

Sustainable Chemistry as Orientation and Pacemaker for Sound Management of Chemicals and Waste (SMCW)

Development of Biobased Economy in Egypt: Challenges and Constraints

v4

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Purpose statement

The purpose of this presentation is to present and highlight:

- The most important findings of our study on the potential of Bio Based Economy (BBE) in Egypt with special focus on challenges and constraints;
- The framework of the proposed model for establishing BBE in Egypt; and
- The shortlisted value chains which were subject to detailed analysis.

Outline

1. The biobased economy as we perceive
2. Challenges and constraints in developing biobased economy in Egypt
3. Proposed model for biobased economy in Egypt
4. Shortlisted value chains
5. Concluding remarks

1. The biobased economy as we percieve

Our focus in biobased economy is on the product level. The development of a biobased economy at product level presents many opportunities to utilize our biomass resources at the local level to establish specialized industrial clusters designed to target specific bio product mixes.

We think of agricultural residues or crops at the primary production stage, bio-waste from processing or food waste at the consumer stage as valuable resources for value addition.

We see the potential of the biological and engineering sciences which enable the replacement of selected fossil resource-driven processes and products with the variety of bio-technologies and innovations provided by research and development.

Biomass feedstocks

Sugar

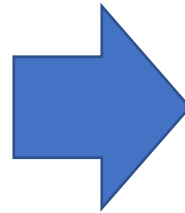
Starch

Lignocellulose

Oils & Fats

Proteins

Mixed biomass, waste



Processes

Physical-mechanical

Filtration Distillation
Extraction Fragmentation
Crystallisation

Chemical

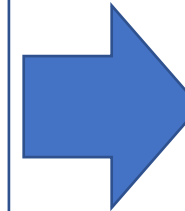
Oxidation Esterification
Hydrogenation Hydrolysis
Etherification Isomerisation
Polymerisation

Thermochemical

Incineration Gasification
Thermolysis Pyrolysis
Hydrothermal

Biotechnology

Fermentation
Aerobic conversion (composting)
Anaerobic digestion (biogas)



