

Chapter 3: Related Theories, Concepts and Definitions

3.1 The Polluter Pays Principle (PPP) and the User Pays Principle

3.1.a Concept

Early history

The Polluter Pays Principle and its extension, the User Pays Principle¹⁷ are descendants of the Precautionary Principle, which evolved out of a German socio-legal tradition that is called "Vorsorgeprinzip". It was first introduced into German politics during the period of democratic-socialist governments in the early 1930s. The main concept was that of "good household management" and was regarded as a constructive partnership between the individual, the economy and the state. Its aim was to manage change so as to improve the lot of both society and the natural world upon which it depended for survival, thus investing the Precautionary Principle with a managerial or programmable quality, a purposeful role in guiding future political and regulatory action.

The "Vorsorgeprinzip" means more than the literal English translation of "foresight planning": "...it absorbs notions of risk prevention, cost effectiveness but in a looser economic framework, ethical responsibilities towards maintaining the integrity of natural systems, and the fallibility of human understanding. The rights of nature means, in part, giving it room to accommodate to human interference [...e.g., the creation of the human environment...]. Precaution presumes that mistakes can be made. For the Germans, therefore, precaution is an interventionist measure. As such it is a justification of state involvement in the citizens' everyday life to achieve good governance. Social planning in the economy, in technology, in morality and in social initiatives all can be justified by a loose and open-ended interpretation of precaution...'¹⁸. For the concept to be practical and successful, it has to be interpreted, defined and implemented in accordance with the local conditions and populace that are subject to management tools based on its principles.

The definition of ownership and responsibility changes

In the past one of the problems of implementing the Precautionary Principle, and later PPP and UPP, has been the liability for pollution from the use of what is called 'The Commons'. These are all physical aspects of an environment and the resources it contains, which are not owned by a person or any organizational body. In human society, ownership is a concept that is preliminary to that of responsibility. As no one person owns 'The Commons', no one is responsible for its maintenance. Regarding pollution, under the old and in many countries still standard definition of ownership, the following rule applied:

A person / body / economic agent is held responsible for pollution/pollutants that are either generated or deposited on property owned and remain there. Once the pollutants have left the property, which is the ownership, the responsibility ceases.

During the industrialization over the last 150 years, this definition has been modified in various forms. In the late 19th century, an old English proverb stated that: "Where there is muck, there is a buck." Meaning that where pollution occurs, there is human activity and industry and there are jobs available: During the early period of industrialization pollution was a way of life.

¹⁷ Both principles are referred to in this study as "PPP", for the Polluter Principle, and "UPP", for the User Pays Principle.

¹⁸ Interpreting the precautionary principle, Earthscan publications Ltd. 1994

An increase in health consciousness brought about a slow change in attitude until the 'London Smog' in the 50s brought the first decisive legislation to slowly modify definitions of ownership and responsibility in order to clean the by then un-breathable London air, as provisions in common laws were not sufficient to define a party or parties that could be directly held responsible. Similar phenomenon in other industrialized countries started to occur frequently and the idea of the 'Vorsorgeprinzip' was revived and led to a new understanding of ownership and a new definition of responsibility, based on precaution:

A person / body / economic agent is held responsible for actual and future pollution/pollutants that are either being generated or deposited on their property and either remain there or are leaving the property in any which way of dispersion. The polluter is also responsible for pollution that is either directly or indirectly generated in order to produce and provide resources or consumer items, as well as pollution generated during any form of consumption independent of location. Consumption equals ownership, which equals responsibility.

From the 70s to the present

Especially during the 70s and 80s in Europe, e.g., the OECD member countries, international guidelines for the local implementation of precaution were introduced, extending to six basic concepts:

- Preventive anticipation
- Safeguarding of ecological space or environmental room for maneuver
- Proportionality of response
- Duty of care and onus of proof on those who propose change
- Promoting the cause of intrinsic natural rights
- Paying for past ecological debt

PPP evolved directly out of those concepts. While retaining the main characteristics of the precautionary principle, it focuses on ecological costs¹⁹ created by economic and human activities. Through the responsibility or financial liability of the polluter those costs are economically internalized.

PPP was introduced into environmental politics as early as 1972 by the OECD-Council and here explicitly named as "Polluter Pays Principle". The early definition was '...for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources...'. Since then the principle has changed into a general instrument to avoid excess (unnecessary) pollution by redefining the terms ownership and responsibility. It is not regarded a sole instrument for pollution prevention anymore, as the international environmental law lists the method of prevention as an independent principle.

