objective is to participate in all value creation areas

**participation in current created benefit

2. Components Development and Application

Advanced Gas Turbine Systems

Aero Derivative Engines as a Starter

- Aero-derivative engines were initially designed for aviation applications which require shorter residence times
 - Jet fuel burns much faster than natural gas ... Fast combustion in diffusion aero applications
 - Abundance of cooling air ... Fast cooling in aero applications
 - No need for a pre-mix combustion chamber space ... Shorter combustor in aero applications
 - Limited space and weight restrictions in aero applications

- However, when applied to land-based applications, this shorter residence time creates major problems
 - High emissions
 - Need for additional equipment (ex. SCR)
 - Inability to balance NOx vs. CO emissions
 - Inability to have good performance at part-load levels (ex. low efficiency and high emissions)
 - Need for additional cooling mechanisms to avoid overheating of first stage vane

Aero to Aero-derivative

LM Series Example



A330 / B747/B767



CF6-80C2/E1



C5 / DC-10



TF39/CF6-6



LMS100
100MW, 44%



LM6000
40-55MW, 42%

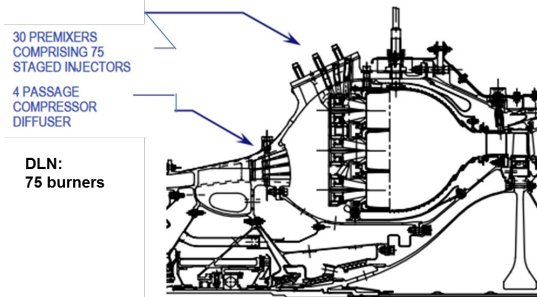
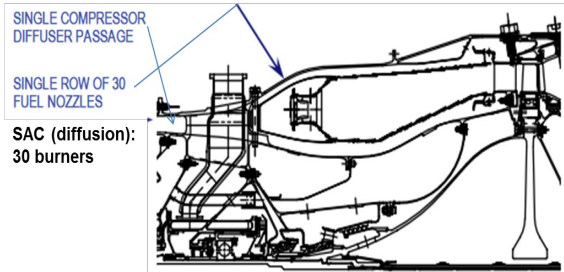
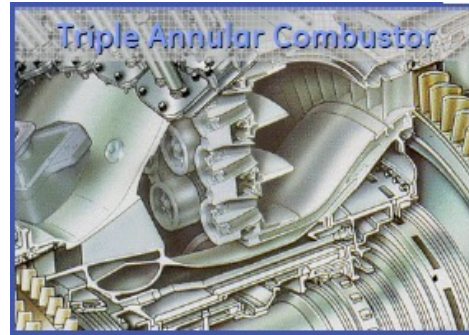


LM2500*+/G4
28-34MW, 39%



LM1800e to LM2500
16-24MW, 36%

Retrofit of LM2500



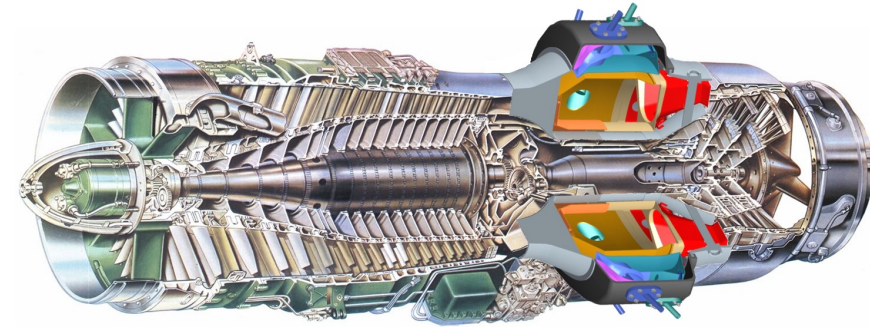
LM1600	LM2500	LM6000	LM5100	Control technology Dry Low Emissions
		✓		15ppm NO _x (gas fuel)
✓	✓	✓		25ppm NO _x (gas fuel)
	✓	✓		Liquid fuel
	✓	✓		Dual Fuel DLE

OEM Retrofit Issues

- Most OEMs offer very expensive retrofit solution
- In the cases that retrofit solutions offered, they tend to be:
 - Bulky ... in order to increase the residence time in the combustion chamber
 - Much more complex ... requiring a major change to the configuration of the engine
 - Extremely expensive

