NEW TECH FOR OLD INDUSTRIES:

LEVERAGING RENEWABLE ENERGY IN SURPRISING PLACES

PRESCOUTER

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New Tech for Old Industries:

Leveraging Renewable Energy in Surprising Places

2018

CONTENTS

INTRODUCTION

In 2017, 70% of net new global power generating capacity came from renewable energy. Renewable energy now comprises over 10% of global total final energy consumption. Based on most projections, renewables will continue their swift increase over the next decade as an important source of energy, replacing fossil fuels, nuclear and other traditional sources of energy.

And yet, renewables are also increasingly being used to support more traditional natural resources industries. In this white paper, we explore combinations of renewable energy and other natural resources technologies, in sometimes surprising partnerships.

First, we examine how **renewables can help remote mines, oilfields and natural gas wells** operate more reliably and less expensively.

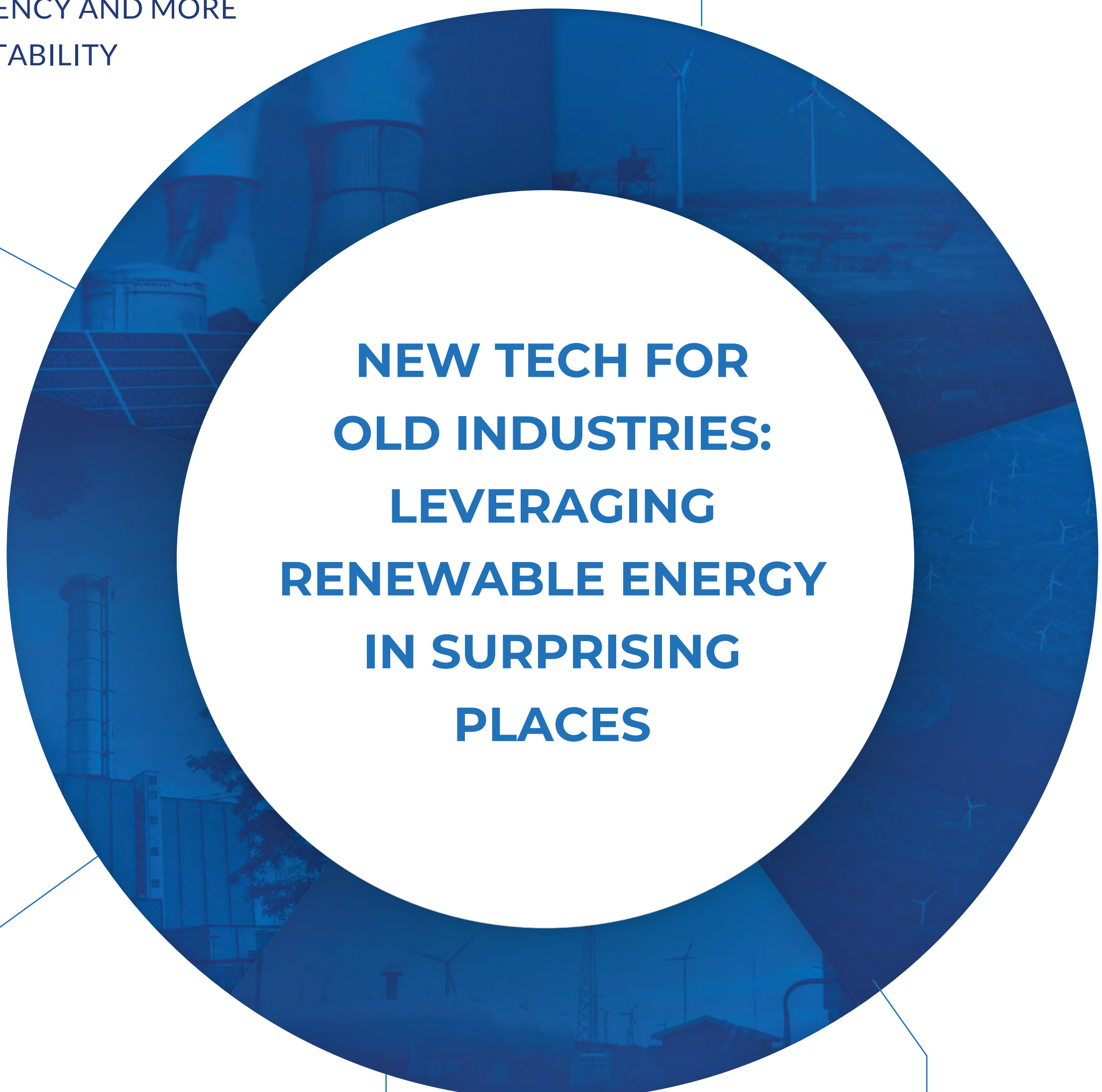
Next, we explore **combinations of nuclear reactors and renewables** as a strategy to improve the efficiency and reliability of both.

Third, we look at improvements to **waste-to-energy technologies** that come closer to a truly renewable and sustainable process for managing our waste.

Following that, our researchers discuss how the **water management industry** increasingly looks to renewables to reduce their reliance on fossil fuels.

Finally, our report dives into unique combinations of renewables, asking if **wind power can help fuel a hydrogen economy**.

