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Bridging the Gap of Uncertainty Can a Mobile Application Address Resource Efficiency for a Better City Understanding?

Mostafa Zakaria El Attal
Teaching Assistant, Misr International University, Cairo, Egypt

Abstract:
Available resources are undue pressure to support the economy, as well as the quality of life in the world. This increased pressure results from the rigorous usage of limited resource, along with placing immense pressure on the environment while threatening the security of raw materials and energy supply. Thus, increasing resource efficiency in every part of the economy is crucial if the world seeks to grow, secure jobs, and improve its management when considering climate changes. Most importantly, the major specialty of reform is represented by the efforts of recycling, as well as patterns of consumption, waste prevention, and a superior maintainable production. As such, businesses and individuals must concurrently address these areas in order for the world to overpower its present economic and life style uncertainty. The more actual and reliable data is available, the more convenient action plans are formulated, and the more realistic strategies are generated.

Keywords: *Urban metabolism, Resource efficiency, circular module, Inquiry medium.*

1. Introduction

Today, more people are living in cities than ever and turning them into critical points where social, economic, technological, and ecological changes occur. Cities in developing countries are experiencing this growth more than those in the developed. However, despite the challenges facing these cities, there are opportunities for achieving sustainability and resource efficiency. The sustainability of urban cities today is faced by several challenges that comprise several global factors such as economic change, rapid social and technological development, scarcity of resources, and environmental risks and climate change. These factors have wide impact on water, food, energy, transport, and waste that are important for sustainability in cities.[i]

By 2050, the world population is estimated to reach 9 billion people. As indicated by the second wave of urbanization[ii], most of this population will reside in cities. Cities in developing countries (majorly African and Asian) will have the highest growth rates. The first wave of urbanization took place in the now developed countries in 1750 and led to the urbanization of 400 million people in 200 years. [iii] It is estimated that the second wave will lead to urbanization of 3 billion people in 80 years. As such, the second wave is expected to provide opportunities for unlocking new areas for thinking and acting on the city due to the challenges that new cities will bring. The resolution of these challenges will facilitate the creation of sustainable cities.

Ultimately, increasing resource efficiency is both an opportunity and a necessity for the all nations around the world. Many countries do not hold convincing long-term prospects in the fields of innovation and research, fisheries, climate change, transport, energy, industry, urban planning and agriculture, if it continues on the same existing path. It is evident that investors and businesses should be concerned with the further advancement of these strategies, as well as resource efficiency promotion. Through these and other measures that are presented in this research, it is likely to increase resource efficiency in the world and especially Egypt, suggesting, at the same time, that a resource efficient world can be achieved.[iv]

2. Resource Efficient City[v]

2.1. Definition and Origin

This term is coined with the UNEP Initiative launched after the Rio+20 summit in Brazil, 2012 which focuses on resource efficiency measures to achieve sustainable urban development: "The new Global Initiative for Resource Efficient Cities". It aims to provide cities with a common framework for assessing environmental performance and encouraging innovative sustainability measures.

2.2. Conceptual Progression

The urban metabolism concept adopts a systems approach to the environmental pressures generated by urban living, so that inflows and outflows have to be quantified. Therefore, the two main features of the systems approach are completeness in the description of environmental flows, and global system boundaries and consumption-based accounting. Completeness implies descriptions that can detect environmental problem shifting across policies. Conversely, global system boundaries imply taking into account not only local impacts and effects, but also regional and global associated impacts.

2.3. Theoretical Progression

(UNEP) has identified six issues that need to be addressed if the transition to sustainable, resource-efficient cities is to be successful (UNEP, 2012). These are:

- Integration (looking at environmental, social and economic factors);
- The urban divide (social and political sustainability);
- Governance (coordinated multi-sector change, with the participation of all relevant stakeholders);
- Smart urban design, logistics and spatial planning (compact and multi-use urban development);
- finance (funding streams and financial incentives, e.g. tariffs, subsidies, taxes);
- Technology and skills transfer and development (particularly relevant for cities in the developing world);
- Innovation (focus on diversity and going beyond technology).

2.4. Core Assumptions & Practice Objectives

Sustainable development initiative revolving around three key components, including the data component, the question component, and understanding the urban system. The data component provides evidence for urban development at urban scales, through available data, data gaps, and inherent linkages. The question component defines policy/research questions on the impact of urban development. Finally, the understanding urban system component offers a platform for reflecting on the relationships across drivers, pressures, and impacts, with a view to design appropriate response strategies.