Bio-based products

Food & feed

Wood-based materials

Fine chemicals

Fibres

Pharmaceuticals

Composites

Surfactants

Lubricants

Polymers

Bioenergy

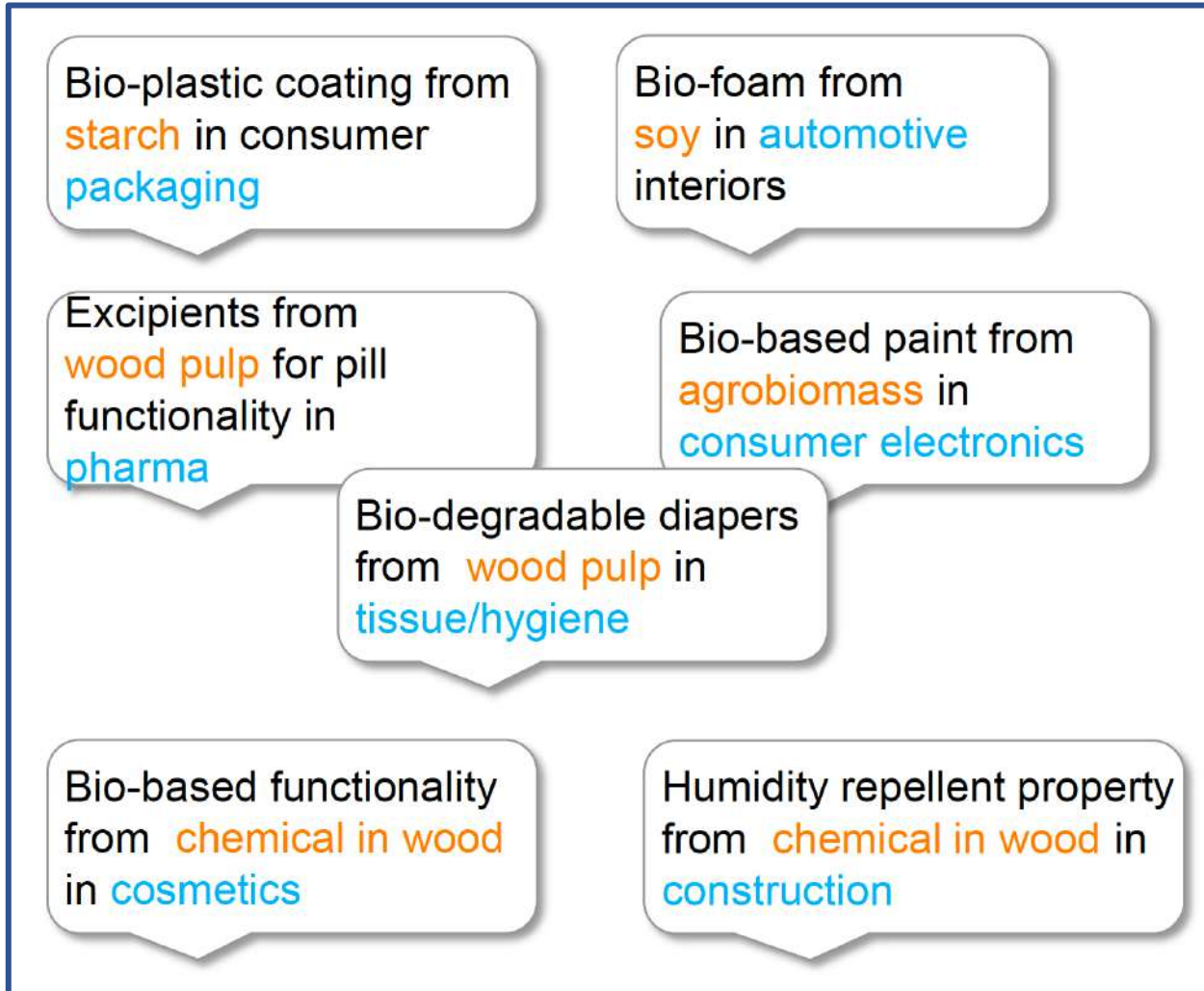
Biofuels

Long list of main bio-based products

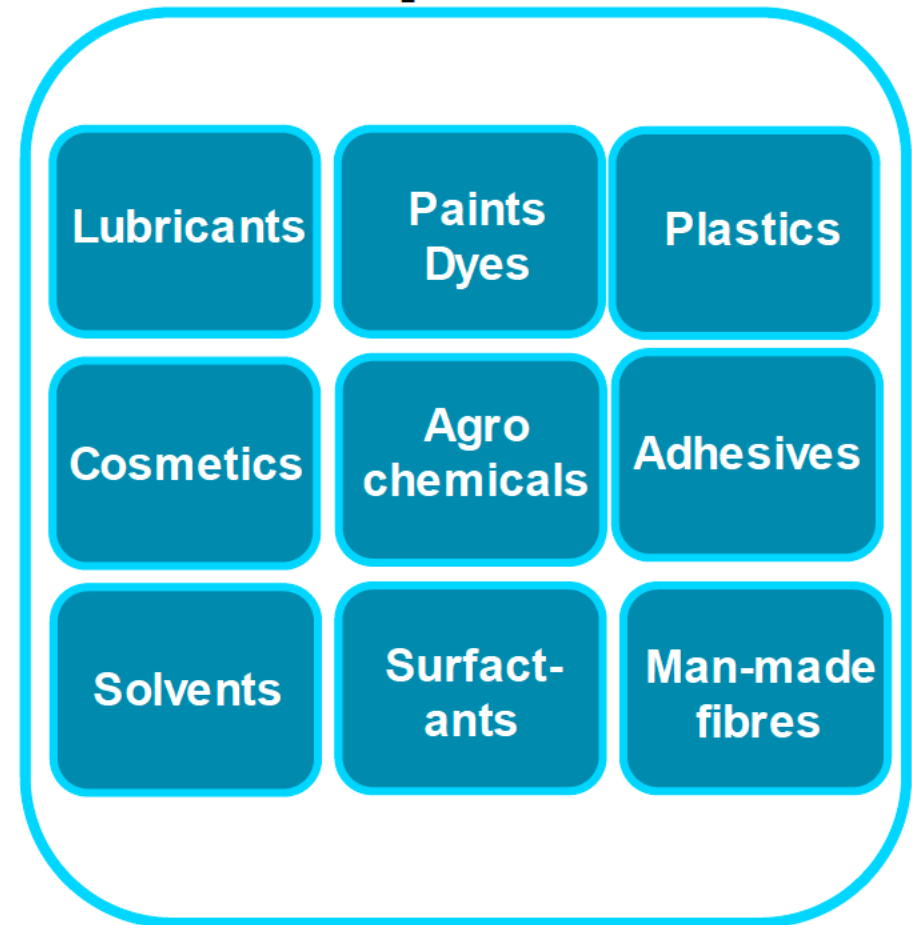
- Absorbents/adsorbents
- Activated carbon
- Biochar
- Carbon black
- Adhesives
- Alternative fibers/bonded fabrics/textiles
- Bio-based fuels such as ethanol and bio-diesel
- Bio-plastics/polymers/films
- Construction and composite materials (Panels, Laminates, Hardware)
- Cleaning chemicals
- surfactants, soaps, detergents
- Fertilizers/ soil amendments