NEW TECH FOR OLD INDUSTRIES: LEVERAGING RENEWABLE ENERGY IN SURPRISING PLACES



MINING AND DRILLING: PROVIDING ON-SITE POWER IN REMOTE AREAS WITH WIND AND SOLAR ENERGY

COUPLING NUCLEAR POWER WITH RENEWABLE ENERGY: GREATER EFFICIENCY AND MORE PROFITABILITY

WASTE-TO-ENERGY: A SUSTAINABLE ALTERNATIVE TO CONVENTIONAL ENERGY PRODUCTION

RENEWABLES AND THE WATER INDUSTRY: BATTLING CLIMATE CHANGE WITH LESS RELIABILITY ON FOSSIL FUELS

FROM WIND TO HYDROGEN: USING WIND ENERGY AS A SUSTAINABLE ENERGY SOURCE

MINING AND DRILLING: PROVIDING ON-SITE POWER IN REMOTE AREAS WITH WIND AND SOLAR ENERGY

Kyle Gracey

Many people see renewable energy and fossil fuels as mortal enemies. One will succeed only at the expense of the other, the thinking goes. When it comes to on-site power, however, the situation reveals a more complex relationship.

Mining and drilling operations often sit in remote areas, far from established electricity infrastructure. Yet, they often have significant power needs—on the order of tens of megawatts (MW) and tens of gigawatt-hours (GWh) per site. Renewable energy technologies can help power their mining and drilling operations.

Traditionally, diesel generators provided this power. However, they are expensive to fuel ($0.28-$0.32/kilowatt-hour, by one estimate).

> *Energy costs can represent 20-40% of mining operational costs.*

Further, regularly trucking in large quantities of fuel represents a risk if that supply is disrupted by bad weather, poor infrastructure, or other barriers.

Cost of electricity in 2014:

DIESEL GENERATOR:	$0.3 /KWH
SOLAR:	$0.17 /KWH
WIND:	$0.14 /KWH

New options offered by wind and solar:

Companies are slowly but steadily installing renewable energy at or near their sites to power at least some of their operations. By one estimate, the mining industry alone spent $209 million in 2013 on renewable energy investments. This makes sense, since the recent cost of on-site wind and solar power can be half that of diesel generators. Examples of recent projects include:

- Rio Tinto supported a 9MW wind farm in the Arctic near its mine
- The DeGrussa Sandfire mine in Australia added a 10.6MW solar power plant

Hybrid microgrids balance fossil and renewable power benefits:

Hybrid microgrids mark another common strategy for providing on-site power. They involve a combination of power sources, usually diesel or natural gas generators combined with some renewable resources. Although many mining and drilling operations are active 24 hours a day, renewables provide power only during the day (solar) or afternoon and evening (wind). However, the fossil fuels can provide power at night. Thus, the power sources are integrated into a single electricity grid to provide continuous power throughout the day. Recent projects include:

- B2Gold added 7MW of solar panels to its Namibia mine to complement existing heavy fuel oil generators.
- The Hilal B oil platform offshore of Egypt was an early adopter of the microgrid strategy, employing a 36kW solar array mixed with generators and other power sources.

Advanced storage extends the capabilities of hybrid microgrids:

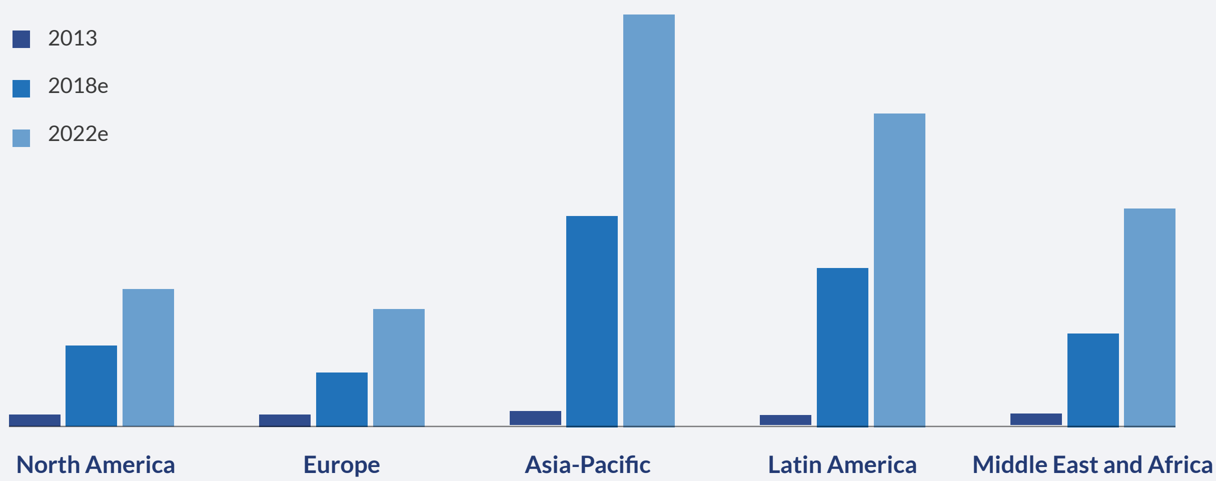
Further still, the most complex power projects take the hybrid microgrid approach and add next generation battery storage. Fortunately, battery technology has advanced rapidly in recent years to keep up with the need to store increasingly large amounts of renewable energy. A variety of new battery technologies can now store larger amounts of power with lower cost and physical footprint. Therefore, adding these to a hybrid microgrid allows the miner or driller to capture excess renewable power. The excess power can be used at night. The fossil fuel source remains part of the grid to provide power when the batteries are depleted. Recent projects include:

- Rio Tinto added an additional 5MW of solar panels, and advanced battery storage, to an existing solar/diesel microgrid to further decrease diesel use at a bauxite mine.
- Caterpillar began marketing hybrid microgrids that incorporate solar, diesel and natural gas generators, and advanced storage options. Target customers include remote mines and drill sites.