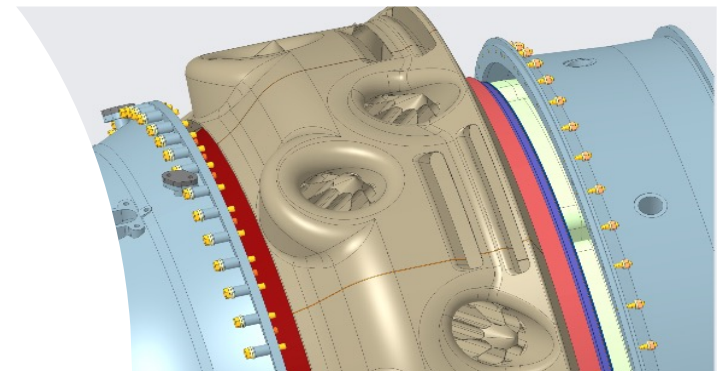
Development and Application of a Multi Fuel Gas turbine Combustor (fossil & green fuels)

- The Company designed and developed a new combustor technology to be used on Avon engines produced by Rolls Royce (now Siemens)
- This technology significantly reduces maintenance costs and emission levels and increases the variety of fuels that can be used on the turbines. The application of these turbines is for power generation on offshore platforms, pumping, heat production in refineries and steam production
- When used as a retrofit to the existing turbines, the end users will reduce their costs from USD 8-12m to USD 1.5-2m. The Company is currently working on the new design, which will be rolled out in the 1st quarter 2024.
- Once the product is commercial on the Avon engines, the retrofit market for other engines can be easily tapped into. Additionally, there is significant potential benefit of this technology to OEMs.
- The new combustion technology is very flexible in its operability: It is able handle multitude of fuels including **blue and green fuels such as hydrogen and ammonia**



Cross sectional view of the Avon gas turbine engine

Sectional view of the T-fired combustor



Attributes of the New ATD Combustor



Lower
emission
levels

Higher
operational
flexibility

Longer life for
key engine
components
(turbine parts)

Handling of
non-standard
fuels
including
green fuels

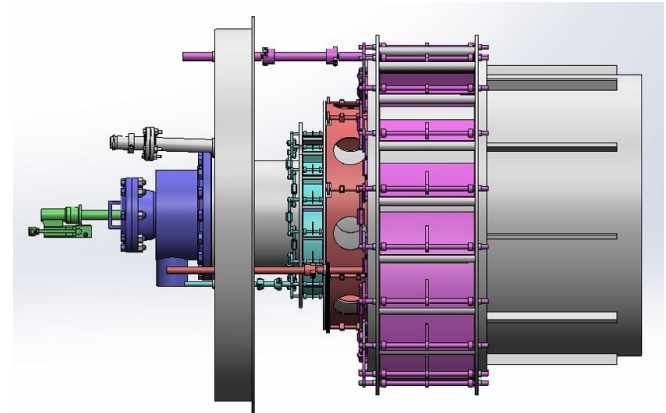
Better part-
load
performance

The potential of
increasing
engine
efficiency

Steam Boilers Multi Fuel Firing System (fossil & green fuels)

Development of the High Efficiency Advanced Telescopic (HEAT) Burner

- The new burner is a new innovative design superior to the original design of Dr. Toqan's developed for ABB/ALSTOM in 1994.
- The main key feature of the disruptive design is using the centrifugal force generated by the combustion air to control the degree of mixing between the fuel and the combustion air.
- By controlling the rate of mixing of the two mediums, the flame can be maneuvered to provide maximum performance
- Two key components are under design, fabrication and testing: new atomizer and a new burner register
- The new design will reduce fuel consumption by roughly 2%
- Designing, building and testing the new burner components is underway. The first burner register sets will be installed in Al Walidia power station in Q1 2023
- The new design features allow very high operational flexibility, longer life and higher reliability and lower pollutants emissions.
- The first burner was built at Factory 200 and it has a rating of 53MW. This burner size satisfies the demand of electricity of nearly 3000 homes.



