Industrial Ecology Open Online Course (IEooc)

Part III: Application

Application part 4: Energy and Sustainability

http://www.teaching.industrialecology.uni-freiburg.de/

IEooc_Application4_Exercise1: Energy Sufficiency

Sample Solution

Goal: *Understand energy sufficiency as a concept and compare it with energy efficiency; think about ideas to introduce energy sufficiency in households; work with numbers to calculate energy savings potential; think about how energy sufficiency can be implemented on a larger scale*

According to the International Energy Agency (IEA), energy efficiency increased remarkably in OECD countries in the last four decades. But, the total energy consumption decreased only by a small number in some countries. In Germany, the total power consumption in the residential sector remained more or less constant over the last decade. This means that energy efficiency is only one of the main determinants of energy consumption of appliances.

In a report titled "Energiesuffizienz" (energy sufficiency), Brischke et al. introduce a causal chain of transformation from basic needs to technical service supplied. Figure 1 shows this chain. According to this concept, **basic, culturally independent needs** (e.g. health) are transformed into **demands, needs and desires** (e.g. fresh food), which are then transformed into **utility needed** (chilled food) and **utility aspects desired** (certain amount of chilled food at home). The final **technical utility demanded** (e.g. refrigerator) is what the consumer needs, which he/she seeks in an appliance with a certain **technical service**.

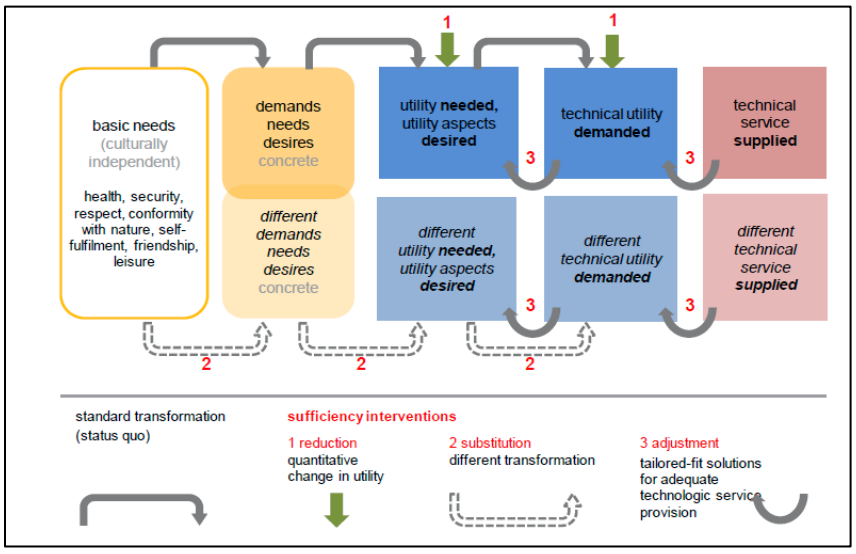

Figure 1: Causal chain of transformation from basic needs to technical service supplied, energy efficiency approaches and points of intervention. Source: Brischke et al. (2015).

The energy sufficiency approach in this causal chain of transformation can be introduced by three approaches – reduction of utility, substitution, and adjustment. Figure 1 also shows points of intervention where these approaches can be introduced in the chain.

With this concept of energy sufficiency in mind, complete the following tasks:

1. ***Select three devices/appliances in a common household which require energy for their use.***

   Three examples of devices in a household which require energy for their use: washing machine, lamp, refrigerator.

2. ***For these three devices/appliances selected, identify:***
   a. ***Basic, culturally independent needs***
   b. ***Culturally influenced demands, needs, desires***
   c. ***Utility needed and utility aspect desired***
   d. ***Technical utility demanded***
   e. ***Technical service commonly supplied***

   For a washing machine:
   a. **Basic, culturally independent need**: Health
   b. **Culturally influenced demands, needs and desires**: Clean, fresh clothes (which smell nice probably)
   c. **Utility needed**: Certain number of washed clothes, **Utility aspects desired**: Clothes' drying, good design (for use as a status symbol), ability to wash different kinds of clothes in different ways, automatic operation, durability, etc.
   d. **Technical utility demanded**: Washing machine (with a dryer, good design and multiple washing options, automatic operation, durability, etc.)
   e. **Technical utility supplied**: Washing machines available in the market

   For a lamp:
   a. **Basic, culturally independent need**: Self-fulfilment, Security, Leisure
   b. **Culturally influenced demands, needs and desires**: Illumination during night time
   c. **Utility needed**: A source of illumination of some intensity and brightness, **Utility aspects desired**: Comfortable color, durability, ease of installation, etc.
   d. **Technical utility demanded**: A lamp (of a certain color and brightness which could last long and could be easily installed, etc.)
   e. **Technical utility supplied**: Lamps available in the market

For a refrigerator:

a. **Basic, culturally independent need**: Health
b. **Culturally influenced demands, needs and desires**: Fresh food
c. **Utility needed**: Certain amount of fresh food, **Utility aspects desired**: Freezer, good design, durability, temperature control, etc.
d. **Technical utility demanded**: A refrigerator (including a freezer, with good design, durability, temperature control, etc.)
e. **Technical utility supplied**: Refrigerators available in the market