- Inks, dyes, pigments
- Landscaping materials
- Lubricants/rust inhibitors/functional fluids
- Oils, waxes, binders
- Packaging material
- Paints/coatings
- Personal consumer items/cosmetics
- Pharmaceutical raw materials
- Solvents & co-solvents
- Specialty chemicals
- agricultural chemicals

The power of innovation in BBE as demonstrated in EU studies

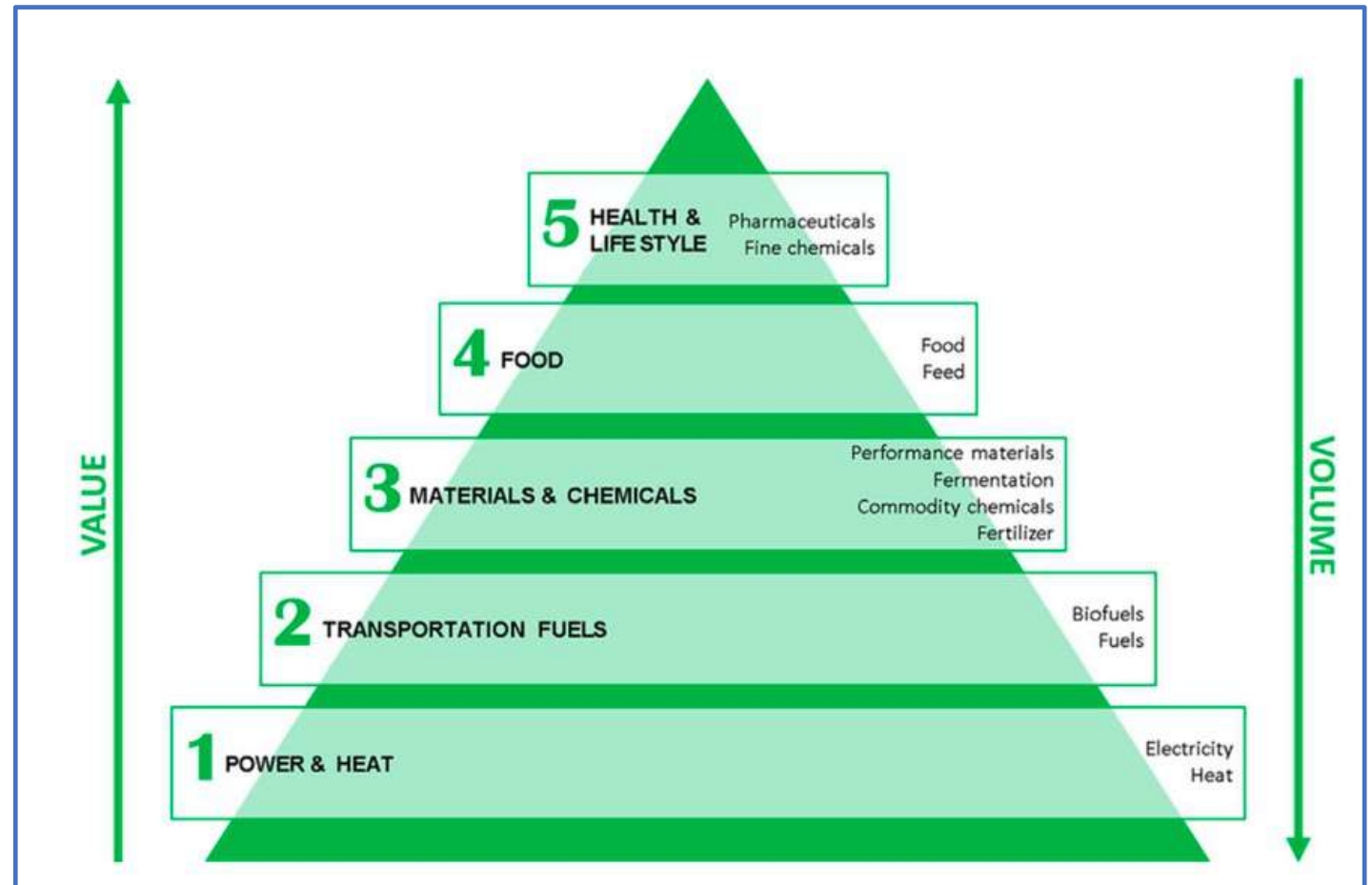


Source: POYRY, Dynamics of the advanced biobased materials business, 2013



Source: Rpad to Bio EU project, 2019

The value pyramid as presented in international models



Source: AGRIFORVALOR 2018: Demand-driven Bioeconomy Research an Innovation Agenda for the. Utilization of Primary and Secondary Biomass from Agriculture and Forestry.

2. Challenges and constraints in developing biobased economy in Egypt

Why BBE is important for Egypt?

- It would support Egypt's efforts to establish a stonger industry base;
- It would support the intended transformation to knowledge-based economy and to be more "scope-oriented" not only "scale-oriented";
- It would give the country the full opportunity to select and optimize the most relevant value chains, coupling the strong agriculture base with industerial base;
- It would strenghten Egypt's efforts to enhance and support the private sector and entrepreneurs in economic and social development; and
