The Perceptions of Technology for Household Energy- a technological method approach

Jui-Chen Yu, Hung-Jen Yang, Hsieh-Hua Yang, Lung-Hsing Kuo and Hsueh-Chih Lin

***Abstract*—**The purpose of this study was to identify technology perceptions for household energy based upon both a technology structure approach knowledge level approach. Energy research could put focus on either of source or consuming. Energy consumer is the one who really decide how to use the energy. It is important to understand user's before trying to promote safety, energy conservation, and carbon reduction

***Keywords*—**Technology perceptions for household energy, Technological method

I. Introduction

THE speedy increasing amount of greenhouse gases on the earth's surface has caused global warming and climate change. The United Nations "International Panel on Climate Change" pointed that the climate change causes the rate of global warming become more quickly than the last century. It is expected to increase temperature and sea level rise surprisingly large.

The statistics of the United Nations revealed that the world population has reached more than 60 million, half of them located in Asia. Estimated total population in 2050 will grow to more than 90 million people, including the fastest-growing Asian region. Highly developed countries brought about the evil nature of the urban environment, will result in ecological imbalance in science and technology driven the rapid development of economic activities, so that human life is also abundant with the physical environment, but a lot of energy towards the development of a large number of consumption, waste a lot of ways, leading to people's lives in the form of the natural environment has exceeded its resilience.

At this point, energy consumption become a critical problem should be resolved. Human faces many challenges in the coming decades. Our children, and their children, will have to live with the effects of climate change. At the same time, Taiwan will need to import ever increasing amounts of energy as fossil fuel reserves diminish fast and prices grow higher than ever.

Many people feel they cannot respond to these challenges. They believe that there is nothing they can do, as individuals, which will change things. But everyone can do something, and collectively make a real difference: be more efficient in our own energy use.

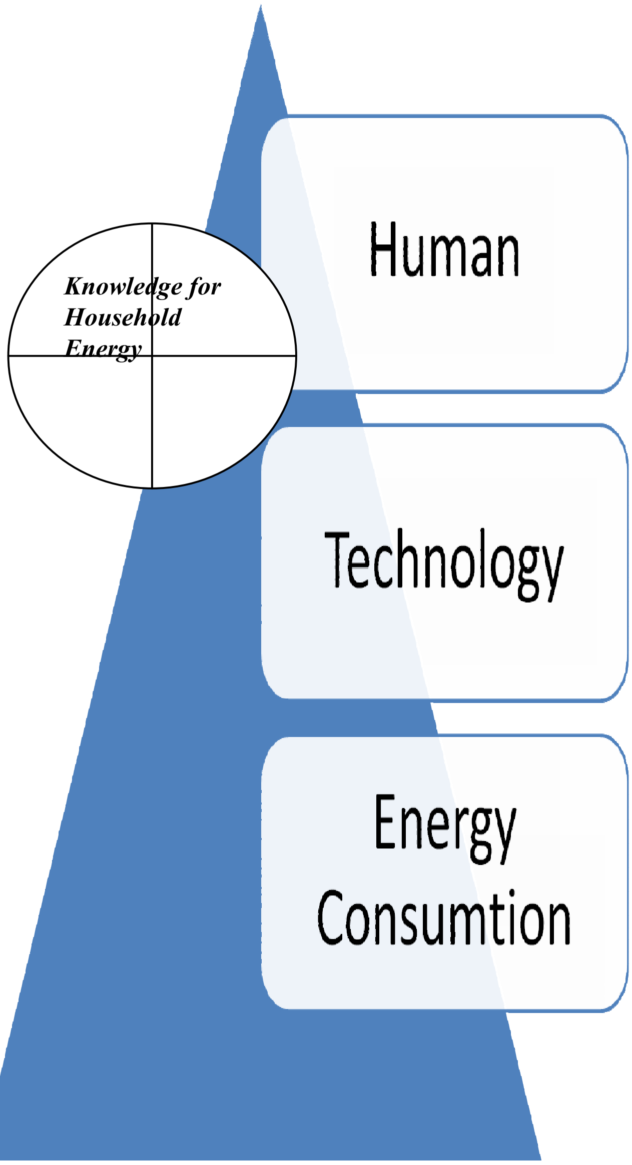

Figure 1Theory frame of the study

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Reducing the amount of energy used by choosing energy-efficient appliances and services that reduce energy use, and ensuring we do not waste energy can make a big difference. It is possible to cut its energy use by 20 % in real terms by 2020 without compromising on performance, through changes in consumer behavior and by investing in more efficient energy technologies-effectively doing more with less.

