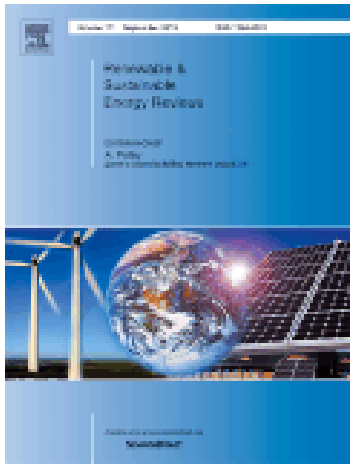

رؤية VISION 2030
المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA

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How Far are We from Integrating the Waste-to-Energy Technologies ?

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Population and Energy Demands

The current world population of 7.2 billion is projected to reach up to 8.2 billion in 2025 with current annual growth rate of 1%.

The Asia, Middle East, Africa and Latin America are the places, where most of this growth will occur due to rapidly growing industries and urbanization.

The energy demand will increase significantly in developing countries, especially in Asia with an increase of 46-58% at annual rate of 3.7% till 2025.

Fossil fuels are the most relied source at the moment to meet the world's energy demands.

The intensive and solely utilization of fossil resources are not only depleting our natural reserves but also causing global climate change.

Waste Generation and its Management

The generation rate of municipal solid waste (MSW) will increase from 1.2 to 1.5 kg per capita per day in next 15 years.

Globally, around 2.4 billion tons of MSW is generated every year that will reach up to 2.6 billion tons by 2025.

In cities of developing world, MSW is the city's single largest budgetary item.

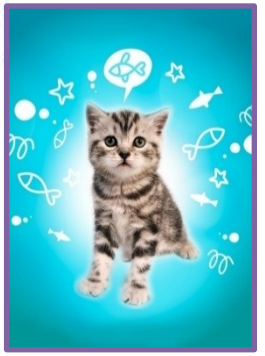
The sustainable disposal of MSW is still at infancy level in most of the developing countries.

The current waste management in developing world include waste collection and disposal of the collected waste to dumpsite or landfill sites without any treatment.

The actual collection of waste from the cities is only 60% of generated waste, while the remaining waste lies in the empty plots, street sides, along road, railway lines, drains, and low areas.

The infrastructure and maintenance facilities for MSW vary according to the economy of the area.

What to do with so much waste?



The MSW can be a cheap and valuable source of renewable energy, recycled materials, value-added products (VAP) and revenue, if properly and wisely managed

Concept of Waste-to-Energy (WTE)

- The concept of waste to energy is known as one of the several energy recovery technologies capable of benefiting a society that wants to cut its fossil fuel addiction.
- The possibilities for converting waste-to-energy (WTE) are plentiful and can include a wide range of waste sources, conversion technologies, and infrastructure and end-use applications.
- Several WTE technologies such as pyrolysis, anaerobic digestion (AD), incineration, transesterification, gasification, refused derived fuel (RDF) and plasma arc gasification.
- The integrating of waste with the generation of energy will provide a solution to the developing world's challenge of waste disposal with energy supply.

Forestry waste	Agricultural waste	Animal waste	Industrial waste	Municipal waste
▪ Bark ▪ Sawdust ▪ Pulping liquors ▪ Fibers ▪ Dead trees ▪ Culling and logging waste ▪ Leaves ▪ Straws	▪ Crop waste ▪ Citrus waste ▪ Green waste ▪ What and rice straw waste ▪ Wood chips ▪ Sawdust	▪ Fats ▪ Tallow ▪ Blood ▪ Meat processing waste ▪ Manure ▪ Swine waste	▪ Olive pulp ▪ Wastewater from pulp and paper industry ▪ Wastewater from sugar or toffee industry	▪ Food waste ▪ Used cooking oil ▪ Sewage ▪ Plastics ▪ Paper and card boards ▪ Textile ▪ Leather ▪ Construction and demolition waste

Single Waste Factory

Why Integration of WTE Technologies?

Can any of the Waste to Energy technology achieve the zero waste concept?