- It would support Egypt's local development by retaining a fair share of the positive impact related to biomass production at local communities.

Challenges and constraints 1

1. Ability of the government to establish the proper institutional framework (policies, laws and organizations) which will be capable to build an effective governance model of biobased economy.
2. Ability of the existing R&D system to satisfy the biotechnology related needs of biobased initiatives and programs.
3. Ability of all involved stakeholders to communicate and cooperate with international well-established sources of know-how in biobased economy.
4. Ability of the existing education and vocational training system to generate the required human resources with the required level of competencies and specialized experience.

Challenges and constraints 2

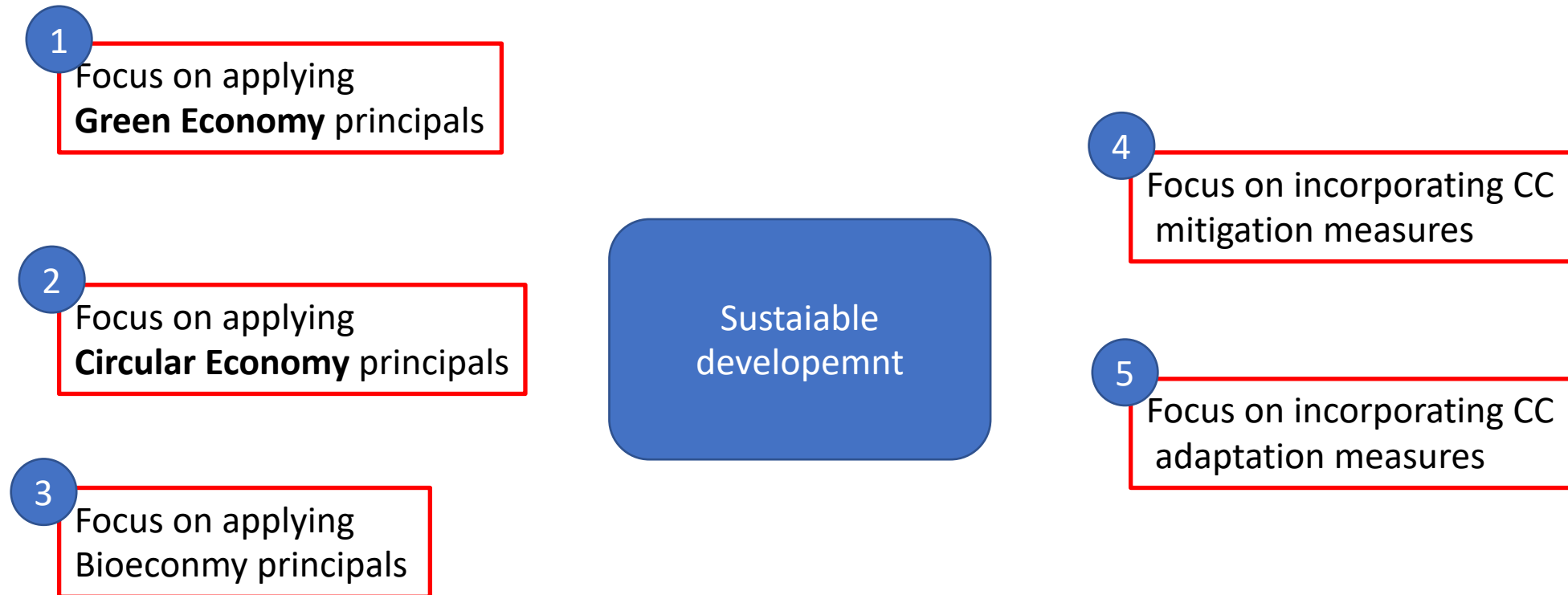
5. Ability to attract and involve the private sector to invest in biobased economy projects within a cluster that is properly designed to utilize available biomass in different regions.
6. Ability of the government to stimulate the biobased economy via implementing demonstration BBE projects in different regions.
7. Ability of the government to integrate BBE programs with the current and planned mega development projects.
8. Challenges related to marketing of bio-based products locally and internationally.