2.5. Interrelated Terminologies & Interchange ability

The underpinning concept of "Resource Efficient Cities" are"

- urban metabolism,
- circular model, and
- compactness in urban resource efficiency

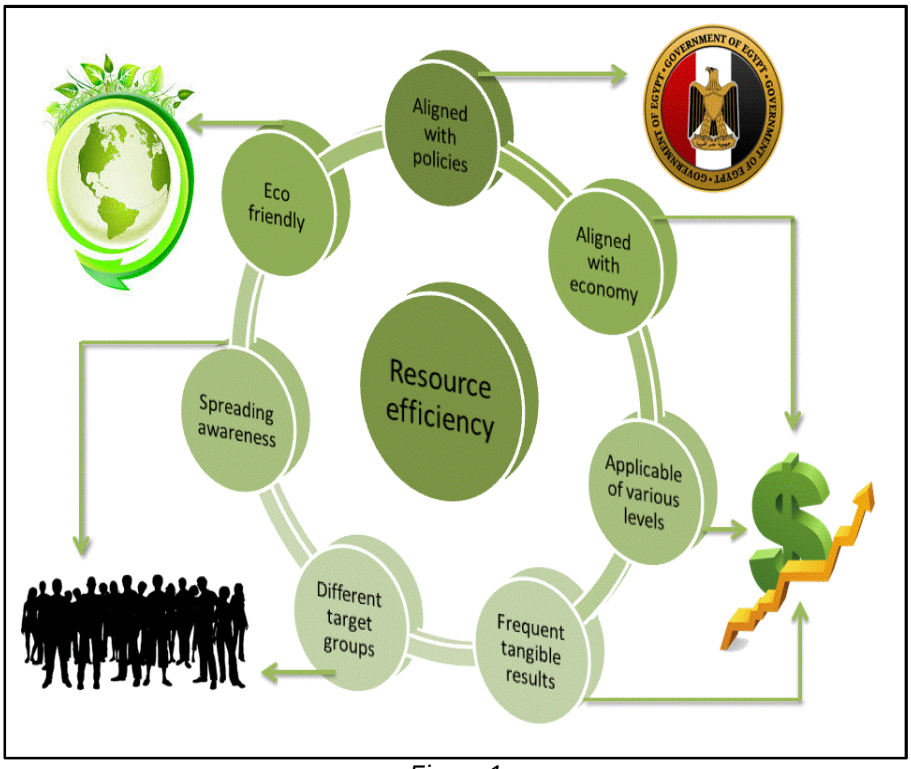

Figure 1

3. Egyptian Cities

Frequently, resources are inefficiently utilized, considering that the information related to the exact cost is unavailable or limited to the community that consumes them. Resource efficiency information inquiry in Egypt can be a break through as it is aligned with the current government policies, in addition to its alignment with the economic conditions. Moreover, resource efficiency possesses various applicability on different levels of intervention. Frequent tangible results of resource efficiency can add up to the value of its implementation. The fact that resource efficiency triggers different target groups and spreads awareness gears up more eco friendly initiations. (Figure 1)

3.1. The Dilemma of Data

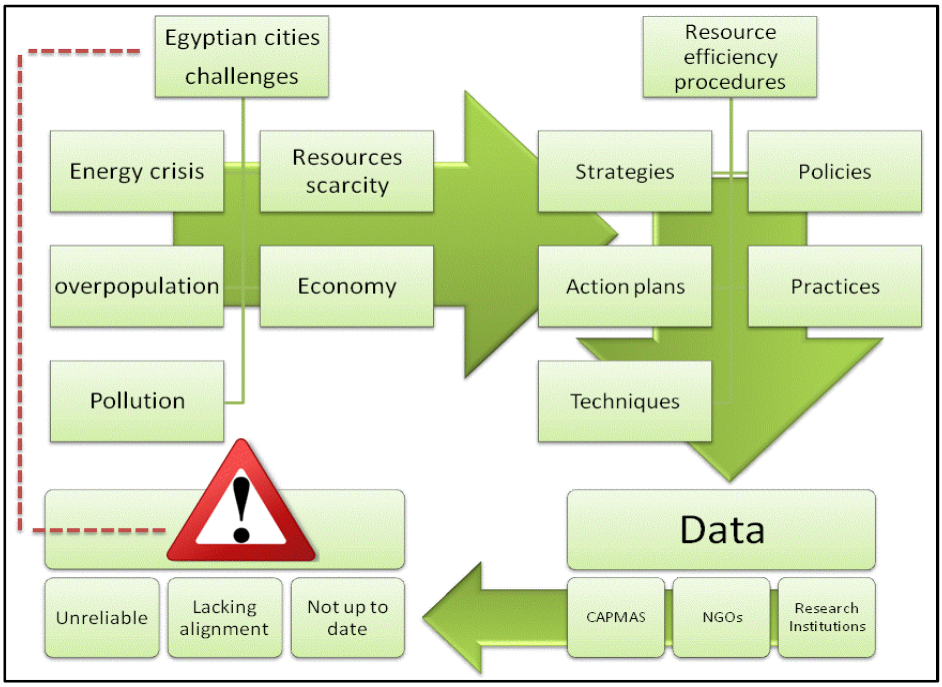

Figure 2

In Egypt, linear urban procedures take place where resources and wastes enter and exit the city boundaries correspondingly, leading to non-closed resources loops, no exploration means to reduce demand on resources, and the absence of offering alternative effective ways to meet resource requirements. The lack of urban resource flows evaluation and linkages schemes between potentials, restrictions, and opportunities; in addition to the absence of correlation between citizens, investors, decision makers, and service providers, leads to segregated procedures through which high loss of resources occur, and minimal return among the various actors.