3. ***For the three devices/appliances, think about how energy sufficiency can be introduced at different points of the chain through each of the three approaches: reduction, substitution, adjustment***

For the example of the lamp:

a. Reduction:
    i. *While transforming demands, needs, desires to utility needed and desired*: Reduce the intensity requirement of your lamp because you don't need very high intensity for the work you are doing.
    ii. *While transforming utility needed and desired to technical utility*: Maybe you don't need a specific color (special colored lights may consume more energy)
b. Substitution:
    i. *While transforming basic needs to demands, needs, desires*: Maybe you could finish your work before dark so that you don't need illumination. Find alternate ways of ensuring security in dark rather than installing a light.
    ii. *While transforming demands, needs, desires to utility aspects needed and desired*: Maybe use candles
    iii. *While transforming utility aspects needed and desired to technical utility demanded*: Use a CFL
c. Adjustment:
    i. *While transforming utility aspects needed to technical utility needed*: Change the number and specifications of the lamps you need
    ii. *While matching technical utility needed and technical utility supplied*: Go for an option which meets all your minimum criteria but don't go for lamps which provide more than you need. Look for lamps which have brightness control to adjust the brightness according to need. Automatic lamp turning on/off.

4. ***For these three devices/appliances, come up with a rough energy consumption per month figure. You are free to take any assumptions necessary.***

   For an incandescent lamp, electricity used = 60 W
   Assuming the lamp is used 5 hours a day every day, for a month, the energy consumption would be: $60 \times 5 \times 30$ = 9000 Wh or 9 kWh.

5. ***In line with the energy sufficiency approaches identified in part 3, calculate energy savings potential for the devices/appliances.***

   For some energy sufficiency measures:
   a. Reducing daily usage to 4 hours instead of 5: Energy consumption will be 7.2 kWh and savings will be 1.8 kWh per month for one lamp.
   b. Reducing intensity of the lamp from 800 lumens to 450 lumens will change the electricity input roughly to 40 W. So, energy consumption will be 6 kWh and savings will be 3 kWh per month for one lamp.

Further, think and discuss about the following:

1. ***How does energy sufficiency differ from energy efficiency? Are these approaches complementary or substitutive?***

   Energy efficiency, in the simplest terms, means increasing the performance of an appliance. This means improving the performance so that you get the same output for minimum input of energy. Whereas, energy sufficiency focuses on reducing the total energy consumption of the system, which involves not only reducing the consumption of energy by means of technical performance enhancement, but also reducing the output desired from the appliance. Therefore, energy efficiency and sufficiency go hand in hand. While it's important to enhance the performance of an appliance, it is also necessary to reduce total power consumption while in operation.

2. ***How could design play a role in energy sufficiency?***

Consider an example of modern information technology devices. Today, we have phones, laptops, tablets and even televisions which can perform similar functions. Why has it become necessary for us to own each of these devices? There is something which is missing in each of these devices while also something which is unique to each of them. A good sufficiency-focused design would be incorporating features from all of these different devices into one single device that would eliminate the need for owning and operating the individual devices. Modular design, where different parts of the device could be detached and reassembled could solve the problem of sizing and specific hardware requirements of these different devices. A sufficiency oriented design method aims for longer duty cycles of devices at reasonable efficiency throughout the cycle. It also considers what happens to the product after it has run its duty cycle, for example, recycling of your used phone or your laptop.

3. ***What kind of energy policy options exist for the sufficiency approaches identified in part 3 above? To identify them:***
    a. ***Think about barriers to implementation of these approaches***
    b. ***Think about policy actions needed for the sustainable options***
    c. ***Build the policies into an integrated strategy***

For the example of a lamp, some policy options would be: implementing a rule banning all incandescent lamps (regulatory), promotion of CFL using energy efficiency ratings on lamps (informative), giving away free first CFLs to all homes (economic), etc.

a. **Policy barriers**: Introducing a law banning incandescent lamps would need monitoring and enforcement of the law. Also, some people would be displeased by such a measure. In case of energy efficiency ratings, people might not be able to interpret what they mean or they may not pay attention to the ratings at all. In case of giving away first CFLs, it would require the government to spend its money.
b. **Policy actions needed**: For a law, it must be approved at the local governing level. Similar for energy efficiency ratings. If these ratings are to be introduced, this means all manufacturers must start indicating their energy efficiency figures on lamps which again means introduction of some kind of law. For economic incentive, a budget has to be calculated and it must again be approved by the appropriate governing body.
c. **A combined strategy** might include combination of two or more policy measures which fit well. For example, energy efficiency standards, plus the 'free first CFL' measures could be grouped together to form a policy package.

References:

Brischke, L.A., Lehmann, F., Leuser, L., Thomas, S. and Baedeker, C., 2015. Energy sufficiency in private households enabled by adequate appliances

Thomas, S., Brischke, L.A., Thema, J. and Kopatz, M., 2015. Energy sufficiency policy: an evolution of energy efficiency policy or radically new approaches?