Specific topics stemmed from the identified challenges and constraints

- Value chains and clusters
- Cross sectoral interlinkages
- Policy instruments, applied and tested
- Role of government in different models
- R&D - scope, active institutes
- Education and training
- Standardization
- Quality control
- Applicable finance models

3. Proposed model for biobased economy in Egypt

Egyptian sustainable developemnt model



The Matrix – Bio-Economy Focus

Current Situation and
needs assessment



Sectors

1. Energy
2. Transport
3. Industry
4. Agriculture
5. Water resources
6. Water & Wastewater
7. Waste
8. Urban development
9. Tourism
10. Biodiversity

Bio-Economy Elements / Objectives

1. Energy Efficiency / Renewable Energy
2. Water Efficiency
3. Material Efficiency
4. Waste Recycling
5. Less GHGs Emissions / Low Carbon
6. Green Jobs / Employment
7. Research and Development
8. Innovation

Dimensions

1. Gaps/Challenges
2. Targets (National/Global)
3. Existing Regulations/Policies
4. Voluntary Actions (Private Sector)
5. BAPs & BATs
6. Financing and Investments
7. Stakeholders Involved / Management
8. Existing Infrastructure
9. Contribution to climate change adaptation

Integration with:

Green Economy
Circular Economy

Existing Policies/strategies and Action Plans

Egypt SD Vision 2030
National Green Economy Strategy
National CC Strategy
Biodiversity Strategy and Action Plan