Renewable adoption will accelerate in coming years:

Despite these advances, renewable energy currently provides only a small fraction of power at mines and wells. This will likely change, and quickly, as prices for renewables and advanced storage continue their steep declines. By one estimate, investment in renewables just for mining will reach nearly $4 billion by 2022. That represents more than a tenfold increase from a decade before. Relatedly, the Sunshine for Mines analysis thinks mining companies alone can reach 8GW of renewable power by 2025.

RENEWABLE ENERGY INVESTMENT IN THE MINING INDUSTRY (BASE CASE, US$M), WORLD MARKETS: 2013-22



Source: "Renewable Energy for the Mining Industry Revenue by Technology, Aggressive Investment Scenario, World Markets: 2013-2022", Renewable Energy in the Mining Industry, Navigant Consulting, Inc., 2013.

Can renewable energy technologies support mining and drilling? A growing number of companies are answering "Yes". As new advances in on-site power develop, PreScouter will keep you up-to-date on the evolving relationship between these seemingly bitter rivals.

KYLE GRACEY

Kyle is one of PreScouter's Project Architects. He specializes in natural resources. Kyle, an alumni of the Scholar Network, has over 2 years and 60 projects of experience with PreScouter. His research and work experience spans sustainability science, engineering, and economics. He is based in Pittsburgh, Pennsylvania.

COUPLING NUCLEAR POWER WITH RENEWABLE ENERGY: GREATER EFFICIENCY AND MORE PROFITABILITY

Navneeta Kaul

Compared to fossil fuel-based energy systems, nuclear, solar and wind provide much cleaner sources of energy. However, they all come with their own weakness. Both solar and wind energy need stable weather conditions for power generation. Conversely, nuclear power cannot be ramped up or down quickly to meet energy demands. It also generates radioactive waste. However, by coupling nuclear power with renewable energy, we can utilize the best from all three sources.

Components of a hybrid nuclear-renewable energy system:

These proposed systems typically have a number of components in common:

- Nuclear reactors
- Steam generator
- Renewable energy generator
- Storage
- Industrial generators

(See infographic on page 9)

Hybrid solar-nuclear power plants:

Several designs have been proposed for the synthesis of nuclear and solar power plants. The nuclear reactors will generate steam at 3000C, while the solar thermal panels super heat salts to a molten state. These molten salts have excellent heat retention. The combination of continual

HYBRID SOLAR-NUCLEAR POWER PLANTS:

Far more efficient
in power generation compared to nuclear or solar power plants alone

Greater profitability
due to the substantial increase in the solar heat to electricity conversion

COMPONENTS OF A HYBRID NUCLEAR-RENEWABLE ENERGY SYSTEM

01

NUCLEAR REACTORS

Preferably small, modular reactors (<300MWe). Larger, high temperature reactor systems may be more suitable for hybrid systems. Studies at Idaho National Labs are testing the feasibility of light water reactor systems.

02

STEAM GENERATOR

To produce electricity from the nuclear reactor

03

RENEWABLE ENERGY GENERATOR

Typically wind turbines, solar panels, or occasionally both. Other forms of renewable energy can also be used.

04

STORAGE

Often in the form of molten salts or firebricks, or other methods for capturing excess energy until it is released to the grid.

05

INDUSTRIAL GENERATORS

Optional components that produce high-value products from the renewable or nuclear process. Products can include gasoline, hydrogen or water.

nuclear power with solar energy stored in the salts allows the reactor to generate super-heated steam to run electricity even at night.

Studies predict solar-nuclear hybrid power plants to be far more efficient in power generation compared to nuclear or solar power plants alone. Along with a substantial increase in the solar heat to electricity conversion, the plants appear to have greater profitability.

Hybrid wind-nuclear power plants:

Physics-based modeling recently assessed the technical ease of combining nuclear power with a wind farm operating in Wyoming. The studies confirm the ability to resolve the variability of power generation by wind turbines. Additional studies are needed to assess the best nuclear reactor designs to use with wind turbines.

Hybrid geothermal and nuclear power plants:

Models have been proposed to pair a nuclear reactor with geothermal energy.

The basic design of power generation includes:

- Geothermal system with an injection shaft to inject fluid into hot dry rock (HDR) zone (e.g., a 3000 to 4000 m deep shaft), and an extraction shaft. Extraction shafts allow extraction of fluid as high-pressure steam to generate power.
- Nuclear reactor is positioned within the HDR region to supplement heat into the zone.

Not only is this strategy innovative, it is safe and efficient for a variety of reasons. Due to the underground nature of the nuclear reactor, the nuclear bore housing is sealed, which provides for built-in radioactive waste disposal. Further, the nuclear heating compensates for the thermal depletion typically seen in a traditional geothermal system, leading to an extended lifespan and increased profitability.

Converting nuclear waste to electricity:

While not a hybrid system per se, another new technology turns nuclear waste itself into a long-lasting energy source. This exciting technology has been developed by a team of scientists at the University of Bristol. It converts massive amounts of nuclear waste into an electricity source. The technology involves encapsulating radioactive waste within artificial diamonds. The "battery" will supply an electrical current when placed in a circuit.

As a prototype, scientists have used nickel-63 as the radiation source to form this "diamond battery". This technology holds great promise, since graphite rods within nuclear reactors generate a lot of carbon-14 nuclear waste on their surfaces. Like nickel-63, carbon-14 emits short-range radiation, which can be quickly absorbed by any solid material. Encapsulation of carbon-14 in diamond, the hardest naturally occurring material on Earth, ensures safe containment of the radiation.

Further, the lifetime of these diamond batteries far exceeds conventional batteries. Carbon-14 batteries will take about 5730 years to lose half of their power. Eventually, these batteries could replace traditional chemistries, particularly in situations where a very long-life battery is desired, such as pacemakers, satellites, high-altitude drones or even spacecraft. For now, though, the batteries are only a prototype.