The Rio-Declaration²⁰ (1992) finally addresses PPP under the paragraphs 13 and 16. By asking the participating states to establish clear responsibilities for environmental damage and pollution in paragraph 13, Rio refers to the essence of the principle "responsibility through ownership" without mentioning PPP explicitly. Paragraph 16 takes this approach onto an international level, by holding the polluter always responsible in principle, worldwide. While PPP focuses mainly on the economy and is an effort to internalize environmental costs into production or development activities, UPP considers pollution on a more general scale by defining, ecologically correct, any form of consumption as pollution. This enables

¹⁹ also called social cost

²⁰ Rio Declaration on Environment and Development, <http://www.gene.com>, here under </ae/AB/IE/Rio_Declaration_On_Environment.html >

governments and administrations to introduce precaution-related policies and measures to the final consumer of a product (and thus every citizen), widening the focus to more than the production cycle itself. The term responsibility is directly linked to consumption and becomes more important than the term polluter or pollution.

Also in 1992, the Paris conference of the OECD, under guidance of the environment directorate, issued an analysis and recommendations for the Polluter Pays Principle²¹. It re-defines terms and introduces a few international guiding principles to be applied within the member states of the OECD and in accordance with associate partners, like for example the United States, Japan and Australia. Here, PPP is regarded as an economic principle for allocating the costs of pollution control and pollution prevention. It is therefore in economic terms addressed as 'partial internalization of [environmental] costs'. Bridging PPP to UPP, the term residual pollution is introduced and defined as 'pollution that occurs after all measures in regard to pollution ordered by the administration have been [applied] successfully'. Polluters are charged 'pro rata', which is for the part of the pollution for which they are directly responsible, for example through consumption of manufactured goods. Although the polluter pays, he is simply the first to pay and he may pass the cost on to the person/body who is actually liable²².

Who is the polluter?

According to the OECD recommendations, at a community level, any person who directly or indirectly causes deterioration of the environment, or establishes conditions leading to its deterioration, is considered the polluter. For example: under this definition, all parties, including the City administration, that were involved in building the Sky-train in Bangkok, would be responsible to ease air-pollution that accumulates under the over-head rails in Bangkok city streets. However, transportation is regarded as a form of environmental change that involves so many parties, that it is recommended '...to identify the polluter as the body / person / economic agent that pays a decisive role in the pollution'. This refers to the fact that pollution often occurs in the form of a pollution-chain and environment degradation has to be understood as a phenomenon where a multitude of factors are responsible for the pollution resulting from consumption activities.

The environment directorate concludes that, '... The polluter Pays Principle started out as an economic principle and has recently become a legal one. It has not yet been codified, for its content has changed and will continue to do so. The predominant trend is to place further liability on the polluter and to alleviate the economic burden which pollution places on the authorities. The Polluter Pays Principle is not a principle of equity; it is designed not to punish polluters but to set appropriate signals in place in the economic system so that environmental costs are incorporated in the decision making process and hence arrive at sustainable development that is environmentally friendly. The aim is to avoid wasting natural resources and to put an end to the cost free use of the environment²³ as a receptacle for pollution. A degree of environmental pollution will certainly persist, and the consumer will bear the cost initially charged to the polluter. But use of the Polluter Pays Principle will

²¹ OECD / GD (92) 81, "The Polluter Pays Principle, OECD Analysis and Recommendations", published by OECD, Environment Directorate, Paris 1992

²² For example, a given company might run on environmentally sound machinery, but it may use more resources than necessary for packaging their products. The final consumer has no choice but to purchase the product with the resource wasted for packaging. This increases the amount of household waste and, although the final consumer pays per volume of collected household waste by the municipal waste collection, part of the cost can be recovered from the producer. In Europe, supermarkets are required by law to offer waste bins for packaging material to their customers, who can, thus, leave packaging material at the shop. The more material is collected, the higher the disposal costs for the supermarket, which will therefore consider carefully what products are put on their shelves. (More examples of PPP or UPP implementation are discussed in the next chapter.)

²³ See also: "The tragedy of the commons", by Harding Garret.

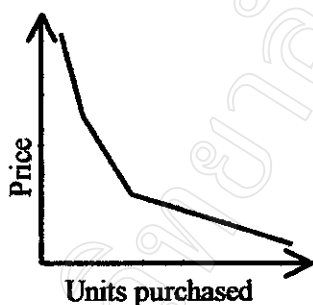
secure economic efficiency and will reduce distortions in (...) trade and investment to a minimum’.