Data availability is a key stone in achieving resource efficiency. The major source of data concerning Egyptian cities is CAPMAS in addition to research institutions and NGOs; that is facing humongous defects considering reliability, alignment with international standards and accuracy. (Figure 2)

The research is to investigate a way to solve the inefficient availability of urban resource flows evaluation techniques, circular procedures, and reliable data concerning use and management of natural resources in Egyptian cities.

4. Methodologies Undertaking Resource Efficiency

Concerning resource efficiency and urban metabolism, various methodologies are undertaken to address their goals and objectives. The following is a comparative analysis including description, scope, action, value, and advantages of six different methodologies.

	Accounting[vi]	Input-output[vii]	Ecological footprint[viii]	Life cycle assessment[ix]	Simulation[x]	Hybrid[xi]
Description	Material flow analysis (MFA) measures resource flows by physical volume or weight	developed to perform empirical assessments of commodity flows between the different producing and consuming divisions of a state economy	sustainability pointer of a human economy	"cradle-to-grave" examination of material flows entrenched within services and products	multifaceted system that comes from the internal procedures of socio-economic and socio-ecological systems	Non-traditional new lines of inquiry for various fields
Scope	performed at numerous scales and considers an array of metabolic flows providing a broad detail range	input-output analysis track resources and products through acquisitions	translates a population's resource utilization into a single pointer of how much land area is required to maintain that population	It assesses all phases of a service or product 'life cycle,'	inter- and trans disciplinary technique for comprehending the behavior of systems over time	concentrate openly on resources
Action	systematically quantify the general magnitude of metabolic flows for a specified period within distinct administrative margins	offers a comprehensive difference between the urban system actors	merges socio-economic development demands with ecosystem carrying capability	Life cycle assessment is mostly appropriate for calculating indirect flows linked with raw materials	inspect relations between entities and the environment so as to capture dynamic behavior trends, adjustment and learning behaviors	Merges different methodologies in data scarce environments
Value	the resource flows simplification into inputs and outputs excludes a number of interactions that occur	assesses the material flows between divisions in an economy by tracking product and sector-specific resource flows	plain framework that informs practitioners and researchers whether a specified metabolism is over-consumptive	ecological impact showed by life cycle assessment is offered as a comparative measure between services and products	present relations of agents at micro scale, as contrasted to the micro and macro scales best fitting to system dynamics modelling	researches have looked to connect resource flows with the human behavior that they facilitate
Advantages	economy-wide material flow analysis	Cross economy-wide material flow analysis	public consciousness instrument to communicate patterns of over-consumption	Helpful instrument while comparing the ecological impacts of different products and processes.	represent the incentives or constraints that determine agents' willingness to cooperate	comprise pointers of social wellbeing or reshaped the span of investigation to offer more comprehensive environmental or sustainability pointers

Table 1

5. Resource Efficiency Analysis Approaches

On the same hand, various approaches do exist aiding resource efficiency in its strategies, practices, decisions, and implementation schemes. The following is a comparative analysis between four different approaches highlighting description, value, where to take place, how to be achieved, scope, and advantages.

	Multi / layer[xii]	Top / down[xiii]	Bottom / up[xiv]	Spatial / temporal[xv]
Description	suite of indicators for economy, education, governance, safety and others	Data employed for urban metabolism evaluation is characteristically derived from top-down or bottom-up methods		Interventions to change urban resource flows from a linear metabolism to a circular metabolism depending on: spatial (form, planning); temporal (short-, medium- or long-term); and sectorial (energy, water, waste, energy) factors of a city
Value	(i) context; (ii) biophysical characteristics; (iii) urban metabolism parameters; and (iv) the role of utilities	65 percent of researches used top-down data	may reduce the data-scarcity difficulties	To support implementation, urban metabolism assessment should be integrated into spatial planning practices
Where	Lacking policy frame works	offer restricted insights into the formation of resource flows through urban regions and concerning urban activities	Data-scarce environments like Africa, where restricted urban metabolism researches exist, can profit from bottom-up methods	This static snapshot in time decreases the usefulness of recommendations
Why	(i) Provide scientific knowledge of resource use and resource requirements especially in data-scarce environments; (ii) provide initial indicators that facilitate engagement with the urban decision-makers; (iii) render urban metabolism data and information that is relevant for practical implementation.	Data scarcity is frequently mentioned as a limiting aspect to embark on an urban metabolism evaluation at city level	The casual economy is not captured in most existing researches as the needed data is unavailable in traditional databases	Linking spatial factors with metabolic flows it likely for urban decision-makers to recognize the price of urban metabolism outputs.
Scope	(i) an urban bulk mass balance, (ii) urban material flow analysis, (iii) product dynamics, (iv) material intensity of economic sectors, (v) environmental pressure of material consumption, (vi) spatial location of resource use and (vii) transportation dynamics		There is a necessity to deploy a suite of data gathering methods which capture behavior-related data	
Advantages	moves from assessing the outputs of an urban metabolism to the direct functional causes, and the opportunities for shaping them		A fundamental urban metabolism assessment would merge such information to support connections with spatial planning	