Going forward:

Hybrid nuclear-renewable energy may play a key role in reducing greenhouse gas pollution, along with increasing the efficiency and reliability of the energy supply. While more prototyping needs to occur for these systems to prove their performance, they, like diamond batteries, hint at the future of our power supply.

NAVNEETA KAUL

Navneeta Kaul is a Ph.D. candidate studying Cell Biology at the University of Denver in Colorado. She was born in the beautiful Himalayan mountains of Kashmir, India, and completed her schooling in New Delhi. After earning an engineering degree in Biotechnology, her passion for cutting-edge biological research motivated her to pursue her Master's at the University of Arizona in Tucson. At the University of Denver, she is studying the biological mechanism behind Fragile X syndrome, which is an autism spectrum disorder affecting nearly 1.3 million adults in the United States. In her free time, Navneeta is an avid singer and practices yoga when not tending to her rose plants.

WASTE-TO-ENERGY: A SUSTAINABLE ALTERNATIVE TO CONVENTIONAL ENERGY PRODUCTION

Anu Antony

Landfills emit by-products like methane, dioxins and leachate (a toxic liquid that is formed when waste breaks down in the landfill and filters through waste), which, when left untreated, can leach into the soil, contaminating water sources, plants and even food.

Waste-to-Energy (WtE) technologies that process non-renewable waste can reduce environmental and health damages, all the while generating sustainable energy.

Types of waste:

At present, waste is classified as the one of the following:

- Municipal solid waste (MSW)
- Process waste
- Medical waste
- Agricultural Waste

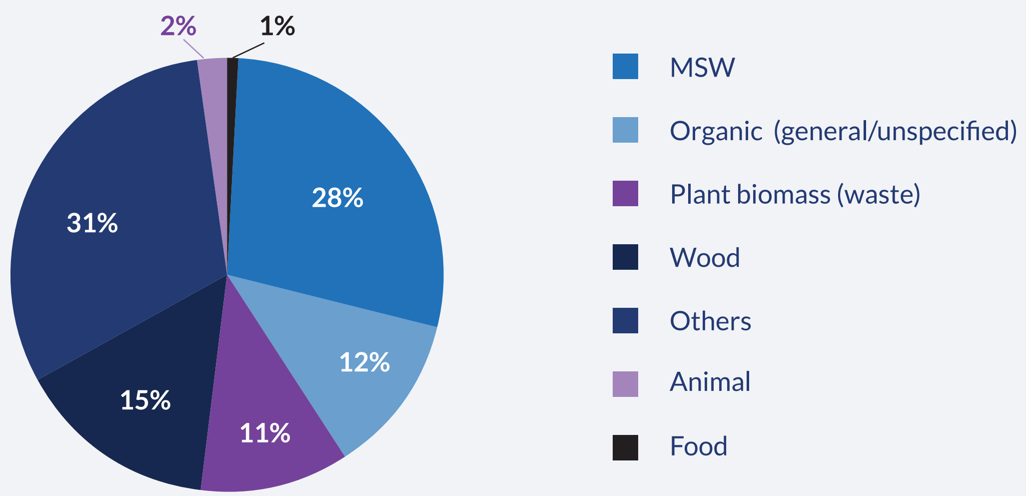


***Figure 1:** Utility scale plants with different feeds*

The World Energy Council (2016) reports that according to the current rate of waste generation, global waste is estimated to reach 6 million tonnes/day by 2025.

So, increasing utility scale WtE plants using MSW or agricultural waste would be a constructive way to deal with waste, as evident from figure 1.

Processing methods:

WtE technology is an energy recovery process that converts chemicals from waste residues into practical forms of energy like electricity, heat or steam. As of now, thermal conversion techniques lead the market among WtE technologies.

MSW has really low calorific value and directly incinerating it will not generate adequate thermal energy. So, pre-treating MSW into refuse derived fuel (RDF) is more effective.

There are various methods to process waste and are classified as follows in figure 2:

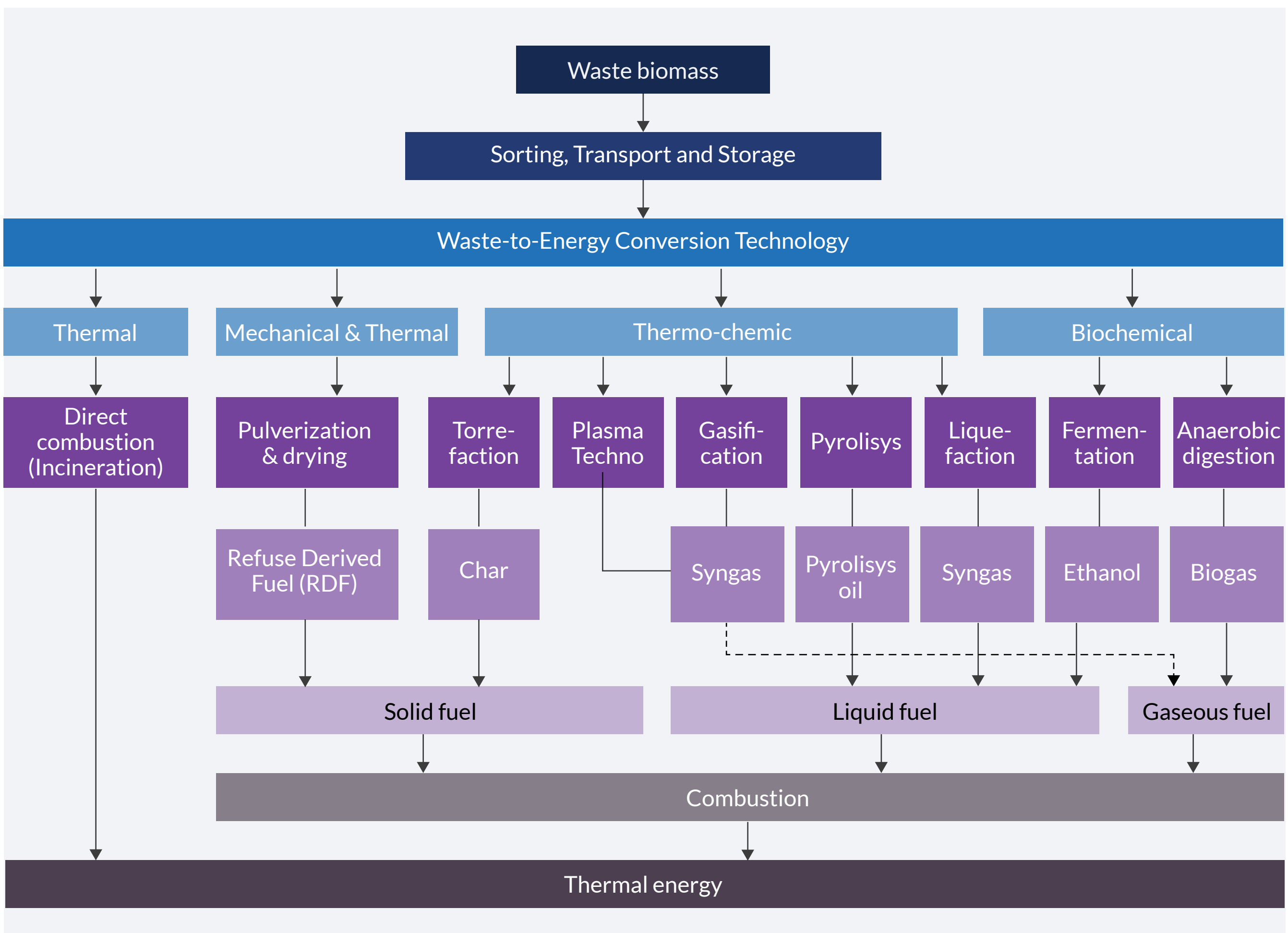


Figure 2: *Waste Processing Methods (Gumisiriza R et al., 2017)*

Incineration is considered when the calorific value of the input feed is at least 7MJ/Kg. When there are no complex collection techniques or when the water content is higher, biochemical methods need to be taken into account. Conversion of thermal energy from incineration can be used to drive a steam turbine for electricity, but only with 15-27% efficiency. Gasification produces syngas that is easily combustible in a gas turbine/engine to generate electricity, which is about 30% efficient.

Anaerobic Digestion (AD) uses more agricultural waste and synthesizes waste that has higher water content through a series of microbial processes to generate biogas. Heat generation can be increased by 90% when syngas/methane is combusted in a cement kiln. Combined heat and power (CHP) WtE plants can have an efficiency of 40% if utilized suitably. Countries that have cold weather always have a high demand for heat and so this can be partially supplied through combined heat and power district heating.

Current utility scale plants around the world:

Figure 3 below indicates that combustion/incineration is still the major type of technology used, while gasification and AD are still in the minority.