This makes sense both for society as a whole and for businesses, individuals and families. Less energy use means lower energy bills. People simply need to think about their energy use. Turn off the television-don't leave it on standby. Use energy-saving light bulbs. Insulate your roof. When buying a new car choose a fuel-efficient and less polluting model and keep your car tires at the correct pressure. And walk, cycle or use public transport whenever it makes sense. Improved energy efficiency is one of my priorities. But Europe can only achieve this goal if it becomes everyone's priority. I am sure that – together with our children – human could make a difference.

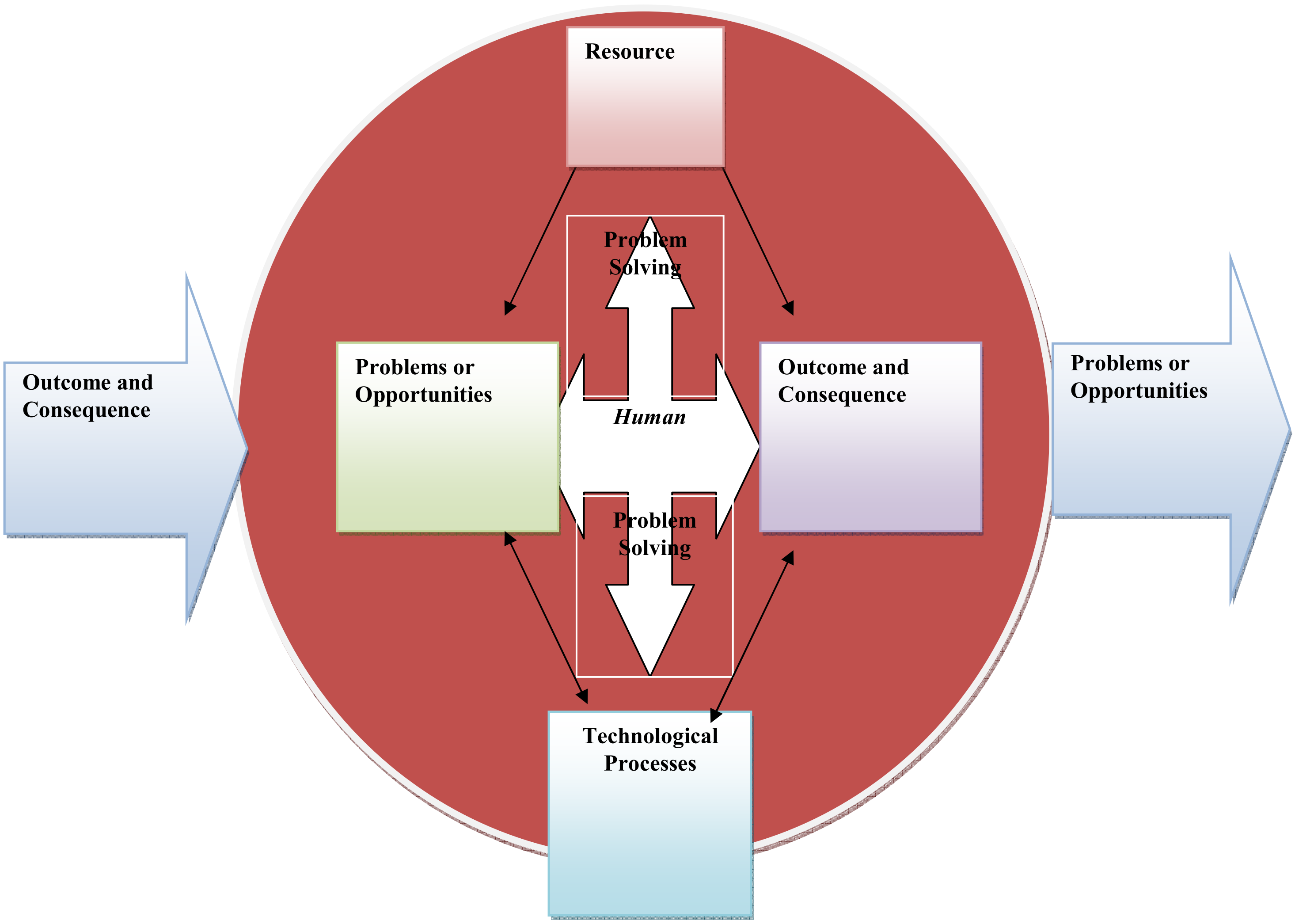

Figure 2Technological method

II. Theory Frame

Technology provide human the way to expanding their capability for whatever they willing to gain. Energy consumption is one part of technology use. To understand users' knowledge of household energy, the model of technological method could play a core role for referencing. The purpose of this study was to identify the knowledge for household energy according to the structure of the theory