Partial internalization of [environmental] costs

Based on the ‘open market’ or ‘open system’ definition of economics we can describe three steps in the production process:

1. The collection and distribution of natural resources from the natural environment.
2. The processing of those resources into products for consumption.
3. The releasing of wastes back into the environment under steps one and two.

The releasing of waste is a natural process (see also appendix A7: sustainability) and has to occur. However, it can reach a critical extent when the amount of pollutants collected over time in an environment reaches a level dangerous to life forms. It is then called man-made pollution, or simply pollution. This phenomenon was first been considered by the economist Pigou²⁴ a few decades ago and was described analytically as ‘externality’. Under the ‘materials balance model’ or ‘the Pigouvian Taxation Theory’ economic theory tries to integrate costs for the environment resulting from pollution into material costs in order to achieve a self-regulating economic mechanism that establishes efficiency in resource consumption. This process is called ‘internalization’.



Graph 1: Cost per consumed unit without economic internalization

Without internalization applied, the more resources someone consumes the lower the price per unit of that resource, as is shown in the following graph. This system rewards extensive use of resources as it applies the principles of external economic systems, which are based on

- the scarcity of goods,
 - supply, and
 - demand,
- without considering ‘The Commons’.

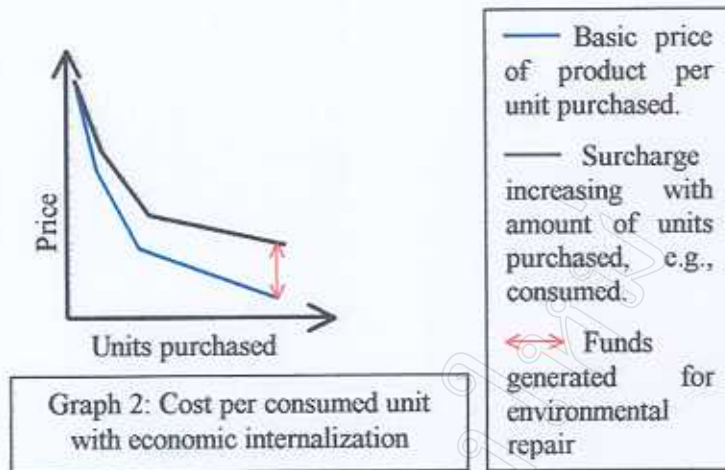
The more electricity a company uses, or the more water an agricultural company consumes, the lower their pro-rata resource cost. The costs for the cleaning of polluted water are externalized, which means that they are not included in the overall cost of the resource water. Instead, managerial concepts are in place that charge consumers per volume of wastewater charged into the public drainage system. It duplicates the principle of externalization and charges the less per unit/volume of wastewater the more you release into the public system.

Under the economic principle of internalization used in PPP and UPP, water consumed is water polluted. The more someone consumes the higher the output of pollutants into the environment. Due to the principle of direct liability, the cost for repairing the pollution damage increases with the amount. This is reflected in a surcharge put onto the price of, for example, water. Someone using little water creates minor pollution and thus the surcharge is low and vice versa. (See graph 2)

²⁴ - คณิต เศรษฐศาสตร์. เศรษฐศาสตร์สิ่งแวดล้อม. เชียงใหม่. 2526

- ปรีชา เบียมพงษ์สามดี. นิเวศเศรษฐศาสตร์และนิเวศวิทยาการเมือง. พิมพ์ครั้งที่ 1. โรงพิมพ์จุฬาลงกรณ์มหาวิทยาลัย. กรุงเทพฯ 1.2541