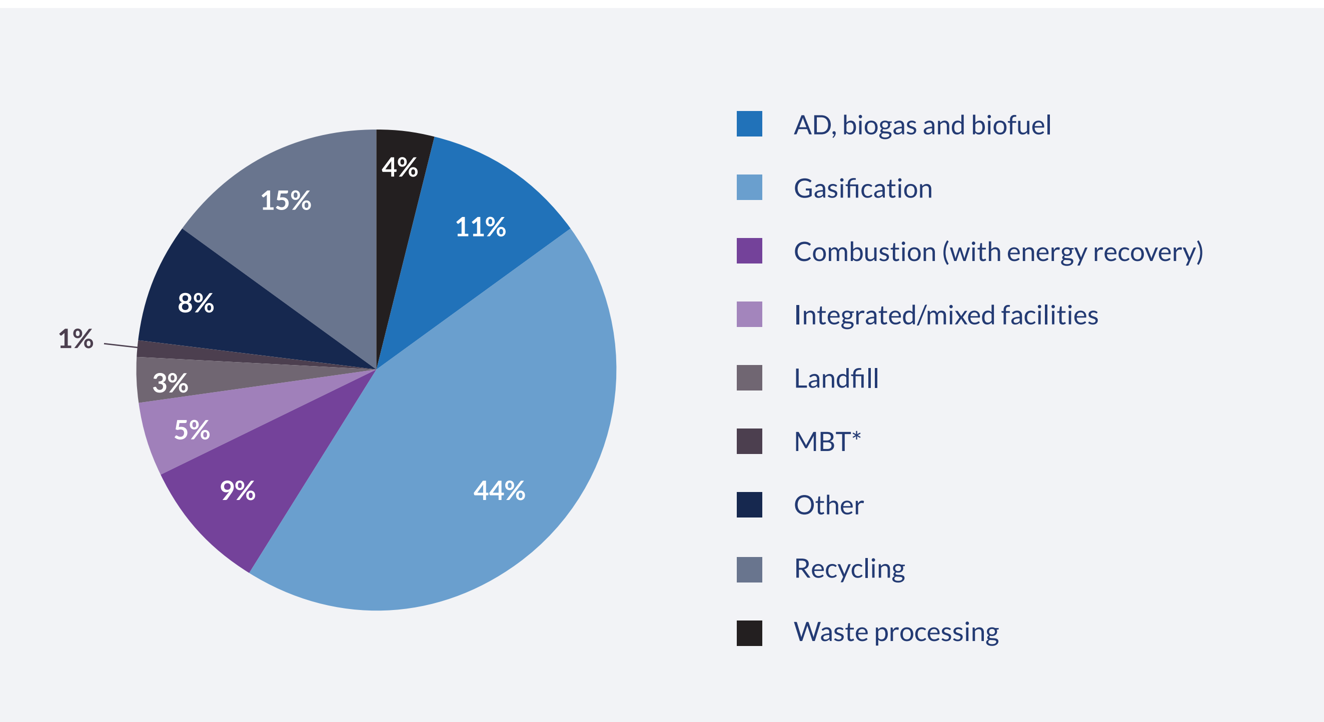


Figure 3: *Utility Scale Plants existing according to the technology used. (Data from 93 countries in 2013-2014 (total of 2723 facilities)). *(Mechanical Biological Treatment-MBT)*

Some of the utility scale plants that are coming up or are already online globally:

China:

China has incineration plants based on circulating fluidized bed (CFB). They have around 28 operational CFB plants of which the recent build was in 2012 handling more than 800 tonnes/day. A new plant is underway to be built in Shenzhen that can handle around 5000 metric tonnes/day, while claiming to become the largest facility for WtE in the world.

Abu Dhabi and Sharjah:

An 8.2 billion USD plant was commissioned in 2012 to be built in Abu Dhabi. As there are already good incineration technologies at hand, Abu Dhabi and Sharjah have taken a new direction to treat waste through a combination of gasification and pyrolysis.

Europe:

There are several operational RDF plants in Italy, Denmark and France. An incinerator was built in 2013 at Naples, Italy that can manage 650,000 tonnes/year. Sweden and Denmark on account of having colder weather, have a number of CHP WtE plants like Aros, Vartan, Herning etc. generating more than 100 kWe of energy. Germany and Sweden, who are the forerunners of WtE, are also known to import deficit waste from neighboring countries!

Turkey:

A micro-scale KI energy plant in Turkey treats biomass, generating around 300 KWth and 50 KWe with fixed bed gasification using pyrolysis.

UK:

A gasification plant Energos (part of ENER-G) in Manchester, UK provides an economic substitute to the large combustion technique of WtE. This facility can treat MSW, industrial and commercial waste with a handling capacity of up to 78,000 tonnes/year.

USA:

Novo Energy is a WtE small scale utility plant that runs versions in four states and uses a combustion technology, processing up to 66,000 tonnes/year. A mobile gasification system based in Massachusetts from IST energy converts around 200 lb of dry waste per hour.

Japan:

Japan has the most modern types of thermal treatment plants that processes around 39 million tonnes/year.

Canada:

The oldest plants use incineration technology and they were improved to use plasma gasification plants from Plasma Energy Group and Nevitus Plasma Inc. Recently built facilities like Nexterra Systems Corp. and Enerkem have used gasification conversion.

Australia:

A plasma gasification plant by Phoenix Energy Australia Pty Ltd. is in the initial stages of commissioning in Kwinana, Australia.

India:

Out of the 14 commissioned plants, only 4 plants (Jindal Ecopoils Management Company PVT ltd, Organic Waste Recycling Systems Pvt, Rochem and Shalivahana (MSW) Green Energy Ltd) are in operation in different states (which uses RDF or dry AD technology). However, dry AD technology seems to be more efficient and 4 more have been commissioned recently using dry AD.

Upcoming technologies:

There a few upcoming new WtE technologies like Hydrothermal Carbonisation (HTC) that fast-tracks the slow process of geothermal conversion of wet waste with an acid catalyst at high pressure and heat to simulate the production of 'hydro-char' that has properties similar to fossil fuels. The main advantages of this to AD is the lower processing time and similar operating conditions needed to generate the same amount of energy.

Dendro Liquid Energy (DLE) is a nearly 'zero-waste' WtE innovation from Germany. It is said to be four times more efficient than AD and costs less.

Conclusion:

Europe is said to be the largest market for WtE technologies (47.6%), while Japan dominates 60% of Asia-Pacific WtE market for incineration. However, China has been growing their capacity since 2011. It is said that biological WtE will grow at an average rate of 9.7% as it becomes more commercially feasible. Despite all the advancements, WtE technologies have a long way to go in terms of being on par with conventional energy sources.

ANU ANTONY

Anu is currently pursuing her PhD research in renewable energy at Newcastle University. She has also completed her Masters in Renewable Energy. Anu is extremely passionate about sustainable energy. She has worked as an Intern/project coordinator at Pollinate Energy(Hyderabad) a social business in India (sponsored by UNSW,UTS insearch, AECOM, Australia) which provides easier renewable energy accessibility for the urban poor in India as well as being involved in Product Development, Business processes, Recruitment,Training and Market Research while successfully completing related projects. She has also volunteered as an auditor for the Green Impact program at Newcastle University.

RENEWABLES AND THE WATER INDUSTRY: BATTLING CLIMATE CHANGE WITH LESS RELIABILITY ON FOSSIL FUELS

Kyle Gracey

The world is thirsty for water. The World Bank expects a major gap between supply and demand by 2030. Meanwhile, pumping water requires significant amounts of electricity. This is expensive. Additionally, most of this electricity comes from fossil fuels. As climate change impacts worsen, the use of fossil fuels faces increasing scrutiny.

Renewable energy can help solve both of these challenges through several different approaches.