The new HEAT burner CAD model

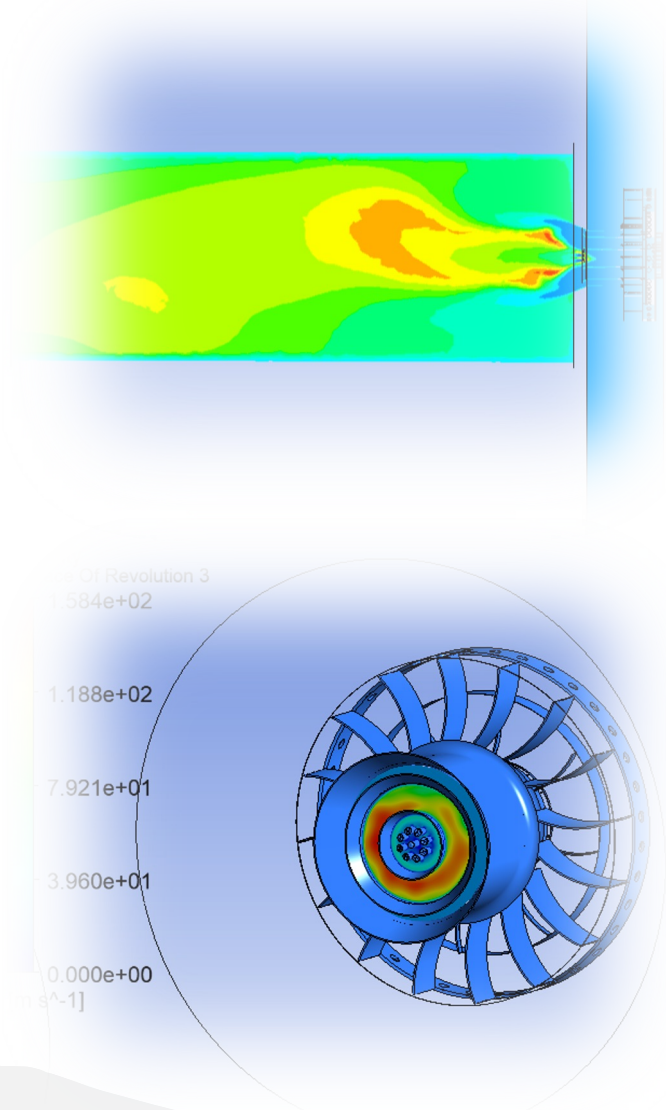


The new HEAT burner system (53 MW)

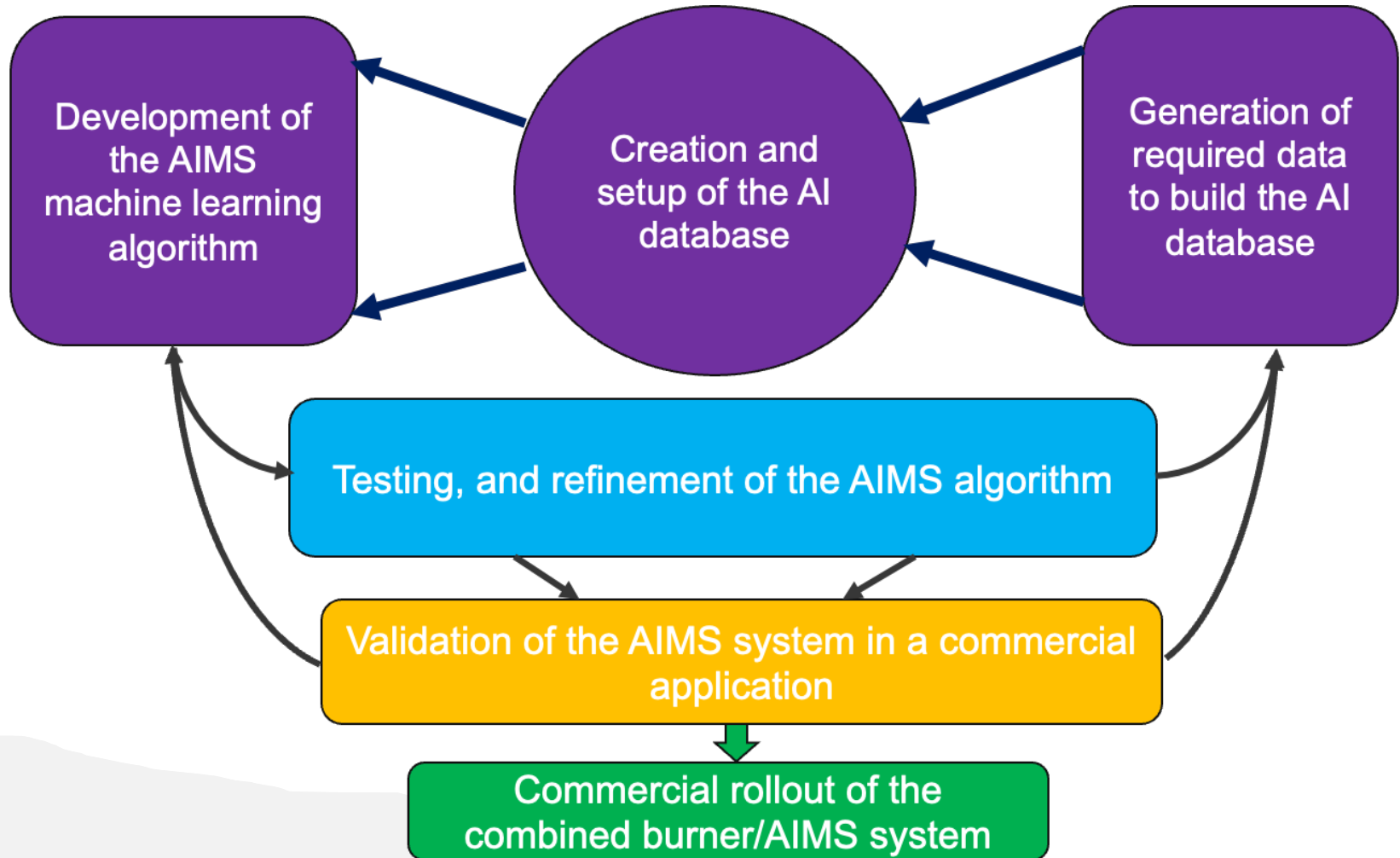
Development of HEAT Dual Fuel Burner System