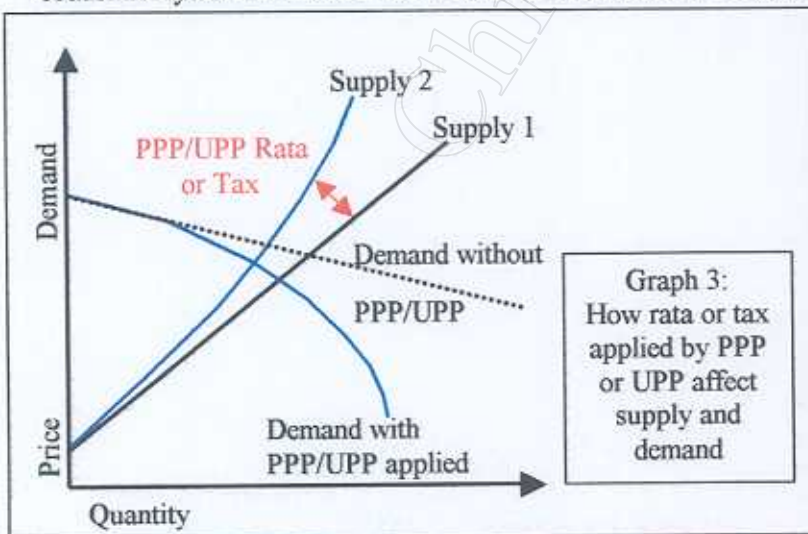
- เวียงเดจ ศิวกรภน. เศรษฐศาสตร์สิ่งแวดล้อม. หลักสูตรและปัญหาสิ่งแวดล้อมไทย. กรุงเทพฯ. 2531



How can PPP and UPP secure economic efficiency on ecological terms?

Economic efficiency can be defined by the economic concept of the free market itself. In economic theory all goods are scarce. This fact creates the demand/supply relationship between consumer and consumer goods, regulated through a price profile. If certain goods or resources for consumption are not scarce, the market will fail to establish a value or price for that item. The self-regulating mechanism of economics cannot take hold, as the consumption of such a good is not defined by capital expenditure. The scarcity of a good is linked to the total amount available in the natural and market environment and to ownership, which presents a limitation on the availability of certain resources or manufactured goods. Without ownership any consumer could walk into any store and take, for example, a car for free, even if that car were manufactured by using some scarce resources. The capital expenditure necessary to acquire that car would not reflect the availability of the good on the market, its scarcity. This is exactly how economic theory of the past treated resources of 'The Commons'. No one considered the air that people breathe, the water that they consume or the environment they utilize as a commodity until the rapid increase in human population and resource consumption created the London smog in the 1950s. Then, for the first time there was an obvious environmental crisis that affected everyone with no one to blame but all consumers, equally.

Internalization through PPP or UPP integrates the resources of 'The Commons' into the economic cycle. It reflects a truth that humans have not realized before, because there is so



much of 'The Commons' about us: *Everything and every single resource is scarce and limited, even air, independent of how limitless and abundant the resource seems initially.*

In combination with a new definition of ownership, and thus responsibility, PPP and UPP bring environmental resources under the self-regulating mechanisms of

the free market, where a maximum of capital gain is tried to be achieved through a minimum of capital expenditure. As less and efficient consumption of a resources is rewarded by less investment cost, internalization provides an incentive to save resources. Self-regulating economic mechanisms that include 'The Commons' can govern the resource market, as is shown in the graph.

The method

As the aim of economic internalization, besides achieving economic efficiency, is to enable the free market to establish ownership for 'The Commons', environmental responsibility can be assigned ("Responsibility through ownership"). According to the PPP and UPP concept, consumption equals ownership and thus equals responsibility. The method applied therefore is very simple and direct:

Assign responsibility for consumption -- ownership -- to the entity most directly responsible for it, so that any increase in consumption leads to higher costs and any decrease in consumption to lower costs for that person, body or organization.

Advantages of PPP and UPP through implementing internalization

Through applying this method, PPP and UPP

- ⇒ Can create profit in form of taxation, fees etc.
- ⇒ Can thus achieve funds for anti-pollution measures and can simultaneously be used as
- ⇒ A tool to modify behavior and attitude.
- ⇒ It can mediate between the industrial and private sector as every consumer of any resource is held equally responsible,
- ⇒ Thus, making PPP not punitive.

Four basic design criteria

To provide optimum conditions for PPP and UPP methods to achieve economic efficiency, an 'AREA' of implementation has to be defined, which centers on consumption, ownership and responsibility. There are four basic design criteria:

1. **Assign responsibility** to an "owner" with direct control over a consumption activity.
2. **Reward the owner** for increase in efficiency (consumption per unit of service or function), and **penalize** for reductions. Rewards may include compensation, recognition or other tangibles and intangibles.
3. **Empower the owner** to decide whether and how consumption is to be changed.
4. **Allow the owner** to freely reduce or increase consumption, while continuing to provide the functions that the consumption is intended to serve.