A. Conceptual framework of energy Technology

The idea for A Conceptual Framework for Technology Education [1] came about as a result of a walk between conference venues at the Tulsa International Technology Education Association (ITEA) conference in 1988. Len Sterry and I were discussing the changes that were occurring in the professions of technology and the inability of the professions to react to those changes. We both felt that the front end material of the Jackson's Mill document was timeless but that the content organizers and processes were beginning to become dated. Also, we felt that the field was beginning to ask, "What comes after Jackson's Mill?"

A Conceptual Framework for Technology Education endorsed the human adaptive systems and domains of knowledge of the Jackson's Mill Industrial Arts Curriculum Theory (Snyder & Hales, 1981) while also focusing on the human as a problem solver who, through the application of the technological method model, could identify and address problems and opportunities and solve problems using resources and technological processes while considering the outcomes and consequences of such activity [2]. The significant contributions of this document are the listing of the universal attributes of technology; the comparison of the features of the body of knowledge of technology to the features of science and the humanities/arts; the development of the technological method model (see Figure 2) and its "spin-off"—a model for technology education; the inclusion of a broader base of content for the study of technology: the recognition of educational philosophies and bodies of knowledge related to technology, science, and the arts/humanities; identification of the methodological and content characteristics of a quality technology education program; and a process model for a course of study. The coauthor of A Conceptual Framework for Technology Education, Len Sterry, has reflected on the place that our document has in its linkage with contemporary initiatives. With his permission, I am presenting his perspective in the next several paragraphs. Note that Len calls his model "the technological method," a potential for confusion on the part of the reader, but Len was clear about his commitment to the new model as his view of the evolving representation of technology. Therefore, the term will be used with (Sterry) tagged to the model for clarification purposes[1].

The ITEA (2002) and its Technology for All Americans Project developed and published Standards for Technological Literacy: Content for the Study of Technology, with funding from the National Science Foundation and the National Aeronautics and Space Administration. Technology content standards are designed to help ensure that all students receive an effective education about technology by setting forth a consistent content for the study of technology. More specifically, the standards include the nature of technology, technology and society, design, abilities for a designed world, and the designed world. All five standard categories and all 20 standards are of equal importance.

B. The Technological Method

The technological method [1] is a model by which we "do" technology. By definition, technology is "know-how that extends human capability." It is more than just knowing; it is knowing and being able to do! It is based on a human desire to produce an outcome. So how does it work? As individuals, organizations, countries, and a world community, we are constantly faced with challenges, problems, and opportunities. To address these challenges, we draw upon our individual and collective knowledge bases along with other resources to produce a desired result.

When we are short of ability, we try to learn more through research and study. As we meet a challenge we usually create new problems and opportunities. In the process we also generate new knowledge that is added to our collective knowledge pool. And thus, the cycle continues, exponentially.

The body of technological knowledge, according to our frameworks and standards, includes our ability to manipulate matter and information.

Atoms account for the physical world of living and nonliving matter while bits make up the world of information. Information and materials technology represent, therefore, the know-how we apply to manipulating our world.

These processing concepts affect to all situations as we provide goods and services ranging from health care to automobiles, from entertainment to structures, from travel to education, and from family life to our global community. They are fundamental processes that apply universally. Therefore, they are concepts that, if taught and understood by students, will be transferable to many situations.

Conceptual understandings will also provide students with an ability to deal with technological change in the future, both personally and professionally. While information and materials technology could appear in the school program as technological systems of the designed world, these technologies are significant to the extent that they will also be a major part of the total curriculum design.

Technological processes are a result of the knowledge domain in the technological method. The processes usually include processing information and processing matter/materials, both living and nonliving.

Depending on a person's perspective, instrumentation is sometimes included as a part of processing information and energy is often separated from the bigger concept of processing matter. In a practical sense, either way will get the job done. Design is sometimes considered as a universal technical concept and included as a technological process. Again, this is not correct in a pure sense but does work well as a practical application.

As stated earlier, Standards for Technological Literacy: Content for the Study of Technology identified seven systems for the designed world. The U.S. Department of Education identifies 16 clusters associated with occupational education. Others have their own set of favorites.

