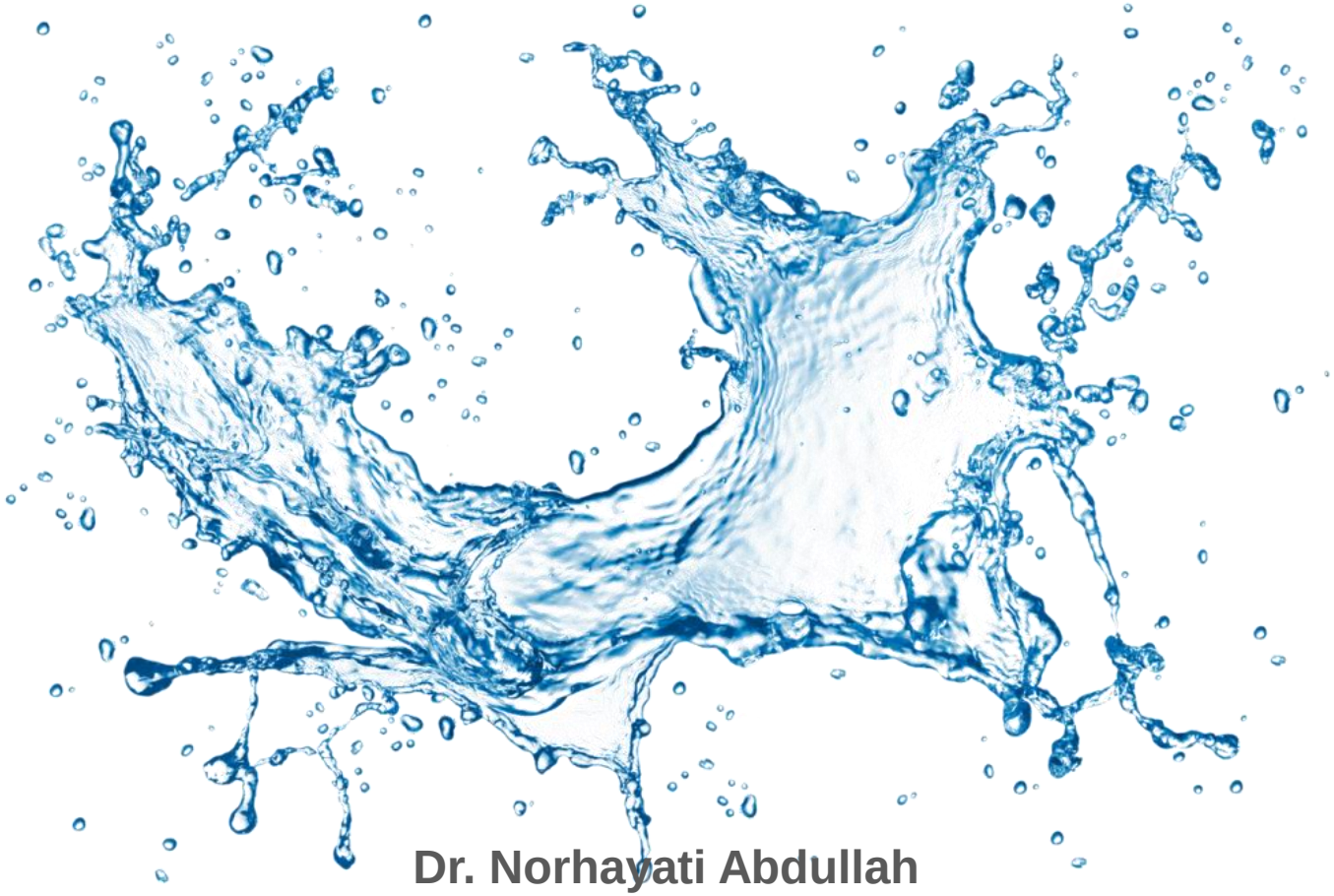
Expanding Business Opportunity In Water Sector