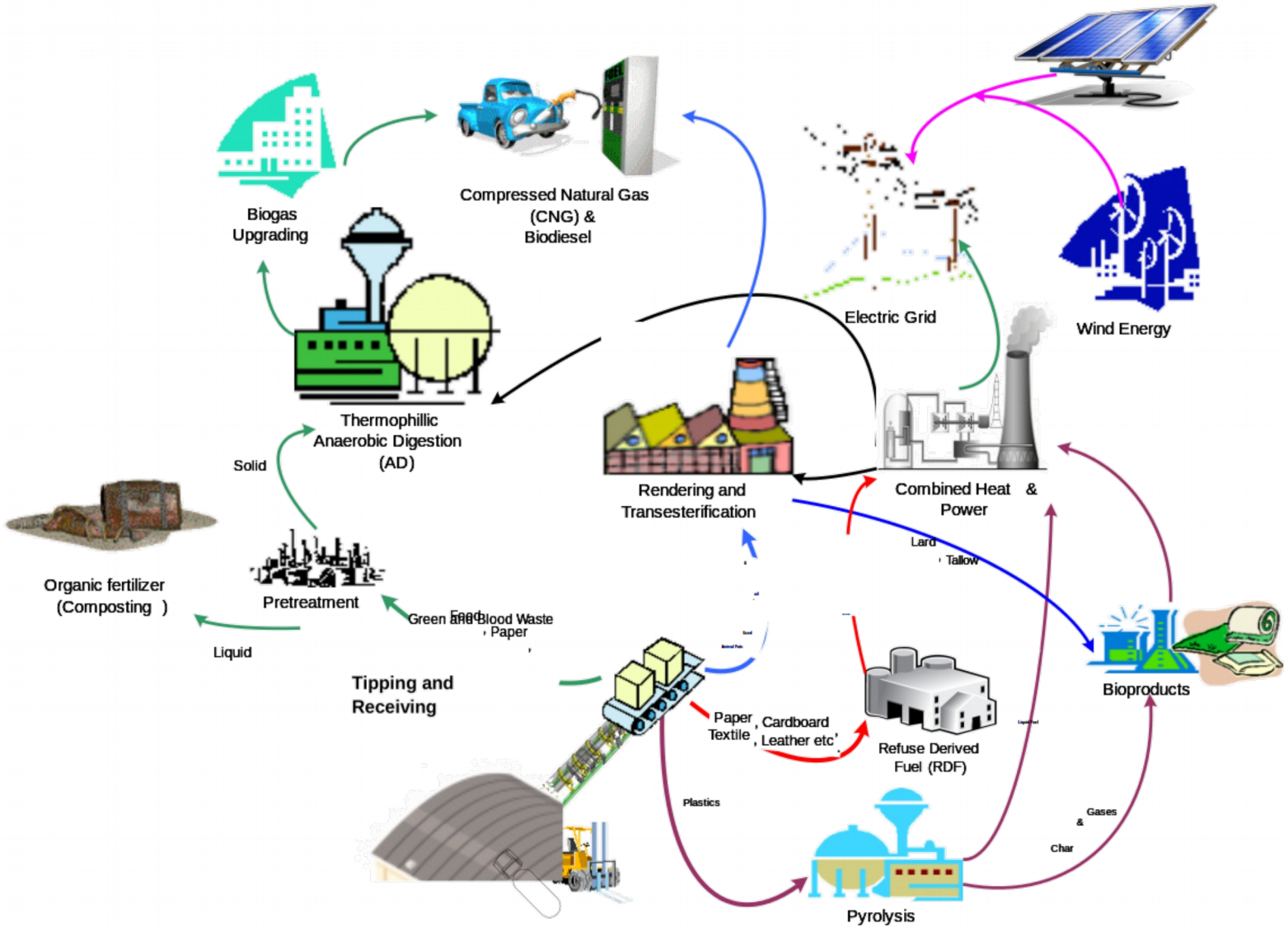
Is any of these technologies capable enough to compete other renewable-energy sources such as wind, solar, etc.?

Is any of the conversion technology can replace the fossil fuel substantially and immediately?

Intergradation of energy recovery technologies under a waste-driven factory.

A biorefinery is a cluster of technologies producing chemicals, fuels, power, products, and materials from