The technological method [1] model identifies a category of human adaptive technological systems that could include any number of systems, depending on how one might choose to organize this part of the model. However, according to Sterry and Hendricks' [3] Exploring Technology, there are generic concepts that apply to human adaptive technological systems:

- Designing/determining products and services—Making decisions about what product or service will be produced.
- Planning production—Determining how the product or service will be delivered.
- Obtaining resources—Securing materials, energy, personnel, financing, and information.
- Tooling for production—Procuring or constructing the necessary apparatus and equipment.
- Actuating the process—Making it happen.
- Controlling production—Monitoring and adjusting the process.
- Packaging—Containerizing the product or service for protection, appeal, and transport.
- Distributing—Marketing and moving the product or service to storage or the consumer.
- Maintaining—Servicing products and relationships.

Using these concepts as a framework, different technologies or systems can be outlined. Some examples include communication; transportation; manufacturing; construction; information; materials; food and fiber; air, land, water, and environmental; energy; medical; and entertainment and media.

C.2.3. Levels of Knowledge

THE TAXONOMY OF EDUCATIONAL OBJECTIVES[4] is a framework for classifying statements of what we expect or intend students to learn as a result of instruction. The framework was conceived as a means of facilitating the exchange of test items among faculty at various universities in order to create banks of items, each measuring the same educational objective. Benjamin S. Bloom, then Associate Director of the Board of Examinations of the University of Chicago, initiated the idea, hoping that it would reduce the labor of preparing annual comprehensive examinations. To aid in his effort, he enlisted a group of measurement specialists from across the United States, many of whom repeatedly faced the same problem. This group met about twice a year beginning in 1949 to consider progress, make revisions, and plan the next steps. Their final draft was published in 1956 under the title, Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain [4]. (1) Hereafter, this is referred to as the original Taxonomy. The revision of this framework, which is the subject of this issue of Theory Into Practice, was developed in much the same manner 45 years later [5]. Hereafter, this is referred to as the revised Taxonomy. (2)
Bloom saw the original Taxonomy as more than a measurement tool. He believed it could serve as a

- common language about learning goals to facilitate communication across persons, subject matter, and grade levels;
- basis for determining for a particular course or curriculum the specific meaning of broad educational goals, such as those found in the currently prevalent national, state, and local standards;
- means for determining the congruence of educational objectives, activities, and assessments in a unit, course, or curriculum; and
- panorama of the range of educational

possibilities against which the limited breadth and depth of any particular educational course or curriculum could be contrasted.

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Like the original, the knowledge categories of the revised Taxonomy cut across subject matter lines. The new Knowledge dimension, however, contains four instead of three main categories. Three of them include the substance of the subcategories of Knowledge in the original framework. But they were reorganized to use the terminology, and to recognize the distinctions of cognitive psychology that developed since the original framework was devised. A fourth, and new category, Meta-cognitive Knowledge, provides a distinction that was not widely recognized at the time the original scheme was developed. Meta-cognitive Knowledge involves knowledge about cognition in general as well as awareness of and knowledge about one's own cognition. It is of increasing significance as researchers continue to demonstrate the importance of students being made aware of their meta-cognitive activity, and then using this knowledge to appropriately adapt the ways in which they think and operate.

The original number of categories, six, was retained, but with important changes. Three categories were renamed, the order of two was interchanged, and those category names retained were changed to verb form to fit the way they are used in objectives.

The verb aspect of the original Knowledge category was kept as the first of the six major categories, but was renamed Remember. Comprehension was renamed because one criterion for selecting category labels was the use of terms that teachers use in talking about their work. Because understand is a commonly used term in objectives, its lack of inclusion was a frequent criticism of the original Taxonomy. Indeed, the original group considered using it, but dropped the idea after further consideration showed that when teachers say they want the student to "really" understand, they mean anything from Comprehension to Synthesis. But, to the revising authors there seemed to be popular usage in which understand was a widespread synonym for comprehending. So, Comprehension, the second of the original categories, was renamed Understand.

Application, Analysis, and Evaluation were retained, but in their verb forms as Apply, Analyze, and Evaluate. Synthesis changed places with Evaluation and was renamed Create. All the original subcategories were replaced with gerunds, and called "cognitive processes." With these changes, the categories and subcategories--cognitive processes--of the Cognitive Process dimension[5].