Table 2

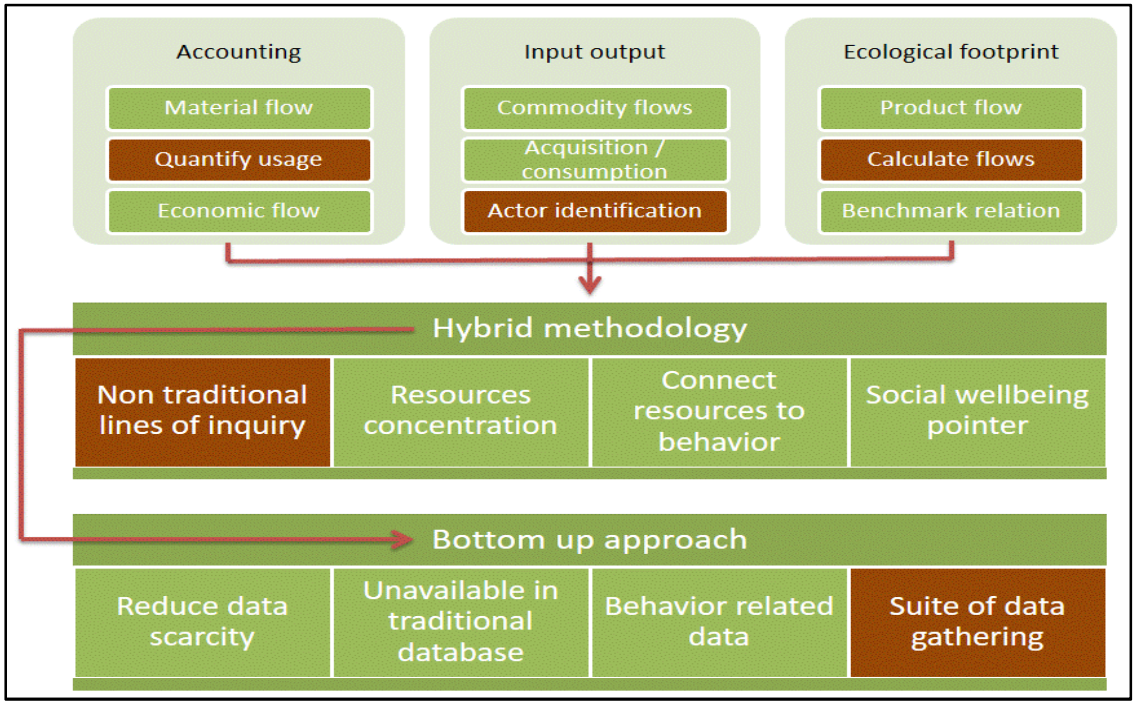

Figure 3

6. Assigning a Method and Approach for Egyptian Cities

From the previously mentioned methodologies, a hybrid method is highly convenient as to introduce a mix between accounting method in order to achieve usage quantification, input output method as to help in actors' identification, and ecological footprint method to introduce a medium of calculating flows.

Concerning a suitable approach, the bottom up approach highly addresses the Egyptian cities condition where data is scarce, information is unavailable in traditional data bases like CAPMAS, lack of recognition of behavioral based data, and the absence of data gathering suites. (Figure 3)