Integrated WTE technologies under Waste-driven Factory



Case Study of Saudi Arabia

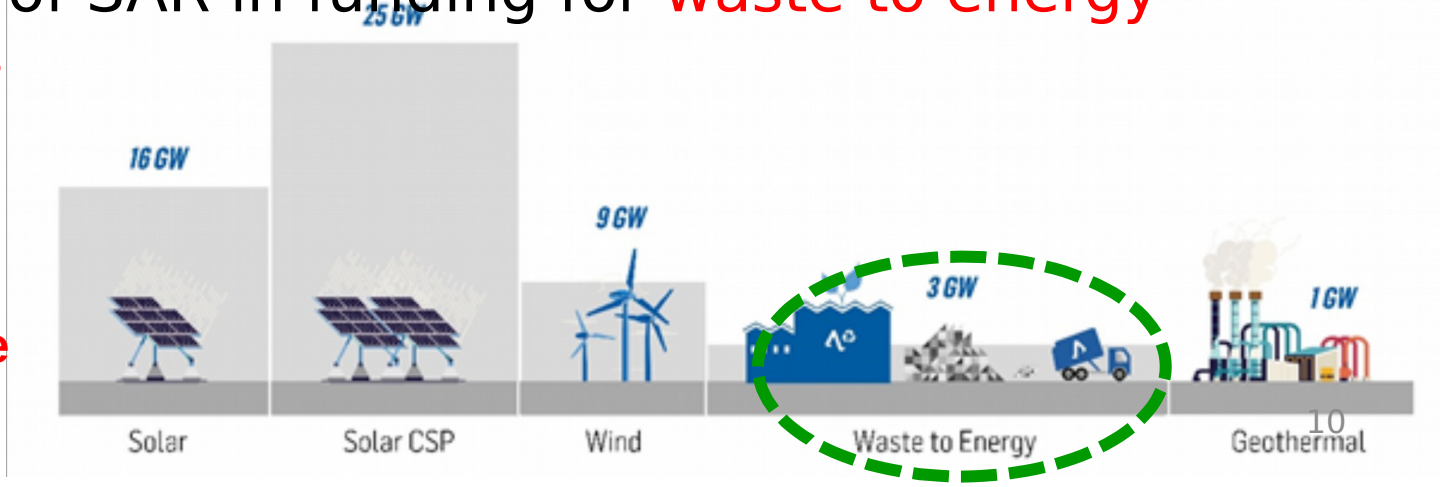
exits in KSA.

- Most of the collected municipal waste is disposed to landfill or dump sites untreated.
- The recycling of metals and cardboards is the only waste recycling practices, which is around 10-15% of the total MSW.
- The problems of GHG emissions, and groundwater and soil contamination along with public health issues are occurring in the waste-disposal vicinities
- Every year, around 15 million tons of MSW is generated in KSA with an average rate of 1.4 kg per capita per day.
- The food and the plastic waste are the two largest waste streams that collectively add up to 70% of total MSW.
- My Solid Waste Research Unit has examined the appropriate WTE technologies for Saudi Arabia