Generating power in wastewater treatment:

The first approach takes the waste in wastewater (sewage) and converts it into energy. This energy can then power the wastewater treatment facility, reducing or eliminating its electricity needs. In some cases, the facility generates a surplus of power that can feed into the grid. Several exciting technologies can facilitate this. They range from anaerobic digestion of sewage to produce methane, co-digestion with organic waste, to direct pyrolysis of the wastewater.

While still a relatively untapped source of power. many pilot and full scale operations now exist throughout the world, including in the United States, China, the Middle East and Europe. Research in this area continues. Recently, scientists were able to use specially chosen bacteria that can process a wide range of the chemicals found in wastewater, using it to ultimately generate hydrogen.

Moving water with renewable energy:

Alternatively, water managers, whether irrigators, desalinators or wastewater treaters, increasingly turn to renewable energy for their electricity needs. For example, solar power production peaks in many of the same time periods and places when water is highest. This includes summer irrigation for agriculture and in deserts.

Many emerging economies have begun to embrace the idea, hoping to bypass traditional electricity infrastructure. Water managers appreciate the potential to site renewable energy generation alongside their water infrastructure. Meanwhile, wind turbines have long found use as water pumps. New versions borrow technologies developed for turbines designed to produce electricity to increase their water pumping efficiency. Another recent pilot uses the wind turbine design to collect water from air and pump it to storage tanks.

Pumping water without electricity:

Lastly, while renewable energy can provide some solutions, other strategies reduce or eliminate the need for electricity altogether. PreScouter has reported on several of these.

Spiral pumps move water without the use of electricity or other fuels. They can irrigate crops in areas with limited access to power. The air wheel essentially reverses the principles that power a water wheel. It can generate electricity in certain marine environments.

SPIRAL PUMPS:

- work without fuel or electricity, since the needed energy is supplied by flowing water;
- save up to 70% of overall lifetime costs compared to diesel pumping;
- require no operation costs ;
- are environmentally friendly.

Image source: *Wikipedia Commons*

Thus far, these innovative technologies have played a minor role in water management. However, as renewable energy technologies evolve, and as water demand grows, expect to see more marrying of these two fields.

KYLE GRACEY

Kyle is one of PreScouter's Project Architects. He specializes in natural resources. Kyle, an alumni of the Scholar Network, has over 2 years and 60 projects of experience with PreScouter. His research and work experience spans sustainability science, engineering, and economics. He is based in Pittsburgh, Pennsylvania.

FROM WIND TO HYDROGEN: USING WIND ENERGY AS A SUSTAINABLE HYDROGEN SOURCE

Thuy Ngo

Hydrogen, an energy carrier, exists abundantly in nature. However, it is always married to other elements in the form of water, hydrocarbons and other organic compounds. For use as an industrial gas or energy carrier, people need hydrogen unattached to other elements.

In 1783, Jacques Charles first used hydrogen as "energy" to lift his balloon flight. Since then, hydrogen has been used in various daily applications. Hydrogen is mainly produced from fossil fuels such as methane by the steam reforming method. Although this process has a low cost, it emits a large amount of greenhouse gas pollution.

Hydrogen produced from water by renewable energy:

Fortunately, alternative methods exist to produce hydrogen, such as electrical water electrolysis, photoelectrochemical water electrolysis and biological processes. So far, electrical water electrolysis has the most developed technologies and commercial applications.

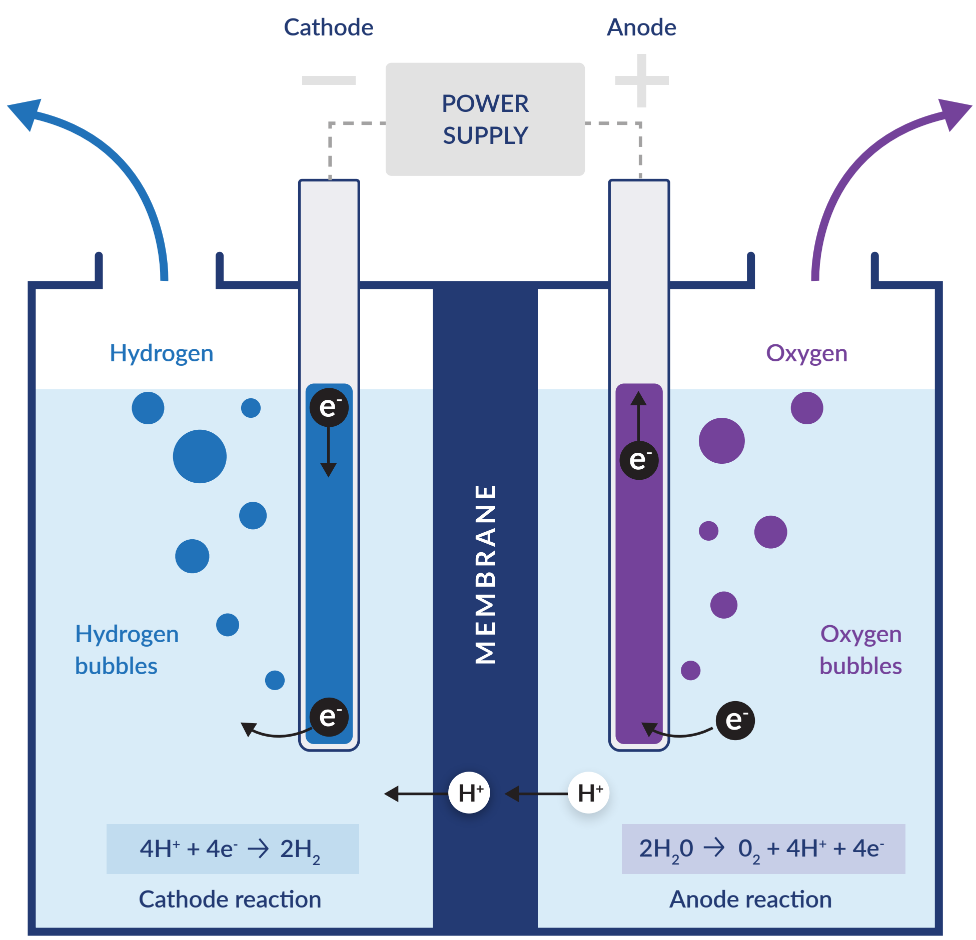
Electrical water electrolysis splits the water into hydrogen and oxygen under the catalysis of an electric current, which can be sourced from wind, photovoltaic, hydroelectric, geothermal and nuclear. Depending on the electrolyte material, four different types of electrolyzers exist:

- **Brine electrolyzer:** hydrogen produced from sodium chloride water solution
- **Alkaline electrolyzer:** hydrogen produced from liquid alkaline solution of sodium or potassium
- **Proton exchange membrane (PEM) electrolyzer and solid oxide (SO) electrolyzer:** both systems generate hydrogen and oxygen from water.

Hydrogen and wind:

Of all the renewable electricity options, wind has the highest potential to produce sustainable hydrogen because of its economic competitiveness. In term of electrolyzers, the PEM system enjoys widest use. A PEM electrolyzer contains a solid polymer electrolyte. At the anode, water will convert to oxygen and positively charged hydrogen ions. The hydrogen ions move across the PEM to the cathode. At the cathode, hydrogen ions combine with electrons, which flow to the external circuit from the anode, to form atomic hydrogen.

PEM electrolyzers were first developed in the 1960s by General Electric to overcome the drawbacks of alkaline electrolyzers, such as low partial load range, limited current density and low operating pressure. PEM electrolyzers thus reduce the operational costs, especially when coupled with a very dynamic energy source like wind. However, recent research suggests a state of the art alkaline water electrolysis may have better efficiency than PEM. The SO electrolyzer also shows promise, but requires further development.



Adapted from the Office of Energy Efficiency & Renewable Energy

Wind-to-hydrogen projects in various countries:

A number of projects already exist around the world, or are being built:

Netherlands:

The Netherlands plans to build a hydrogen-generating wind turbine in the Wieringermeer area at the start of 2019. The project, named "Duwaal", exists as a partnership between HYGRO, a sustainable hydrogen supplier, Largerwey, a wind turbine manufacturer, and the Energy Research Centre of Netherlands (ECN). Different from other projects utilizing hydrogen produced from wind energy, the Duwaal project integrates a wind turbine with an electrolyser to produce "sustainable hydrogen" directly. The produced hydrogen will go to at least five hydrogen refueling stations to serve 100 hydrogen powered trucks.

Japan:

A project designed to test a sustainable hydrogen supply chain from wind operates at Tokyo Bay in Yokohama and Kawasaki. Electricity generated from the Yokohama City Wind Power Plant electrolyzes water to produce hydrogen. The hydrogen powers fuel cell forklifts at four locations, including a factory, a vegetable and fruit market and two warehouses. The project has many partners, including the Kanagawa Prefectural Government and the municipal city governments of Yokohama and Kawasaki, Iwatani Corporation, Toshiba Corporation, Toyota Motor Corporation, Toyota Industries Corporation, Toyota Turbine and Systems, Inc. and Japan Environment Systems Co., Ltd.

USA:

A project called "Wind to Hydrogen" exists as a cooperation between Xcel Energy and the National Renewable Energy Laboratory (NREL). This project aims to improve the sustainability of hydrogen produced from wind so that it can compete with traditional energy sources. At the National Wind Technology Center near Boulder (Colorado), where the project sits, electricity from two wind turbines electrolyzes water to produce hydrogen. Generated hydrogen is compressed and stored for later use, either at a hydrogen fueling station or by converting it back to electricity and integrating it into the power grid.

Other countries also have projects, including Denmark with HyBalance, Scotland with Surf 'n' Turf, Germany with h2herten, and several others.

For now, wind-to-hydrogen remains a niche technology in the ever expanding renewable energy landscape. However, as more projects like the above come online, and if hydrogen infrastructure grows, this approach may join more established sources of renewable energy in powering our future.

THUY NGO

Thuy Ngo is currently a freelancer living in Maastricht, Netherlands. She was born in Vietnam and completed her bachelor degree in Biotechnology at Natural Science University in Ho Chi Minh City, Vietnam. She had since proceeded to pursue graduate degrees followed by a research fellowship in the field of protein biochemistry and structure at Konkuk University, Seoul, Korea. In 2016, thanks to Maastricht University Holland High Potential Scholarship, she came to the Netherlands to earn her Advanced Master in Intellectual Property Law and Knowledge Management at Maastricht University. Thuy is a sci-fi series lover as she is fascinated by innovations. She joined PreScouter to be exposed to the innovations that industry and society need as well as to learn about business. She is interested in working in the field of Technology Transfer or Consulting or the like where she can work on the interface between science, business, and intellectual property law.

"I don't know enough about X, and I don't have the time to research and learn it. Quickly get me up-to-speed on what I (specifically for my role and context) need to know, so I can understand my options."

Spend less time on tedious, tactical activities	Spend more time on high-impact, strategic activities
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Searching databases	Analyzing landscapes that are state of the art
Studying research journals	Road-Mapping internal programs
Mining large amounts of data	Making decisions

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> *"PreScouter made us aware of 23 emerging technologies that we probably would not have become aware of (otherwise)"*
>
> **Dr Richard Demke**
>
> SUNSTAR

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PreScouter quickly gets Corporate Innovators up-to-speed on what they need to know to make informed decisions.

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