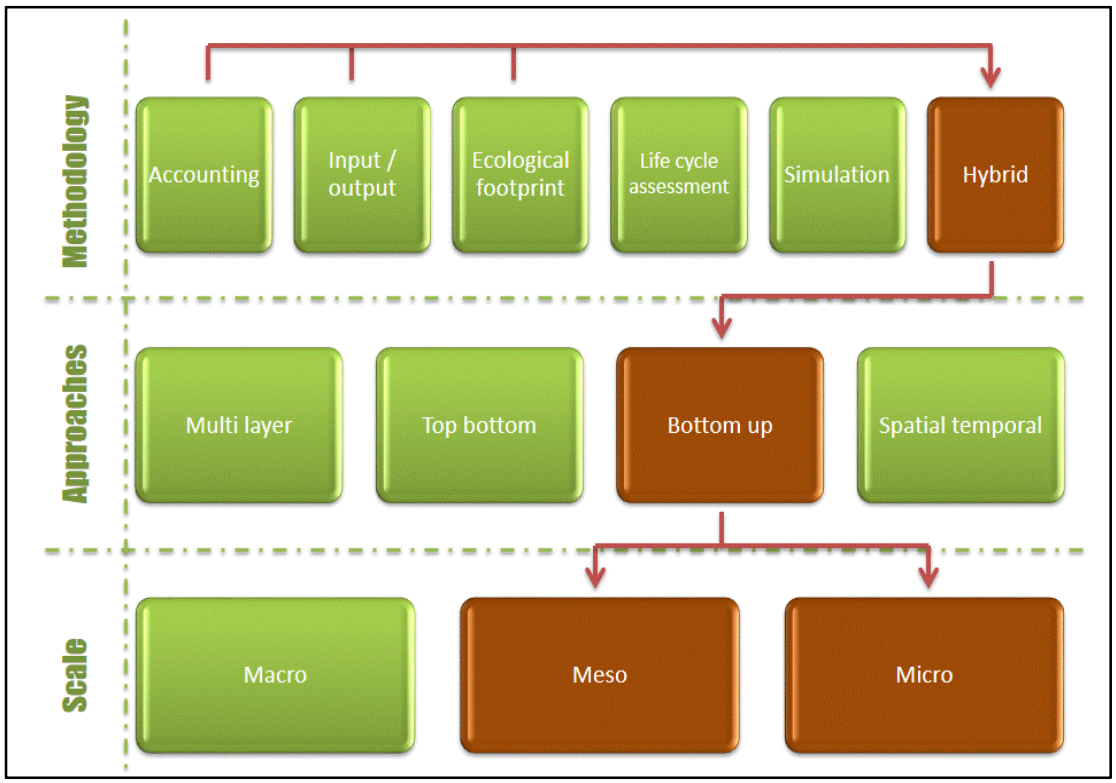

Figure 4

The empirical study shall only concentrate on meso to micro scales going back and forth between households to districts. Hybrid methodology indicates the need for establishing an unconventional line of inquiry, while bottom up approach stresses the urge for a suite of data gathering. The Empirical approach suggests a mobile application acting as a resource efficiency engine shall align with the required methodology, approach, and scale of analysis. (Figure 4)

6.1. Matrix Establishment (Formulation of a Convenient Interface)

As mentioned before, the new line of inquiry can be a mobile application that directly linked to actual users, and affording exact allocation. The following is a suggested matrix through which urban form, metabolic flows, inquiry schemes, resource efficiency leverage points and potential interventions are interrelated in order to come up with the required items to be assigned in an interface directly used via mobile phones.

Urban Form	**Metabolic Flow**	**Inquiry scheme**	**Resource efficiency leverage points**	**Potential intervention**	
				Short term	Long term
Household ↕ District	Energy (Electricity)	Consumption by item	Wattage usage	Promote Energy efficiency practices	Supply electricity saving appliances
		Collective consumption			Structure laws and enforcement
	Water	Consumption by item	Liters usage	Promote water efficiency practices	Supply water saving fixtures
		Collective consumption			Structure laws and enforcement
	Waste	Sorted Vs. Unsorted	Sorting schemes Co2 Emissions	Promote sorting on domestic scale	Structure collection schemes
					Establish sorting and recycling planets
	Transportation	Usage scheme	Co2 Emissions	Highlight carbon emission scheme	Encourage carpooling and public transportation
					Structure laws and enforcement
	Economy	Consumption schemes	Collective usage schemes	Allocate high consumption zones	Establish a single or multi economic hubs
		Acquisition schemes	User allocation	Allocate high interest zones	Structure laws and enforcement