Whereas the six major categories were given far more attention than the subcategories in the original Taxonomy, in the revision, the 19 specific cognitive processes within the six cognitive process categories receive the major emphasis. Indeed, the nature of the revision's six major categories emerges most clearly from the descriptions given the specific cognitive processes. Together, these processes characterize each category's breadth and depth[5].

Like the original Taxonomy, the revision is a hierarchy in the sense that the six major categories of the Cognitive Process dimension are believed to differ in their complexity, with remember being less complex than understand, which is less complex than apply, and so on. However, because the revision gives much greater weight to teacher usage, the requirement of a strict hierarchy has been relaxed to allow the categories to overlap one another. This is most clearly illustrated in the case of the category Understand. Because its scope has been considerably broadened over Comprehend in the original framework, some cognitive processes associated with Understand (e.g., Explaining) are more cognitively complex than at least one of the cognitive processes associated with Apply (e.g., Executing). If, however, one were to locate the "center point" of each of the six major categories on a scale of judged complexity, they would likely form a scale from simple to complex. In this sense, the Cognitive Process dimension is a hierarchy, and probably one that would be supported as well as was the original Taxonomy in terms of empirical evidence [5].

III. Knowledge Scale for Household Energy

Based upon technology method model, a scale of knowledge scale was designed and standardized. There are 33 items within four dimensions.

- Household Energy Resources
- Household Energy problems/ opportunities
- Household Energy processes
- Household Energy outcomes and consequences

There are three categories in the communication channels. Those are formal education and government institutions sector, social interaction sector, and informational media sector. For the other four dimensions, factual, conceptual and procedural knowledge are three types of energy knowledge considered for exploring.

Table 1 Knowledge Scale for Household Energy

1. I could identify what is energy consumption equipment such as an air conditioner.
2. I could identify type of certain energy consumption equipment such as an air conditioner.
3. I could operate energy consumption equipment such as an air conditioner.
4. I could distinguish whether energy consumption equipment such as an air conditioner is needed.
5. I could identify the criteria of choose certain energy consumption equipment such as an air conditioner.
6. I could choose appropriate energy consumption equipment such as an air conditioner.
7. I notice the safety issue of using energy consumption equipment such as an air conditioner.
8. I understand how to safely operate energy consumption equipment such as an air conditioner.
9. I could follow safety operating procedure to use energy consumption equipment such as an air conditioner.
10. I notice the energy conserving issue of using energy consumption equipment such as an air conditioner.
11. I understand how to be conserving operating energy consumption equipment such as an air conditioner.
12. I understand the step of energy conserving of operating equipment such as an air conditioner.
13. I understand energy supply is required for energy consumption equipment.
14. I understand there are certain rules should be followed when using energy.
15. I understand there are certain steps should be followed when using energy.
16. I understand maintenance is required for energy consumption equipment such as an air condition.
17. I understand maintenance items of energy consumption equipment such as an air conditioner.
18. I understand how to maintain the component of energy consumption equipment such as an air conditioner.
19. I understand measuring equipment is required for assessing energy consumption equipment such as an air conditioner.
20. I understand assessing items of measuring energy consumption equipment such as an air conditioner.
21. I understand assessing procedures of measuring energy consumption equipment such as an air conditioner.
22. I understand energy consumption equipment such as an air conditioner would use energy for operating.
23. I understand energy utilization principles for operating energy consumption equipment such as an air conditioner.
24. I understand energy utilization procedures for operating energy consumption equipment such as an air conditioner.
25. I could evaluate energy consumption equipment such as an air conditioner after using.
26. I understand the criteria of evaluating energy consumption equipment such as an air conditioner.
27. I understand the evaluating procedure of assessing energy consumption equipment such as an air conditioner.
28. I understand the cost of using energy consumption equipment such as an air conditioner.
29. I understand the charge stander of using energy consumption equipment such as an air conditioner.
30. I understand how to calculate the cost of using energy consumption equipment such as an air conditioner.
31. I understand there is the aging limit of energy consumption equipment such as an air conditioner.
32. I understand the aging stander of energy consumption equipment such as an air conditioner.
33. I understand the procedure of energy consumption equipment substitution.

A two sizes scale from uncertainty to certainty was applied for those 33 items.

IV. CONCLUSIONS

Energy consumption is an important issue and had been studied repeatedly [6-9]. The purpose of this study was to identify the knowledge for household energy based upon both a technology structure approach knowledge level approach. A proposed model in Fig. 3 was conducted according to the original model of technological method.