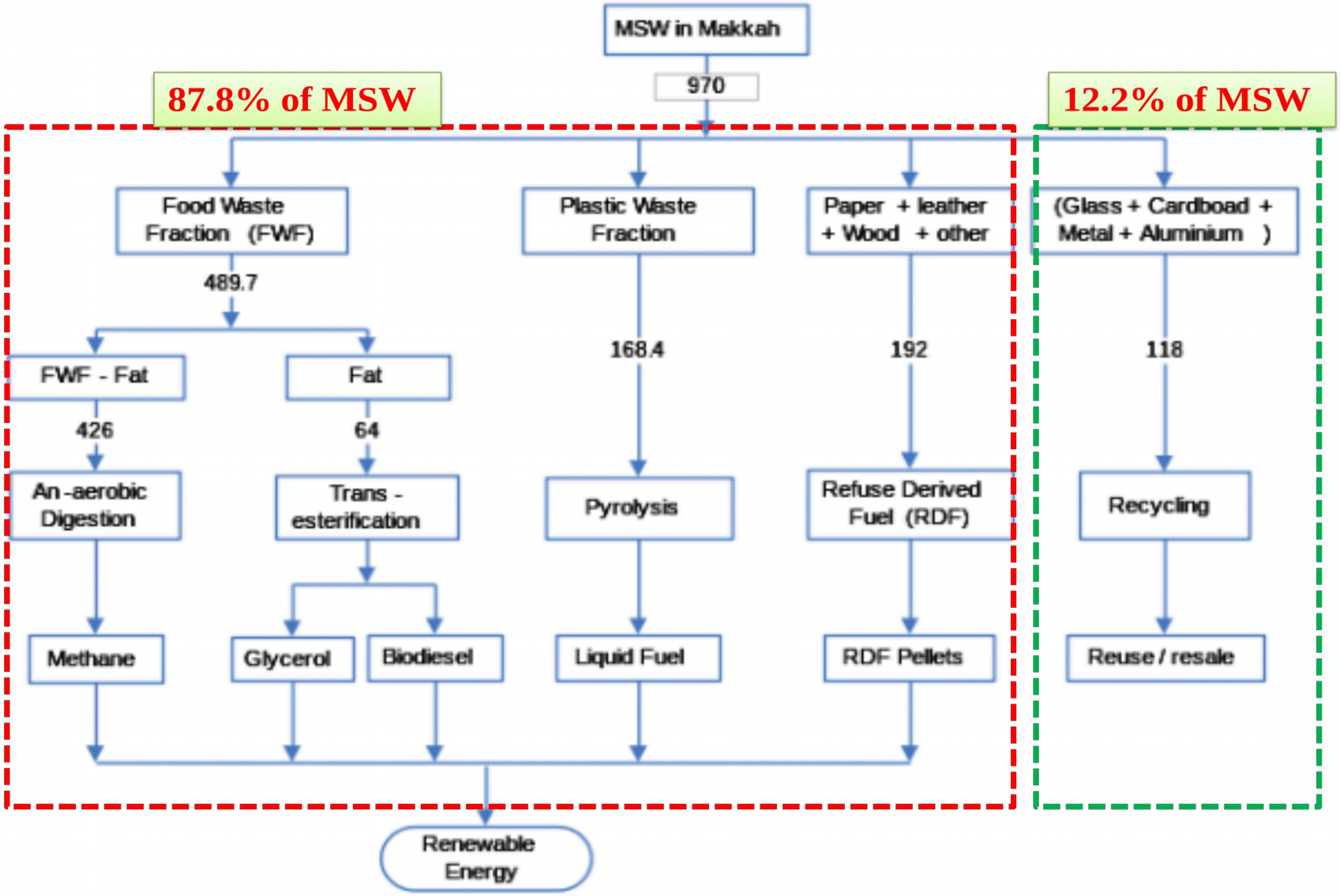
VISION 2030 – Saudi Arabia

- Improving efficiency of waste management
- Recycling projects
- Reducing all types of pollution
- Utilizing treated and renewable water
- Localizing renewable energy
- we still lack a competitive renewable energy sector at present
- Initial target of generating 9.5 gigawatts (GW) of renewable energy
- Millions of SAR in funding for waste to energy projects

KACARE Target
72 GW renewable
(2032)



Waste-based Factory in Makkah



Economic and Environmental Benefits of Waste Recycling in Makkah

There are significant economic and environmental benefits for the Makkah city by recycling only 12.21% of Makkah's municipal solid waste including the recyclable materials such as

Cardboard (6.6%)	Glass (2.9%)	Metals (1.9%)	Aluminium (0.81%)

It is theoretically estimated that up to 140.1 thousand Mt.CO2 eq. global warming potential (GWP) will be achieved with savings of 5.6 thousand tons emission of CH4.

A net revenue of 113 million SAR will be added to the national economy every year only from recycling practices in Makkah city.

AS Nizami et al. 2017. Developing waste biorefinery in Makkah: a way forward to convert urban waste into renewable energy. Applied Energy. 186 (2): 189–196

Economic and Environmental Benefits

A total net revenue of 758 million SAR can be generated from;

landfill diversion (530.4 million SAR)