The new burner system provides the following benefits:

- Much lower pressure loss through the burner allowing a reduction in the electric power consumption of the forced draft fans and as a result higher net power production
- Higher combustion efficiencies are achieved and less carbon emissions from the boiler. This in turn results in a reduction in the specific fuel consumption per kWh
- Lower excess air levels are required to burn the fuel and as a result an increase in fuel efficiencies; ~ 2% reduction in fuel consumption
- Since the combustion efficiency is improved, lower tendency in fouling and slag deposits in the super heater reheater sections of the boiler.
- Lower pollutants emissions are achieved with the new design due to higher flexibility in staging of the flame within the furnace proper
- Longer life is expected out of the burner as a result of reducing the swirlers exposure to high temperatures
- Reduction in corrosion levels in the boiler and air rotary heater as a result of reduced O₂ content in the flue gas.
- Eliminate the need to introduce fuel additives into the boiler to control the corrosion level inside the boiler
- **Flexibility in handling blue and green fuels; hydrogen and/or ammonia**



Development of the Artificial Intelligent Management System (AIMS) for operating the HEAT Combustion System



Competitive Manufacturing of Key Products

Manufacturing of Power Plants Components



Acquisition of Manufacturing Capabilities

- While carrying out the rehabilitation work of the Walidia power plant, ATD identified that it can lower the plant's capital investments significantly, if the power plant's components were produced locally.
- As a result, ATD investigated the most critical items that should be manufactured locally.
- ATD adopted a two prong strategy to manufacture those critical components in Egypt:
 - Acquisition of the manufacturing knowhow capability and securing the proper manufacturing equipment to make the parts locally.
 - Establishing strong partnerships with military manufacturing factories in Egypt such as Factory 200 to manufacture power plant's components.
- This strategy led to a major reduction in capital requirements in the Walidia power plant. The investment needed was reduced by a factor of 3 times as a result of maximizing the local manufacturing of the parts.



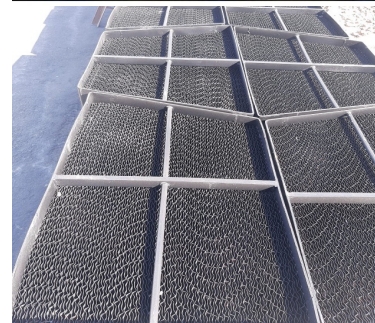
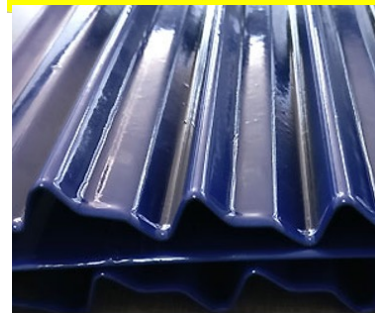
ATD's acquired manufacturing capability



Military Factory manufacturing capability

Manufacturing of High End Power Plants Components

- Examples of items that the company succeeded in manufacturing in Egypt include:
 - Boilers superheater/reheaters bundles
 - High pressure feed water pumps components
 - Air preheaters enamel coated and uncoated elements and baskets
 - Soot blowing systems
 - Combustion systems for wall and tangentially fired boilers
 - Rebuilding of high and low pressure power plants feedwater heaters
 - Steam turbines parts
 - Fuel atomizers and gas injection fuel guns and nozzles
 - Manufacturing of pump cooling systems
 - Etc.



Manufacturing Strategy

- Since the major reduction in the COP comes from localizing the manufacturing in Egypt, a low-cost country, ATD struck an accord with several factories among them Factory 200 (one of the big military factories in Egypt) to manufacture key components for the power and industrial sectors.
- Manufacturing of the HEAT burner in conjunction with Factory 200 is a first major step in the process.
- This allows the group to display its capabilities in producing very complex systems and in turn secure manufacturing of most of what is required by the power stations and industrial plants by this team.
- The manufacturing of the first prototype burner system is complete. A first commercial set will be produced in 2024.
- A key objective of teaming with the right factories in Egypt is for the group to secure direct long-term contracts with power generation and industrial asset owners for the manufacturing of key plants components at highly reduced prices.

Thank you

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