Dr. Norhayati Abdullah

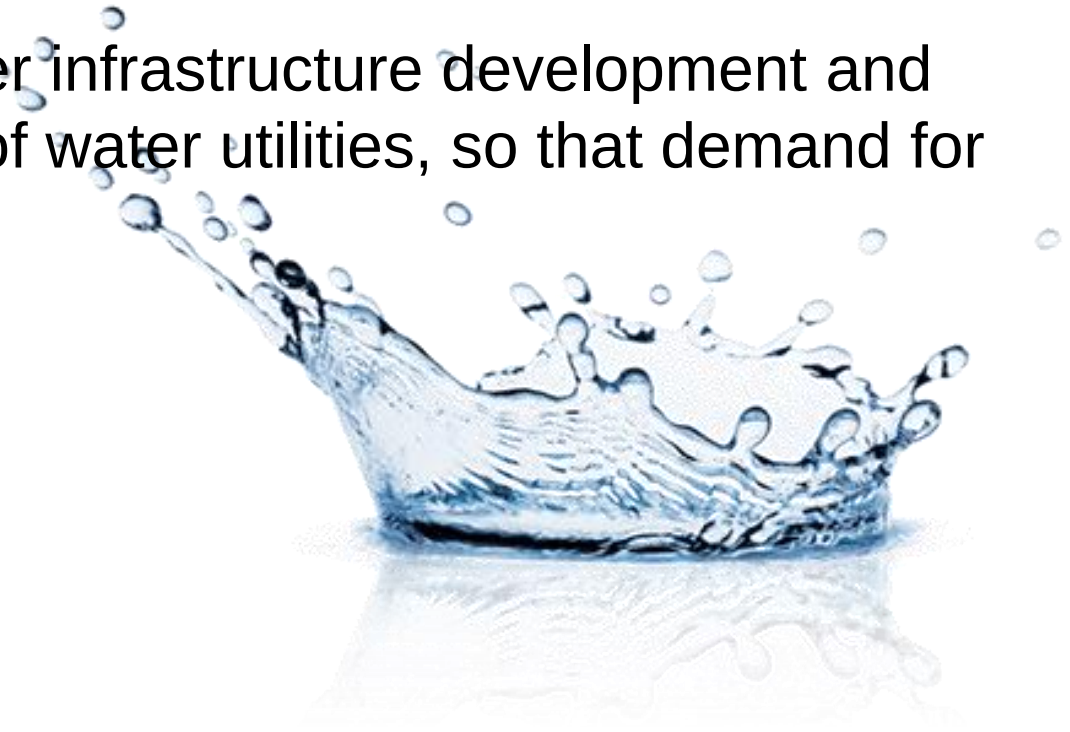
AT A GLANCE

- The world’s water resources are under increasing strain and the situation looks certain to deteriorate.
- Climate change and demographic pressures are set to worsen water shortages, jeopardize food production in many countries, put businesses at risk of drying and drowning assets, and pollute and degrade natural ecosystems.

AT A GLANCE

- Asia Pacific needs at least US$59 billion in investments for water supply and $71 billion for improved sanitation to meet these basic needs, according to the Asian Water Development Outlook 2013 report published by the Asian Development Bank (ADB).

- These investments are needed to fund water infrastructure development and increase the capacity and efficiency levels of water utilities, so that demand for water can be met.



Turning Water Problems Into Business Opportunities

- The world’s worsening water crisis provides opportunities for the private sector to create financial value.
- There is a huge opportunity for companies and investors to invest in projects that generate robust financial returns and improve water resource management.
- Private sector involvement is essential to meet the estimated US$1+ trillion of annual investment needed to secure water for all.

Opportunities with Digital Economy

The digital economy refers to a broad range of economic activities that use digitized information and knowledge as key factors of production.

The digital transformation can spur innovation and productivity growth across many activities, including to meet the future policy for water resilience.

The digital market for water services will provide the water business community, particularly SMEs, with new opportunities to scale up across the water sector.

Water and Circular Economy

Relationship between Circular Economy Principles and Water Systems Management

Circular Economy Principles (Ellen MacArthur Foundation)	Water Systems Management
Principle 1: Design out waste externalities	• Optimise the amount of energy, minerals, and chemicals use in operation of water systems in concert with other systems. • Optimise consumptive use of water within sub-basin in relation adjacent sub-basins (e.g. use in agriculture or • evaporative cooling) • Use measures or solutions which deliver the same outcome without using water
Principle 2: Keep Resources in Use	Optimise resource yields (water use & reuse, energy, minerals, and chemicals) within water systems. • Optimise energy or resource extraction from the water system and maximise their reuse. • Optimise value generated in the interfaces of water system with other systems.
Principle 3: Regenerate Natural Capital	Maximise environmental flows by reducing consumptive and non-consumptive uses of water. • Preserve and enhance the natural capital (e.g. river restoration, pollution prevention, quality of effluent, etc.) • Ensure minimum disruption to natural water systems from human interactions and use.

Source: Water and Circular Economy - Ellen MacArthur Foundation

Water and Circular Economy
Example and opportunities

Wastewater Treatment & Industrial Symbiosis

- Continuous process treatment of sludge to form biogas. Compared to other methods, it offers a significantly smaller carbon footprint.
- CE Opportunity: (1) optimisation for water reuse and energy use, (2) extract other nutrients

Fertilizer and pesticide application

- Process: Application of fertilizers and pesticides for in agriculture
- CE Opportunity: (1) Capture of chemicals and nutrients from runoff or waste biomass;