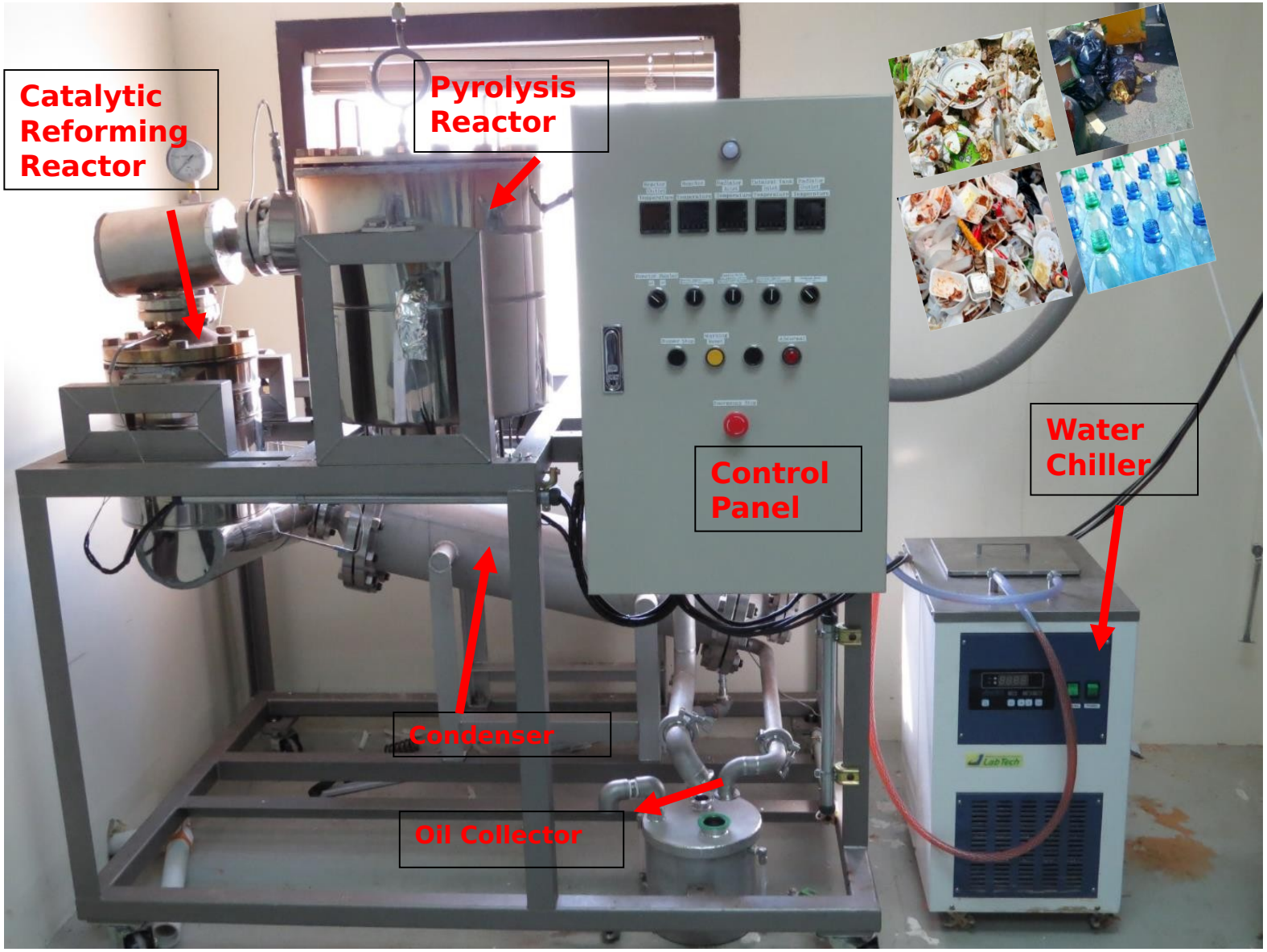
electricity generation (181.6 million SAR)

recycling (45.5 million SAR).

1.95 million barrels of oil and 11.2 million mcf of natural gas can be saved with a cost savings of 485.5 million SAR.

AS Nizami et al. 2017. Developing waste biorefinery in Makkah: a way forward to convert urban waste into renewable energy. Applied Energy. 186 (2): 189–196

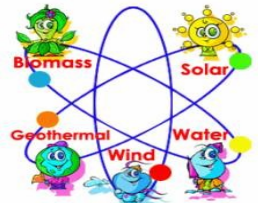
Two-Stage Batch Pyrolyzer System



Benefits of Waste-Based Factory

IMPROVING PUBLIC HEALTH

RESEARCH AND DEVELOPMENT



Renewable Energy and Valuable Products

SOLVING WASTE PROBLEMS

NEW BUSINESSES AND JOB CREATION

MINIMIZING ENVIRONMENTAL POLLUTION

Conclusions and Recommendations

Increasing energy consumption has exerted great pressure on natural resources and results in significant GHG emissions in

towards sustainable energy production, mainly from the non-food biomass, including forestry and agricultural residues and industrial and municipal organic

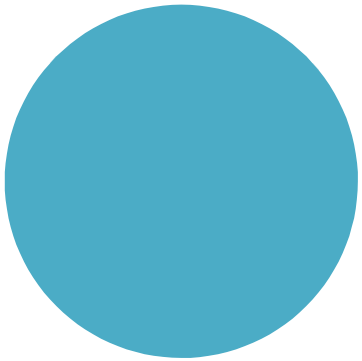
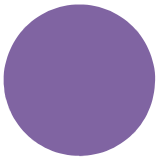
The commercialization of WTE technologies are expected in near future due to continuous improvement in process technologies with reduced process costs, governmental subsidizes and generation of multiple energy and valuable products

The Life Cycle Assessment (LCA) based studies on the integrated waste-based biorefinery will provide a knowledge base platform for academics and industries about technical, economic and environmental benefits and limitations of the conversion technologies.

Recycling is considered to be a key component of modern waste-reduction practices to reduce the GHG emissions and environmental impact of waste.

A case study of KSA showed potential economic and environmental benefits of developing integrated waste-based biorefinery in the country.

Collaboration Established with National and International Institutions

Thank You So Much