Proposed model for a cascaded agro-industrial BBE in Egypt

Tertiary Level

Specialized Biotechnology
Processing Centers

**Secondary
Level**

Biotechnology Processing
Centers

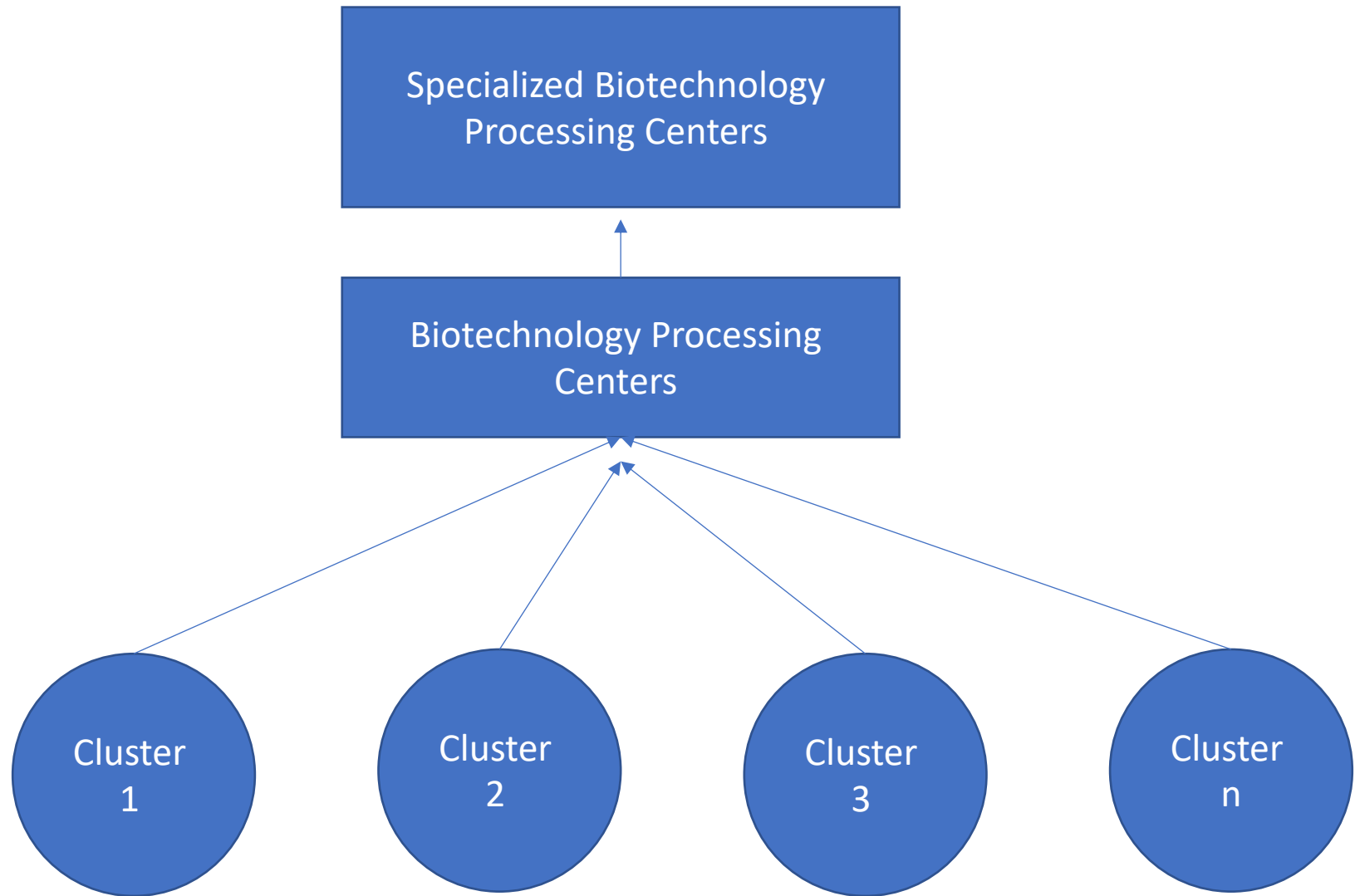
Primary Level

Cluster
1

Cluster
2

Cluster
3

Cluster
n



Enabling programs to be established during the first 5 Yrs of a 15 Yrs plan

- Development of institutional framework
- Design and implementation of financial packages
- Design and implementation of R&D support system
- Design and implementation of government-led investment program
- Planning and development of selected industrial clusters in different regions and assignment of cluster development agents
- Design and implementation of entrepreneurship support program
- Design and implementation of HRD programs
- Establishment of technical support and knowledge exchange program

Topics reviewed and analysed

- BBE products – the long list
- BBE products - the short list
- Value chains viability analysis
- Supply chains studies
- Technology Readiness Level (TRL)

- List of demonstration projects
- Potential anchor investors

4. Shortlisted value chains

Shortlisted value chains in the Egyptian study

#	Code	Cluster	Product Group (subgroup)	Products
1	CP	Carbon Products	Solid fuels	Subcoal, Charcoal, Torrefied Pellets (TOPs)
			Activated carbon	Activated carbon
			Biochar	Biochar
2	BM	Building Materials	Building Material	Particle board panels, Gypsum composite
			Manufacturing Material	Wood-plastic composites, Compressed earth block, Medium-density fibreboard (MDF)
			Plastic/polymers (Thermoplastics)	High-density polyethylene (HDPE) composites
3	BEF	Biofertilizers	Biofertilizers	Biofertilizers, Ammonia-rich biochar fertilizer
4	OL	Industrial oils and lubricants	Lubricants (Base oil/ Base stock)	Polyethylene, polyethylene glycol
			Solvents (Oxygenated), Lubricants (Base oil/base stock), and Building blocks for Cosmetics	Propylene glycol
			Building block for: Cosmetics, Paints, lubricants, Solvents, Adhesives, and Plastics/polymers	Acetaldehyde