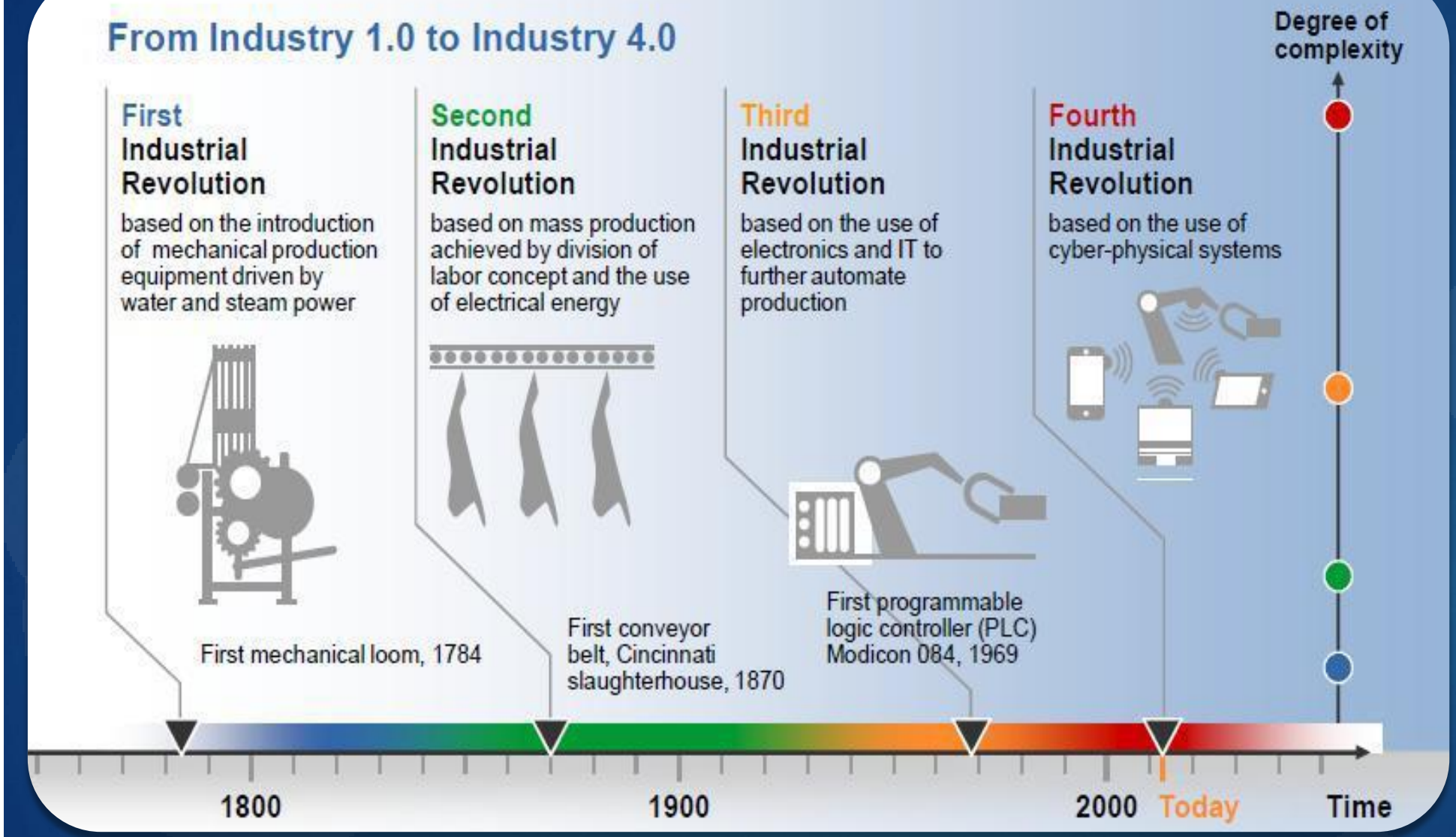
Livestock effluents

- Process: capture and treat livestock farm effluent to ensure water quality
- CE Opportunity: (1) capture nutrients and (2) extraction of bio-matter to generate of energy through anaerobic digestion.

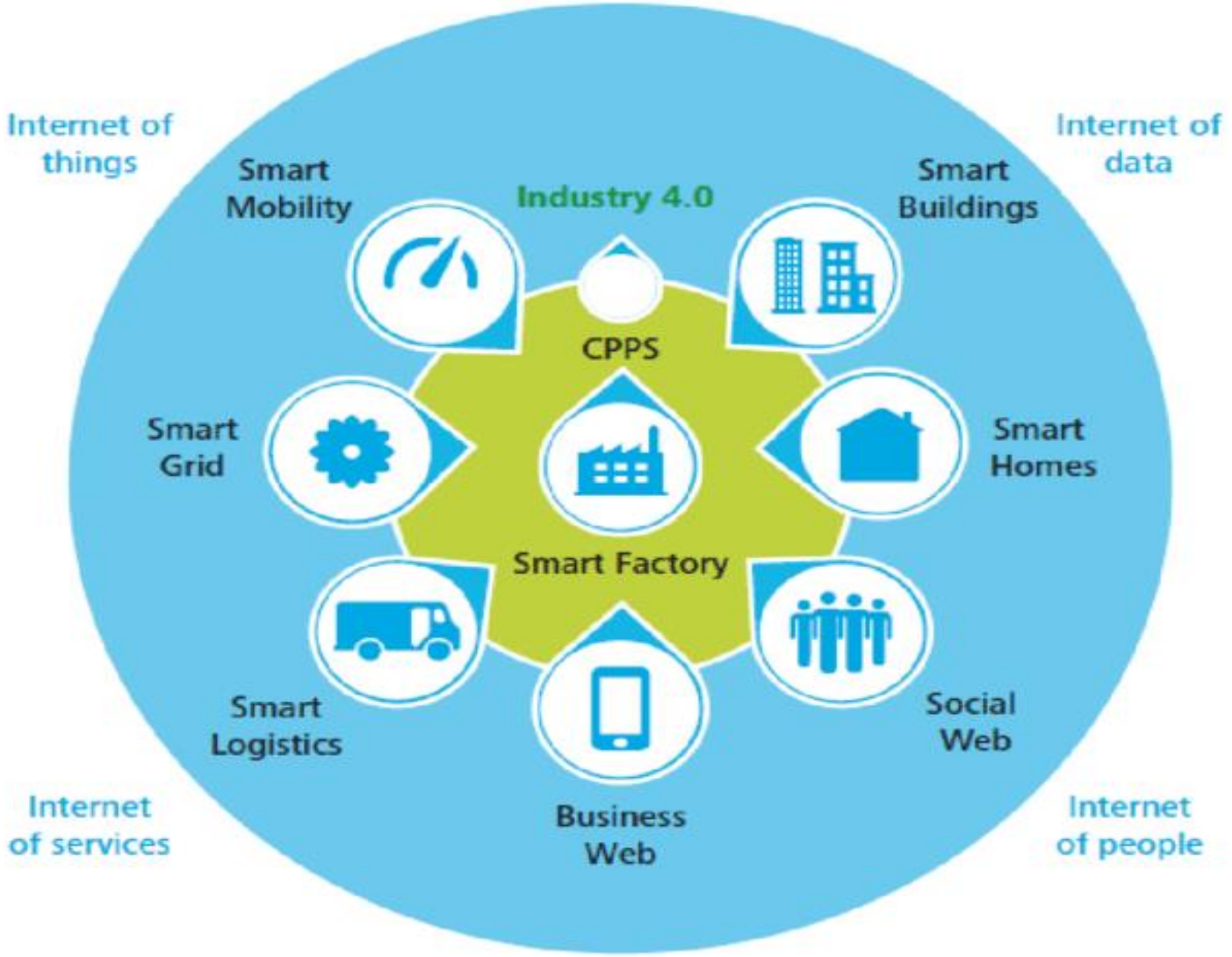
Greywater reuse

- Process: Capture and reuse of slightly used ‘greywater’ for non-potable purposes within the urban fabric.
- CE Opportunity : (1) extracting value from by-products from greywater processing. (2) extraction of thermal energy.