Table

6.2. Scale of Inquiry

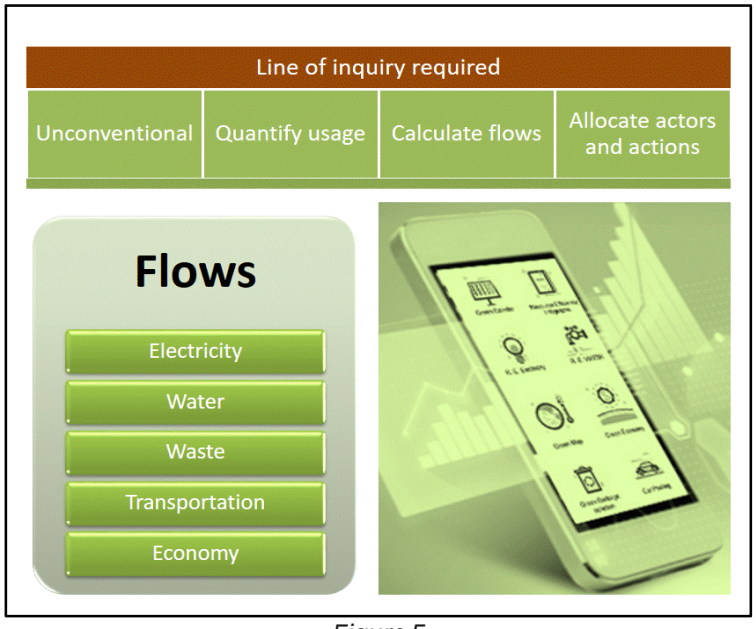

Figure 5

Urban environments and their behavior are managed at sub-national level, mostly, municipal or city level. Efficient interventions at municipal level can facilitate accomplishment of resource efficiency and other sustainable development objectives. Enhancing the understanding of a sustainable urban transition at local level needs linking general urban activities within urban planning. Urban metabolism assessment is recognized as a framework to operationalize resource flows and identify likely resource-efficiency measures. The present challenge of urban metabolisms is to transition from a linear perspective to a circular perspective. So as to move from theory to practical execution, this report proposes the following, founded on insights from literature:

- A necessity to undertake *basic urban metabolism assessment for all cities*
- Combine traditional *top-down approaches* with more *bottom-up approaches*
- Linking *spatial and temporal issues* in urban metabolism assessments
- Switching between the different *scales of analysis*
- Promoting a *Trans disciplinary approach*.
- Promoting *system dynamics modelling* to examine the complex, dynamic interrelationships that exist in physical and social processes of the urban metabolism.

A mobile application can form a new line of inquiry addressing metabolic flows and affording resource efficiency leverage points, highlighting actors and linking potentials to opportunities. (Figure 5)

7. Data Gathering Platform Development

The online application shall be formulated bridging in between various modules of exposer, exploration, implementation and networking; establishing a collective platform through which aspects of urgency, actions and management procedures can be introduced. (Figure 6)

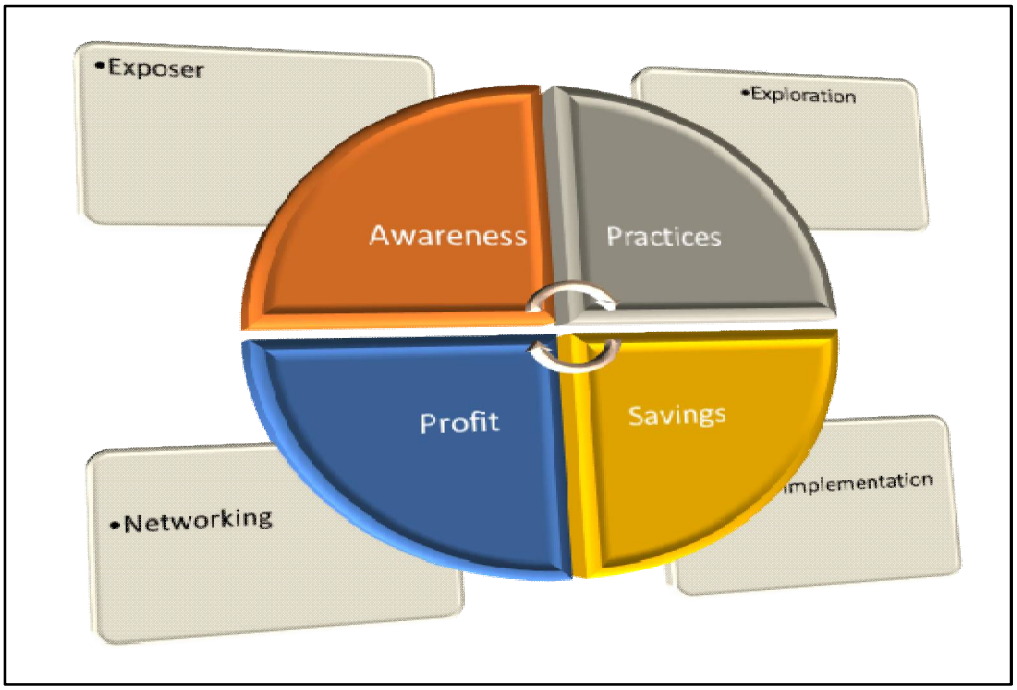

Figure 6

7.1. Potential Mapping

By the aid of "google maps "a full mapping process shall be applied on the area of greater Cairo to point out the intensity and geographic location of interested target groups

7.2. Target Group Justification

The application is targeting smart phone owners who are platform friendly with English based mobile applications. The application shall be freely downloaded through both apple and android stores.

7.3. Application of the Engine ... Getting on Online Stores

Once the application is online on stores, a daily monitoring shall be applied to highlight the following:

1. Numbers of downloads (interested quota)
2. Locations of downloaders (map based analysis of various areas the app have been downloaded in)

3. Age groups of interested downloaders
4. Professions of interested downloaders

Figure 7

It is hoped that such an application can highlight various resource efficiency aspects concerning urban development and establishing a data basing engine that can be used for:

1. Highlighting resource efficient potentials geographically.
2. Establishing green economy opportunities and linking investment to production.
3. Spreading awareness concerning resource efficiently to minimize the use of both energy and materials.
4. Formulating a reliable data base for resource efficiency in Egyptian cities.