Different managerial tools of PPP within organizations or bodies of consumption (internal tools):

Based on those four design criteria, a range of tools of PPP and UPP can be devised. As PPP has been in use in industrialized countries in regard to industrial consumption, there already exist a variety of managerial approaches that are used within the management structure of industrial organizations or bodies. They are normally divided into three main categories, which each category having a set of independent tools that can be applied individually or in combination. These groups are:

1. Accounting Practices
2. Management Practices
3. Environmental Management practices

The most commonly known industrial tools of PPP are²⁵:

1. For Accounting Practices

- ◆ ABC = Activity-based Costing
- ◆ Resource Productivity and Waste Intensity Measures
- ◆ Least-Cost End-use Analysis
- ◆ Life Cycle Analysis

2. For Management Practices

- ◆ SBM = Systems based Management
- ◆ TQM = Total Quality Management
- ◆ 5 S's (the Ss are derived from the Japanese phrases Seiri, Seiton, Seiso, Seiketsu and Shitsuke; the English translation would be: Organization, Neatness, Cleaning, Standardization and Discipline)
- ◆ BPR = Business Process Re-Engineering
- ◆ Learning Organization
- ◆ Scenario Planning

3. For Environmental Management Practices

- ◆ Industrial Metabolism/Material and Energy Flow Analysis
- ◆ Dematerialization and Decarbonization
- ◆ Life Cycle Planning, Design and Assessment
- ◆ Design for the Environment
- ◆ Product Stewardship/Extended Product Responsibility
- ◆ Industrial Symbiosis/Eco-Industrial Parks

Different tools of PPP outside of organizations or bodies of consumption (external tools):

PPP and UPP tools that are used outside of organizations or bodies of consumption normally are not managerial in character, for example fees and taxes for different forms of individual consumption and consumption that concerns a group of consumers with different stakeholders. While the managerial tools can be applied for the process of consumption itself in order to reduce internal costs, fee or taxation tools are applied in general and regarding a predefined topic or area where consumption takes place. External tools do not manage the consumption, but the resource demand on the market. Here, the actual form of concept implementation very much depends on local and / or regional circumstances. The reason is one major difference between managerial PPP and UPP tools and taxation tools: within a company PPP and UPP can always rely on an internal enforcement agency. As soon as more than one group of people is involved in the PPP and UPP measures, an external enforcement agency has to be established, ideally consisting of representatives of all stakeholders.

If we consider, for instance, the considerable change in traffic management that would have to take place in order to reach a form of land-use at university as indicated by the questionnaire, the implementation of PPP would be an ideal instrument to generate revenues to finance changes. For example, consumer fees could be linked to type of vehicle and size of engine. Generated revenues can be used to create a campus that step by step leads away from development focusing on motor-driven vehicles and traffic to be replaced by development centering on the human being. However, in trying to create alternatives through the external tools of PPP and UPP, we should consider that not all stakeholders at CMU are equal in regard to interests, resources and liability. How, then, would an external enforcement agency be organized?

²⁵ For more information see some reading recommendations in the appendix, A12.

How can external tools be implemented?

As environment management measures based on taxation always depend on regulations, laws or standards and impact the economic situation of the stakeholders directly, they need to be worked out carefully and to be adapted to the local conditions. Only thus, is it possible to outline policies to curb and control pollution (consumption) and to contain environmental damage that are accepted successfully. For instance in traffic management, it is necessary to recognize economic circumstances in a given PPP and UPP implementation area and isolate specific factors and their relative importance that lead to pollution. Only by describing the relationship of those factors correctly is it possible to introduce alternatives that are workable in a local or regional context. If we use PPP to build alternatives in regard to transportation, it is therefore necessary to

- Recognize local economic conditions;
- Realize cultural specifics of the given target area;
- Understand social and political opportunities and restrictions.

Once those three factors have been established, as a next step a relationship-model can be built in order to understand dependencies between these outlining factors. There are two (and more) standard tools in helping to build a relationship-model of a given target area:

- People (stakeholder) Participation
- Participatory Rural Appraisal

By including the target group into the process of recognizing local conditions, alternative and so far not or little used modes of behavior that are more environmentally friendly can be pinpointed and introduced with a higher probability of success. An implementation of PPP guidelines that respect local and social conditions as much as possible and introduces ambient standards²⁶ is less likely to fall short of its objective than one that uses technological standards²⁷ or benefit standards²⁸. As the implementation of PPP and UPP measures and related standards take effect through an external enforcement agency, the level of social organization and administration becomes important.