Industrial Revolution

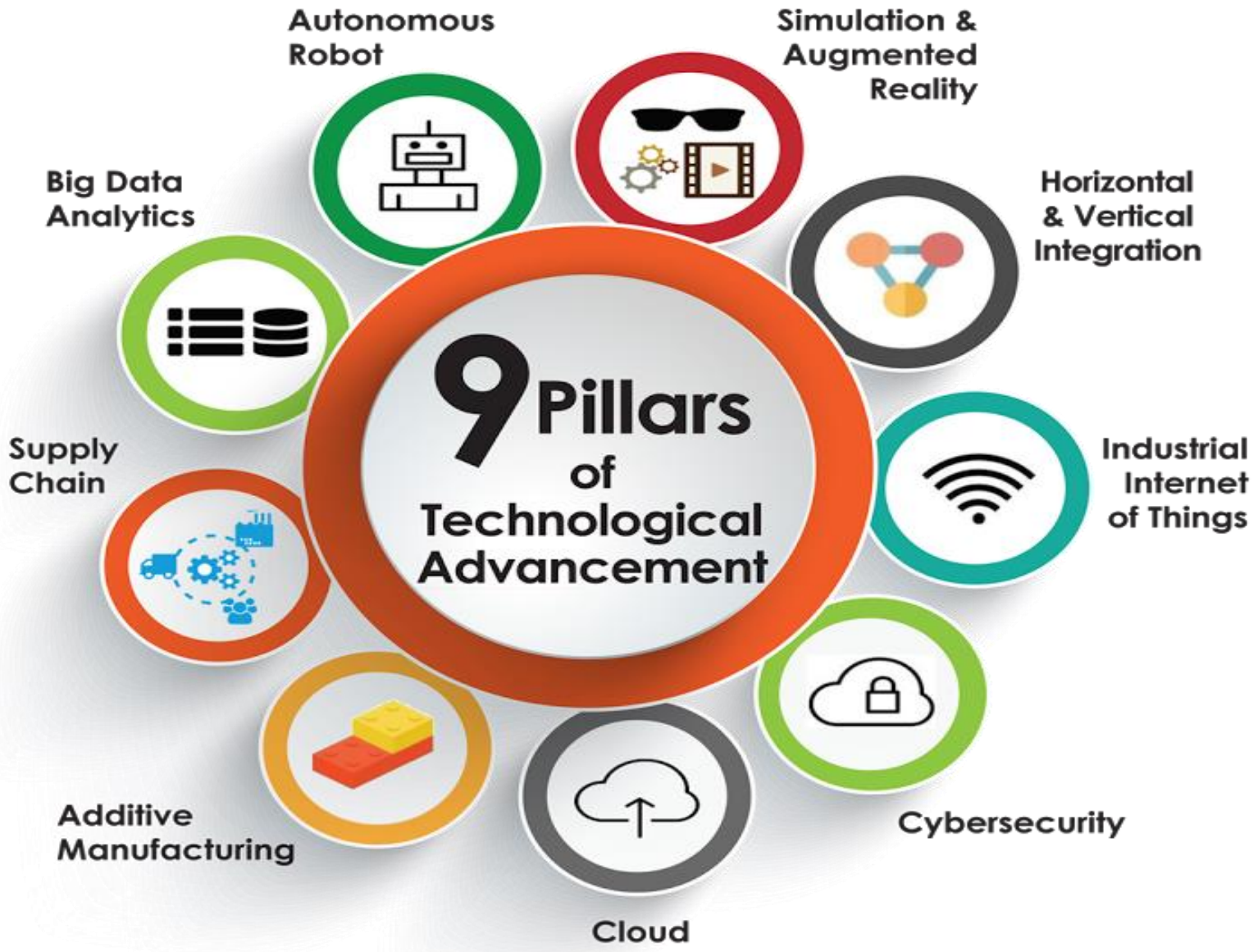


INDUSTRY 4.0 ENVIRONMENT



Cyber-Physical Production Systems - AI

TECHNOLOGY PILLARS OF INDUSTRY 4.0



WATER 4.0

- The fourth industrial revolution has been initiated with the development of the Internet, wireless communications and the application of smart (CPS) Cyber Physical Systems.

  The water supply term implies catching, treating, transporting and distributing water used for drinking, food preparation, hygiene and economic needs, from its wells to the final consumer.

  With accelerated population growth, urbanization and already present effects of climate change, it is increasingly difficult to ensure and maintain sufficient quantities of drinking water.

  WATER 4.0 puts digitisation and robotisation at the focal point of a procedure for asset productive, adaptable and aggressive water the board.

- It consolidates a similar principle highlights and terms of the mechanical upset Industries 4.0
- In the execution of WATER 4.0, Cyber Physical Systems (CPS) are drivers of the ideal systems administration of virtual and genuine water frameworks, with arranging, development and activity being generally done by programming.
- This permits the intelligent networking of water users and components in a sustainable water infrastructure with nature and the water circuit and pursues an all encompassing methodology along the value-added chain.
- Besides, WATER 4.0 permits a high level of transparency for water users, hence covering current needs, and gives chances for sustainable, creative activity areas in water management.

reference: Freitag M, Zelm M. Standardization Connecting the Initiative „Industry 4.0“and Service Life Cycle. 6th Workshop on Enterprise Interoperability. Nimes, France, 2015.

CASE STUDY:

Operational real-time control and warning system for Aarhus, Denmark

City: Aarhus, Denmark
Project: “Smart Real-Rime Control of Water Systems”.
IR4.0 Component: Big Data, IoT and
Cyber-Physical System.