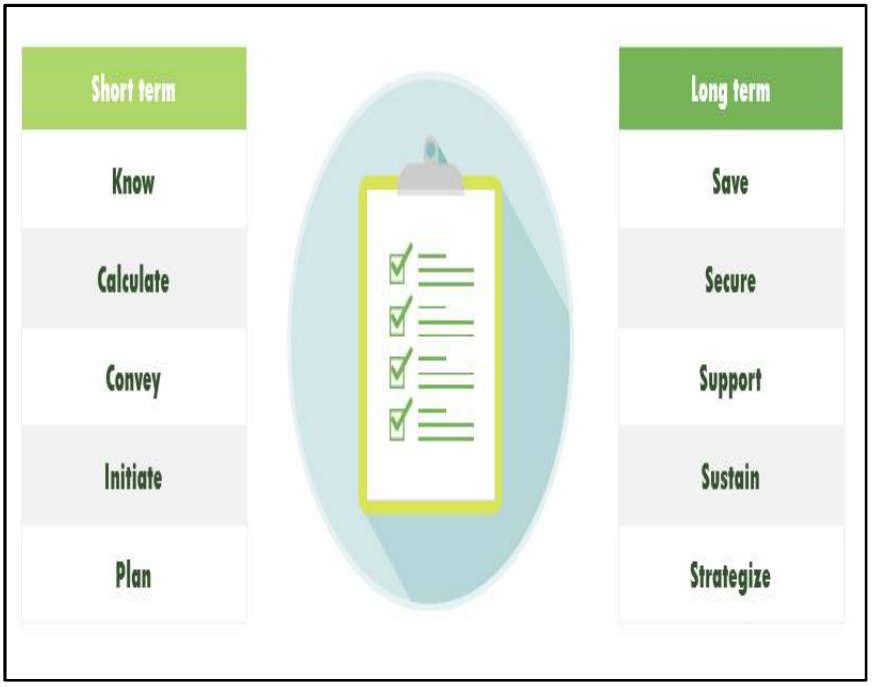

Figure 8

The application shall have two set of goals; short term and long term. The short-term goals go from knowledge of generic information, to actual calculations of resources flows. With such information available, users will be able to convey and share knowledge with other to spread awareness. Moreover, a fourth step shall evolve to form individual initiations, with a planning framework of efficient usage schemes that aims towards saving. (Figure 8)

Short term goals				
Know	Calculate	Convey	Initiate	Plan
Info	Watt Litters Co2 Gas	Communal interaction	Practices	Procedures
Long term goals				
Save	Secure	Support	Sustain	Strategize
Usage scheme	Consumption scheme	Communal projects	Reduce Reuse Recycle	Action plans

Figure 9

The long-term goals start with saving schemes built on knowledge, in addition, users shall start to secure their needs through the best efficient procedures. Support will evolve from individual initiations to communal network based projects. Sustainability 3Rs (Reduce, reuse, and recycle) shall take place forming a long term based communal strategy through which various actors are aligned. (Figure 9)

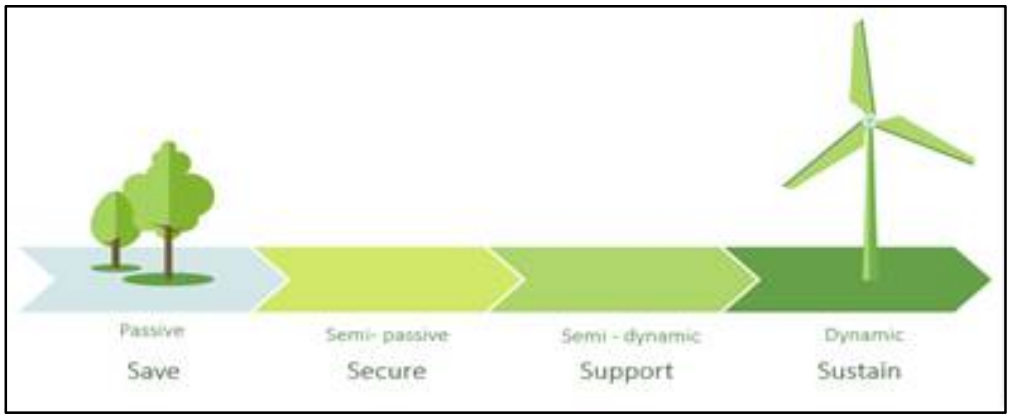

Figure 10

Such escalation from short term to long term goals is aligned with the fact that resource efficient practices shall move from passive to dynamic actions. (Figure 10)

8. The Suggested Online Application Interface

The following is the suggested interface and what each item shall afford concerning data built upon the previously introduced matrix, in order to acquire the required information as shown below.