5	BFI	Biofibers	Plastics/polymers (Bio-based plastics)	Bio-PET staple fibers/filament
			Building block for: Man-made fibres, Solvents, Adhesives, and Plastics/polymers	1,2-Butanediol, 1,4-Butanediol, 2,3-Butanediol
			Building Blocks for Plastics/polymers and Man-made fibres	Biobased PA (Polyamide/Nylon)
			Man-made fibres (Synthetic polymers)	Polytrimethylene terephthalate (PTT), Bio-PTT fibres/filament, Polyurethane foams
			Building block for: Man-made fibres and Plastics/polymers	Acetic anhydride
			Building block for: Cosmetics, Man-made fibres, Plastics/polymers, and adhesives	1,3-Propanediol
			Man-made fibres (Natural polymers)	Cellulose nanocrystals
6	ESM	Energy from sludge and/or MSW	Building Blocks	Biogas, Biomethanol
			Electricity	Electricity
			Solvent (hydrocarbon)	Bioethanol
			Biofuels	Biomethane
			Solid fuels	Refuse derived fuel (RDF), Solid recovered fuel (SRF)
7	EB	Energy from biomass	Electricity	Electricity
			Solvent (hydrocarbon)	Bioethanol
			Biofuels	Biodiesel, Bio-oil, Ethyl tert-butyl ether (ETBE), Gasoline, jet fuel
			Building Blocks	Biomethane, biogas
			Hydrocarbon fuels	Hydrocarbon fuels
			Green Hydrogen	Hydrogen

8	BC	Bio Chemicals	Building blocks / Platform chemicals	Ethylene
			Surfactant (Anionic)	Sorbitol
			Cosmetics (Functional ingredient)	Squalene
			Paints and coatings (Solvent)	Ethyl acetate
			Agrochemical (Fungicides and Insecticides)	Furfural
			Solvent (Hydrocarbons)	Ethyl lactate
			Solvent (Oxygenated)	Isobutanol
			Solvents (Oxygenated) and Building block for Plastics/polymers (Synthetic polymer)	Ethylene glycol
			Building blocks	Furfuryl alcohol, Ethylene-propylene-diene monomer (EPDM), Citric acid, Succinic acid, Lactic acid, 1,4- dicarboxylic acids, Levulinic acid, Farnesene, Ethylene
			Adhesives (Synthetic adhesives)	Epoxy resin
			Building block for: Cosmetics, Man-made fibres, Plastics/polymers, and adhesives	1,3-Propanediol

			Acetone: Cosmetics (solvent), and Solvent (Oxygenated) Butanol: Building blocks Ethanol: Solvent (hydrocarbon)	Acetone–butanol–ethanol (ABE)
			Cosmetic (Botanical extracts)	Skincare products, Terpenes
			Plastics/polymers (Bio-based plastics)	Polylactic acid
			Building block for: Cosmetics, Paints, Agrochemicals, Surfactants, Solvents, Adhesives, and Plastics/polymers	Acetic acid
			Building blocks for Plastics/polymers, Adhesives, Paints and coatings	Itaconic acid
			Food additives	Glutamic acid
9	BSS	Biomass Side Stream	Pharmaceutical	Polyphenols and bioactive compounds
			Bio-dyes and pigments	Natural colorant
			Man-made fibres(Natural polymers)	Cellulose nanocrystals and cellulose nanofibrils
			Man-made fibres(Synthetic polymers)	Cellulose acetate fibers
			Biodegradable products	Biodegradable tableware
			Building Material	Mycelium-based bio-composites
			Activated carbon	Activated carbon
			Food additives	Flour
			Animal feed	Animal feed

5. Concluding remarks

Concluding remarks

1. There is a great potential to establish biobased economy in Egypt which fits in the country green economy national strategy
2. Egypt is considering a product oriented BBE model, the most viable value chains were analysed with special focus on maximizing the benefits on the local level
3. There are many challenges and constraints which have to be addressed to enable the transformation to BBE to achieve the intended social and economic outcomes of BBE