The project focuses on improving the operation of urban drainage systems by using a new modelling approach that combines traditional physically-based models with fast surrogate models and a Model Predictive Control (MPC) framework for real-time system optimization.

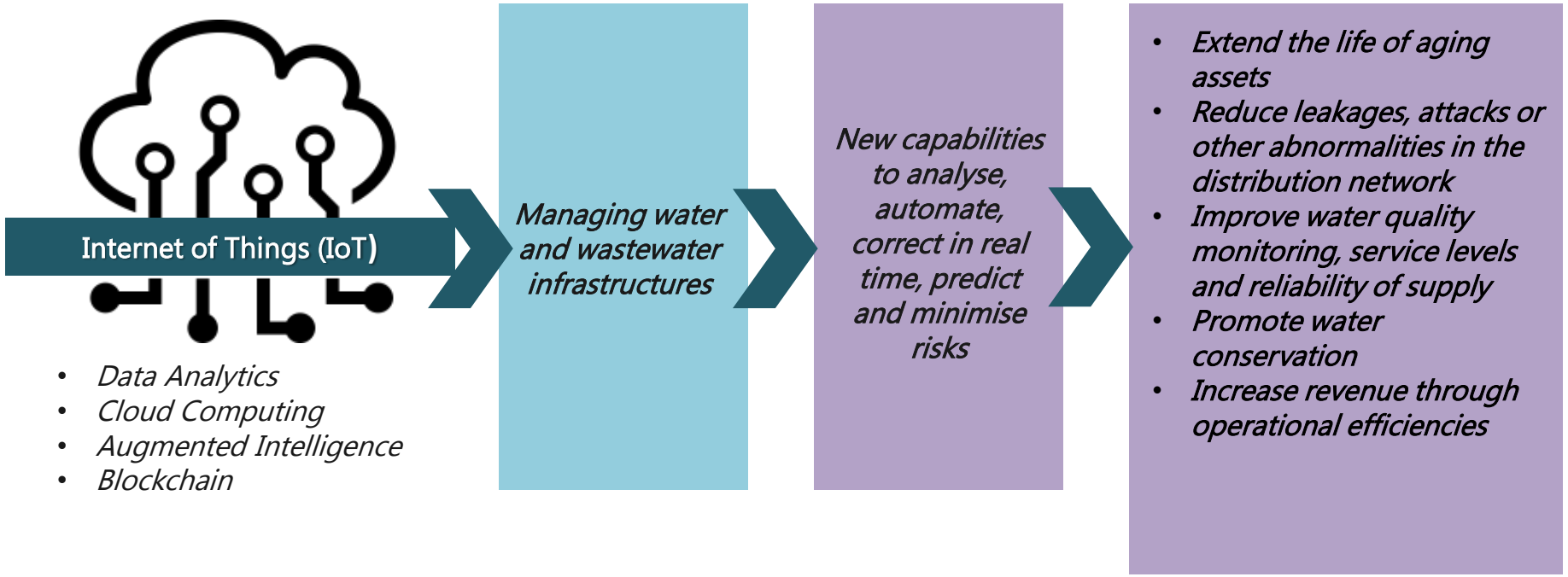
It comprises three sewage treatment plants and nine underground wastewater storage tanks all networked to the combined sewer overflows and rainwater overflows, as well as a local weather radar.

The system handles data acquisition, processing, and validation, modelling and strategy optimization, issuing control instructions and controlling the infrastructure elements, triggering operational alarms, and alerting the public.

Benefits

- Reduced flooding
- More food can be produced
- More hydropower can be generated
- Great for environmental protection
- Increase in economic growth

What is Digital Water?



Importance

- New digital technologies are enabling water utilities and industries across the world to extract greater information and efficiencies from legacy water infrastructure to:
  - enhance decision-making,
  - promote water conservation,
  - build twenty-first century water infrastructure,
  - increase the value and benefits of the global water infrastructure network.
- According to the United Nations Food and Agriculture Organization (FAO)
  - Current global water consumption is around 4.5 cubic kilometres (km^3).
  - Leakage rates in major cities range from 10 to 50 percent.
    - If, on average, 25 percent of water leaks before it reaches its intended use, that means that 1 km^3 of water is lost every year as a result of aging and inefficient infrastructure
- If digital tools can help water utilities detect and reduce water leakage by just 10 percent, this translates to an annual water savings of 0.1 km^3—or nearly 30 billion gallons

Opportunities for Digital Water Utilization

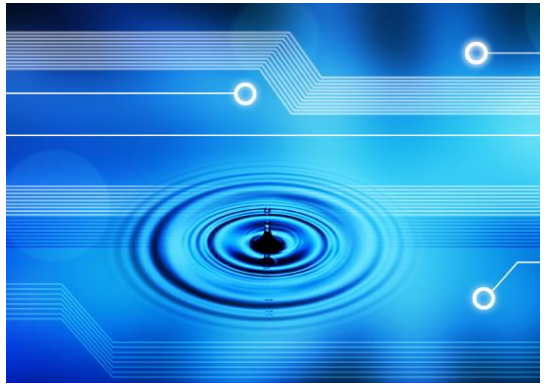
- The total global size of this opportunity in the global water utility sector is significant.
  - According to Global Water Intelligence (GWI), a leading authority on market intelligence, news and analysis on the international water industry,

- The 2016 market for digital solutions for water utilities was $17.7 billion in 2016
  - GWI expects the market to grow to $25 billion by 2021.
    - This represents an average annual growth rate of 7.2 percent between 2016 and 2021

Insights

- Large commercial and industrial water consumers can save a significant amount of money using digital solutions. The bill actually matters in commercial organizations due to the scale.
- The other realm is wholesale (reservoirs, pipes, and treatment centers) where digitization can impact leakage, pressure control, and provide an understanding of dynamic networks/dynamic control in real-time.
- The journey to digitization will take another generation but says that five years ago people didn't even use the term "digitization of water."