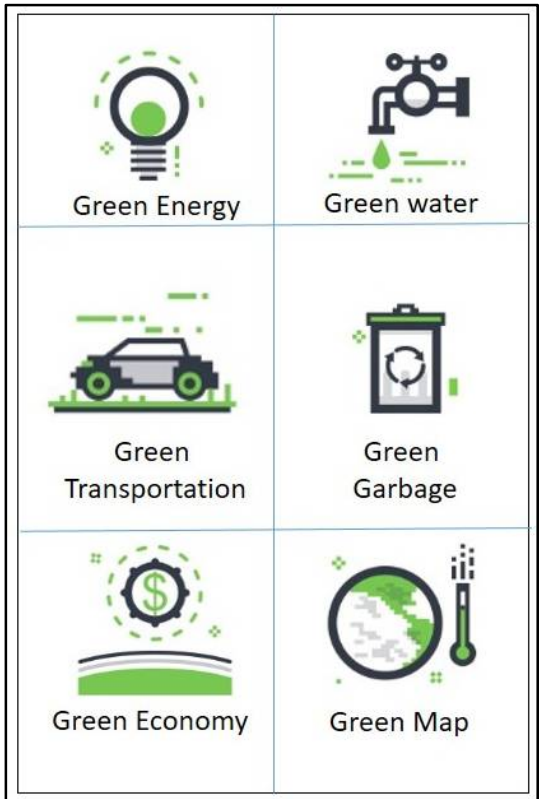

Figure 11

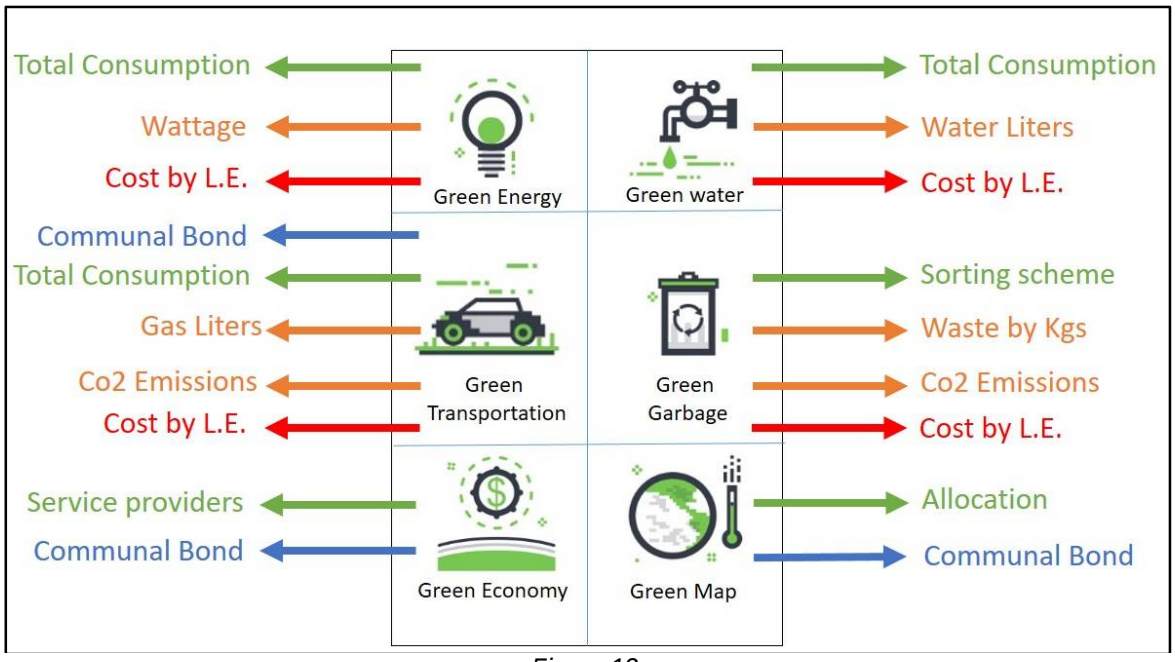

Figure 12

9. Conclusion

The quest of resource efficiency and its applicability in Egyptian cities is faced by the fact that exact, and reliable data is available. As resource efficiency is characterized by innovation, the process of acquiring data shall also establish nontraditional scheme of data inquiry. Adopting a hybrid method through a bottom-up approach on a meso-micro scale can quantify/calculate flows, as well as identify user groups and their consumption schemes. A mobile application can bridge the gap of data unavailability as it can directly relate to actual usage schemes of users, as well as being able to exactly allocate each and every resource based actions. Such application can act as a snowball medium, growing in time acquiring data, attracting users, and establish a realistic understanding of resources flows within the city. Such platform can gather both potentials, problems, and opportunities on a unified common ground where resource efficient action plans can be generated.

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