In this study, a thirty-three item scale was designed for evaluating knowledge for household energy. It was based upon the model in the figure 3. Energy research could put focus on either of source or consuming. Whenever focus on consuming, technology theory model would play a well reference role for exploring energy problem as a general technology problem. Energy consumer is the one who really decide how to use the energy. It is important to understand user's before trying to promote safety, energy conservation, and carbon reduction. This study contribute reveal the relationship between technology theory model and the knowledge for house hold energy.

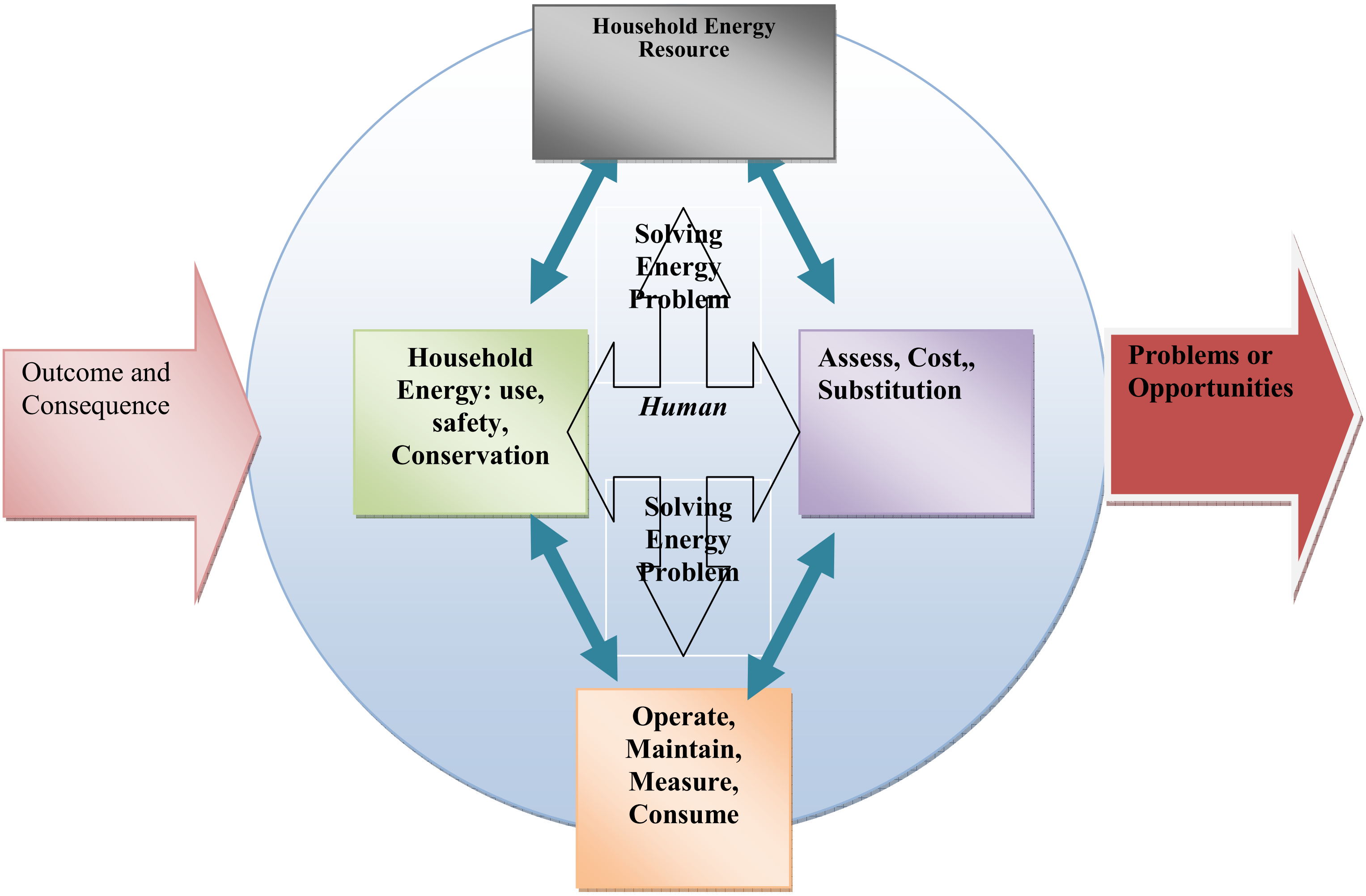

Figure 3 Proposed Model based upon technology method approach

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