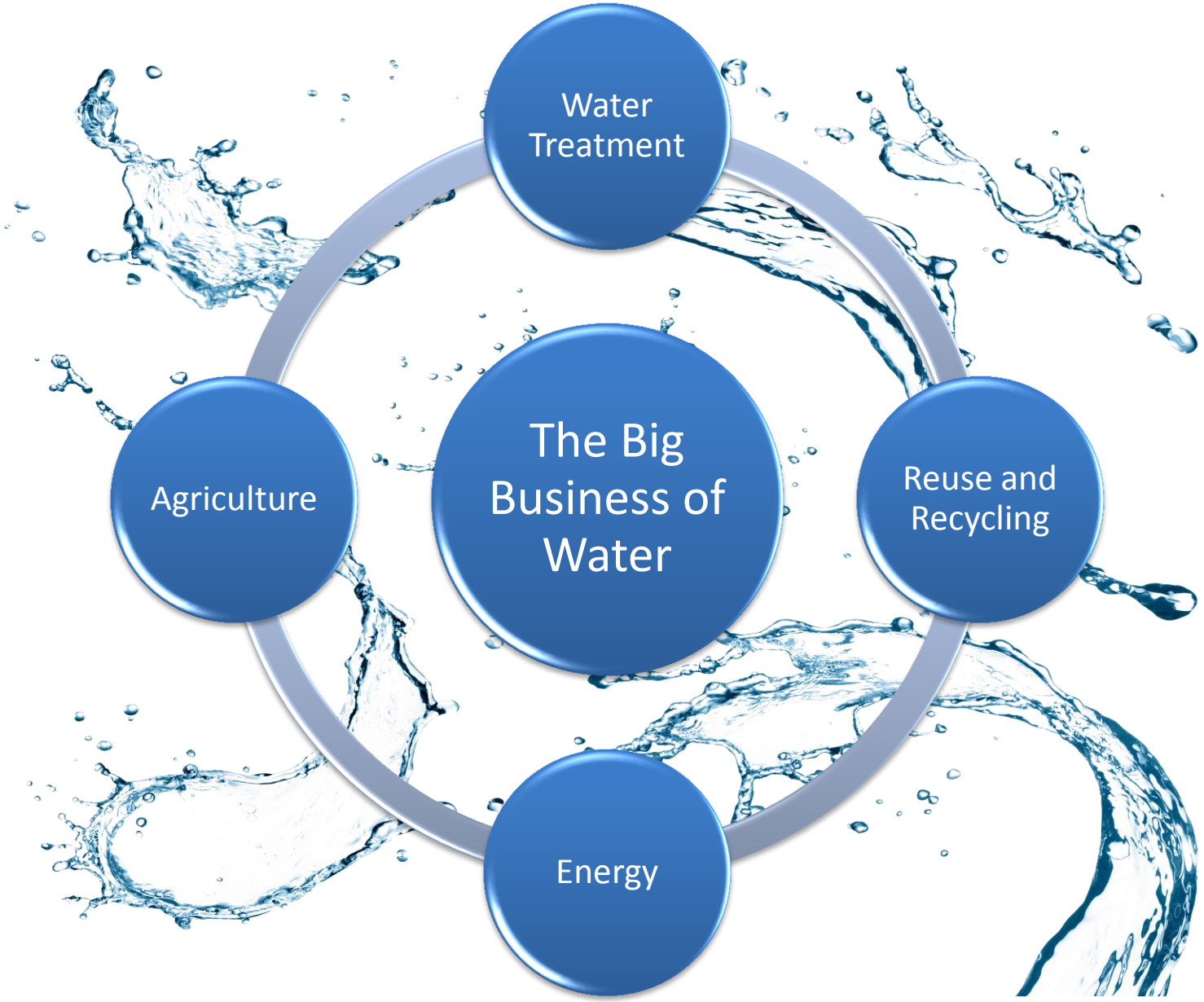
- Piers Clark, Founder and CEO of the Isle Group



Insights

- The world is at an inflection point in the adoption of digital water solutions.
- The growth trend in adoption is driven by externalities outside the water sector. These externalities include:
  - inexpensive sensors, consumer preference (i.e. the widespread use of smart phones), increased need by the industrial sector to streamline operations and reduce costs, increased adoption of cloud-based data solutions, and increased sales of software solutions to small and mid-sized companies.
- Digital water solutions in water industry - lags decades behind the energy sector in the use of data & analytics.
- Several challenges confronting the adoption of digital water solutions:
  - the need for standard protocols, disparate water data sources, and historical challenges in generating big value and financial returns in the sector.
- The most encouraging signal of digital water applications - the public and private sectors currently make decisions on poor data sets—incomplete data and less than robust analytics.
- The winners in digital water - companies that address very specific applications such as customer information systems, environmental data management, stormwater runoff, chemical management, etc.
- The adoption of digital solutions will significantly reduce the need for infrastructure spending—better data and analytics equals better allocation of investment dollars and workforce resources.

- Dave Henderson, Managing Partner of XPV Water Partners


Water Treatment
Agriculture
The Big Business of Water
Reuse and Recycling
Energy

1. Water Treatment

- Municipal or private water utilities and many large businesses spend hundreds of billions of dollars a year making water fit for human consumption and industrial activity and then transporting it, through pumps and pipes, from treatment plants to points of use.

- The costs include expenditures on new infrastructure, such as a new treatment plants. China and India alone are building hundreds of them to treat water and wastewater and on operating and maintaining systems.

- Two-thirds of this spending occurs in developed countries, but much of the growth in new systems will take place in Asia and other developing regions over the next two decades.

- Trillions of dollars will be spent on technology, equipment, and services.

- **Kurion** provides a fascinating example of Silicon Valley innovation helping to address a major water crisis.
- The company has generated hundreds of millions of dollars in revenue since its founding in 2008.

- Kurion Awarded Contract to Treat Tank Water at Fukushima Daiichi Nuclear Power Plant

- The company's technologies, which include removal of hazards from wastewater streams, were deployed at Fukushima after the nuclear disaster.

- Kurion's solutions removed more than 70 percent of the radioactivity from the water.

KURION

- **Desalitech** has also attracted venture investment with novel water treatment technology. The company innovated on the widely used reverse osmosis treatment methodology.

- Its proprietary closed-circuit process design and engineering cuts the water wasted in reverse osmosis treatment by half or more, and reduces energy used in treatment by about one-third.

- It offers customers a typical payback within a year, and sells mostly to large industrials, including Coca Cola.

- Desalitech raised $11 million in December, 2014, led by Spring Creek and Liberation Capital.

2. Reuse and Recycling

Countries that have learned to cope with water scarcity, like Japan, reuse the majority of their water. In Malaysia, just a tiny fraction of our water is recycled.

In fact, we use water that is treated to drinking quality standards for almost every application.

- Nexus eWater, born in Australia’s drought-stricken environment, provides an onsite treatment solution for homes to reuse wastewater for outdoor irrigation and flushing toilets.
- The grey water treatment and reuse system, called NEXtreater, was the first product of its kind to pass a 6-month test program and meet NSF/ANSI 350 code requirements out of the box.
- By adhering to strict international health and safety standards, NEXtreater produces water that can be reused in spray irrigation and toilet flushing.

3. Energy

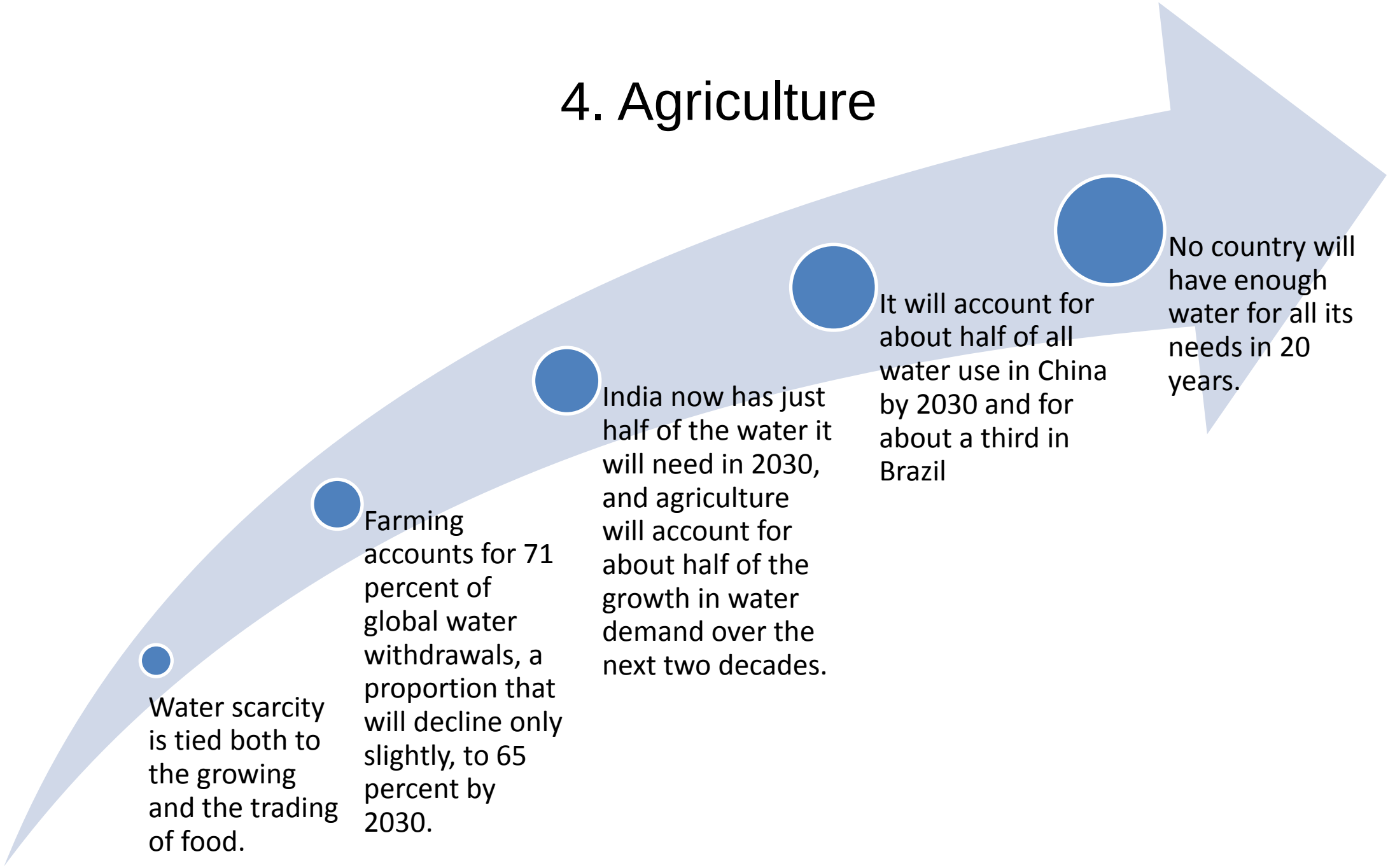
- The International Energy Agency (IEA) state that the availability of an adequate water supply is an increasingly important criterion for assessing the physical, economic and environmental viability of energy projects.
- The growing demand for energy, especially in rapidly developing countries such as China, Brazil and India, has stimulated an expansion of renewable energy. Hydropower is often a key component in achieving renewable energy targets as part of climate change policies
- Hydropower, or hydroenergy, is the most important and widely-used renewable source of energy. It represents about 17% (International Energy Agency) of total electricity production.

NATEL ENERGY

Natel Energy is changing the way hydropower is built to enable sustainable, climate resilient, low cost hydro.

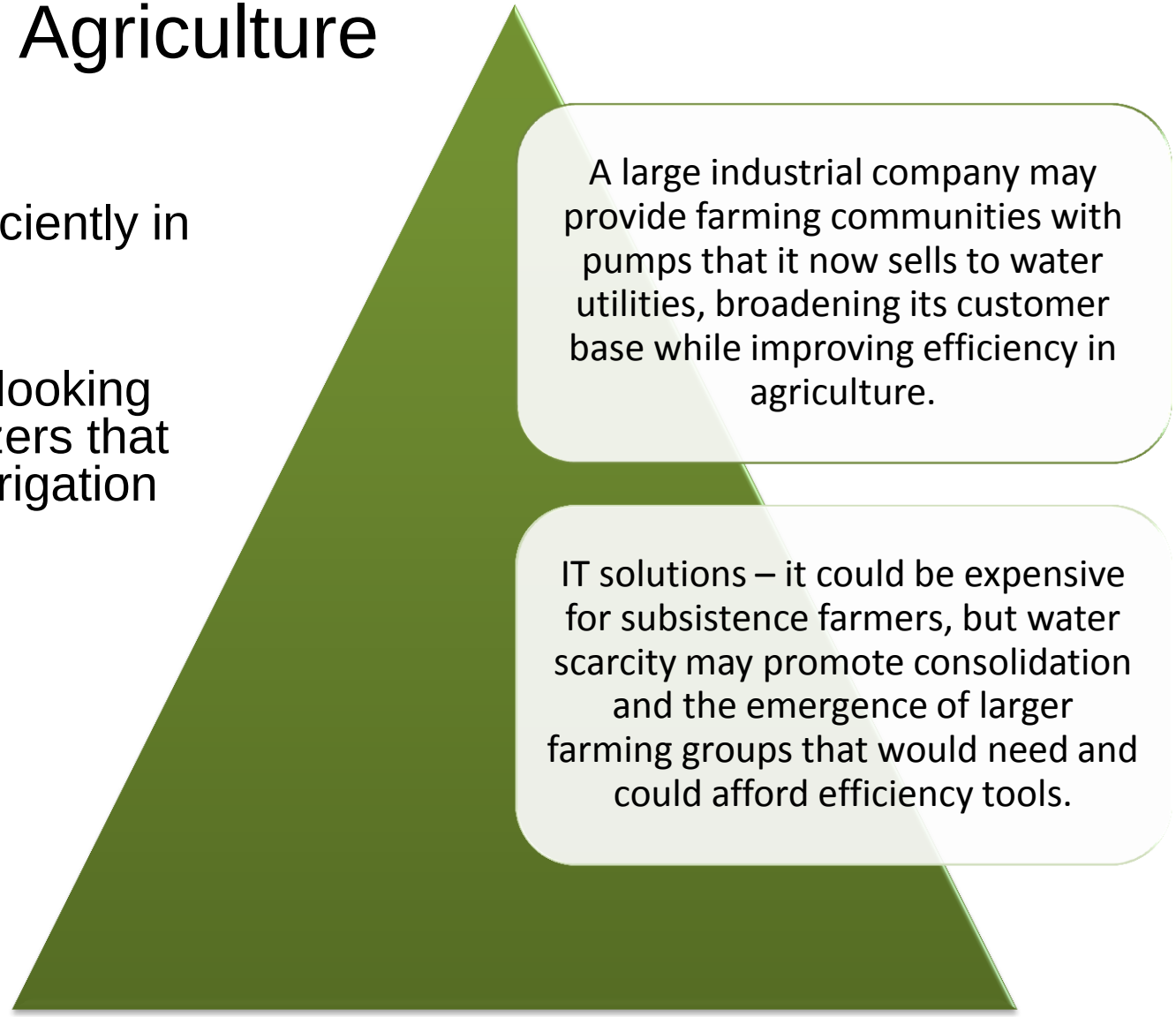
- Hydropower generation in small water conduits using novel turbine technology.
- Historically, hydropower systems have required a high vertical drop in water flow to generate power efficiently.
- Natel's solutions open a range of new installation opportunities by working with lower vertical drops.
- The company's customers include Apple, which recently partnered with Natel to develop hydropower in an existing irrigation canal in Oregon.

4. Agriculture



4. Agriculture

- Finding ways to use water more efficiently in agriculture is critical.
- Agricultural companies are already looking for ways to design seeds and fertilizers that require less water, and better drip irrigation technologies will keep farmers from overwatering their fields.



4. Agriculture

Finally, financial institutions and investors can benefit from efforts to boost water productivity in treatment, efficiency, and agriculture.

- Banks will need to provide capital for many water productivity investments, especially when the public sector can't.
- In India, for instance, some drip irrigation projects could help farmers reduce the cost of certain inputs (such as fertilizer) by up to 50 percent, depending upon the crop.
- Investors could capture a share of this value either as lenders or as equity holders in companies active in the drip irrigation value chain.
- China needs about $1.8 billion a year in capital to reduce leakage in municipal water systems. With a 22 percent rate of return, these investments could be an attractive solution for municipal utilities and their lenders alike.

Zero Waste Management

Net Zero Water Building Strategies

- Reducing demand by employing innovative technologies that consume less water.
- Producing alternative water sources to offset purchased freshwater.
- Treating wastewater on-site and reuse or inject treated wastewater into the original water supply.
- Implementing green infrastructure by infiltrating stormwater to the original water supply.