The implementation can also be greatly enhanced by focusing on practiced environmental and traffic behavior and knowledge building. This approach needs less of an external enforcement agency. Defined by its goal or expected outcome, the procedure of the implementation itself, through the tools of PP and PRA, becomes a management tool. Creating alternatives through knowledge building can happen on two basic levels

- General knowledge building or general education; and
- Specific knowledge building or applied problem management.

As knowledge is an important aspect of shaping attitudes and behavior of human beings, it is imperative to start environmental education on traffic related issues as early in the implementation process as possible. Thus, an understanding of the relationship between humans and the environment while interacting with each other can be built.

3.1.b PPP and UPP Related Examples of Implementation

In this chapter we will introduce some measures utilized by other countries that demonstrate the variety of possible approaches in PPP and UPP implementation and their impact. Before a description of the measure itself, a short explanation is added on how the measures introduced link to the concept of PPP and UPP.

²⁶ Standards based on necessity or definition, defined by goal.

²⁷ Standard based on technological possibilities.

²⁸ Standard based on a balance between cost and benefit.

Examples regarding traffic, here, infrastructure policy, planning and design²⁹

- **UK National Cycling Strategy³⁰**

Contrary to bicycles, cars, trucks and busses, and the petrol they depend on are subject to taxation in the United Kingdom. By encouraging bike-use through local infrastructure measures, the consumer is given a choice according to the PPP/UPP 'AREA' design strategy as discussed in the previous chapter. With taxation for other forms of transportation already in place, this new bicycle policy has sufficient funds to draw from and it is vivid example of how PPP can be achieved by re-thinking and a change of perspective.

"Britain's first National Cycling Strategy (NCS) has been launched by the Secretary of Transport. The NCS [...] marks a shift from words to action. Most significantly, targets have been set to double bike use by 2002 and quadruple it by 2012. The NCS focuses on the potential to transfer short trips from other modes of transport to bicycle. This focus is based on the fact that half of all trips are below 2 miles in length and 60% of car trips are less than 5 miles. Coupled with the fact that cycling in Europe is primarily a practical form of daily transport, the NCS focuses on 'utility' cycling and routes within urban areas."

- **Bicycle Friendly Community³¹**

This is an example on how the acceptance of an alternative in transportation that is promoted based on PPP and UPP is dependent on consumer acceptance. Even though individuals through using bikes can achieve a financial gain, the implementation of the new policy very much depends on the last A of 'AREA'. The owner only reduces (traffic) consumption, if the function of safety and practicability of motorized traffic can be continuously provided for other forms of transportation, as well. An extra incentive is offered here by recognizing and rewarding communities that meet bicycle related criteria in their transportation infrastructure.

"Bicycle Friendly Community" is a project of the League of American Bicyclists, the purpose is to increase awareness and acceptance of bicycling as a means of transport, recreation, and fitness, and to promote bicycle safety both on and off the road. The program achieves its purpose by:

- Encouraging local governments to make a continuing commitment to developing and maintaining safe on and off street bicycling facilities.
- Requiring communication between local government and the bicycling community on cycling related issues.
- Promoting bicycling events and bicycle safety.
- Recognizing communities meeting bicycling related criteria."

- **Copenhagen Presents First Bicycle Balance Sheet³²**

An example of a PPP managerial tool within an organization, here a city administration, to arrive at a better and internalized cost-estimate of the city infrastructure.

"For years the concept of green accounting has been discussed and developed. Now Copenhagen pushes the concept further. The city - which is a member of both the "Cities for Cyclists"- and the "Car-Free Cities" clubs - has presented the world's first bicycle balance sheet, the newspaper Berlingske Tidende reports. As all normal balance sheets - the bicycle balance sheet is to be presented once a year - with the clear aim of achieving better and better bottom lines. This first year, 63% of the cyclists found Copenhagen to be

²⁹ More examples of traffic related measures that can be applied in a PPP/UPP context, are given in the appendixes, chapter A2.

³⁰ For a synopsis of the policy write to: Cycle-Wise, Bicycle Assoc., Stanley House, Easton Road, Coventry, CV1 2FH, UK

³¹ For the complete program description and qualification process contact: LAB, 1612 K St NW #401, Washington DC 20006 USA. Email: bikeleague@aol.com Internet: <http://www.bikeleague.org>

³² Source: The Bicycle News Agency, Editor Ernst Poulsen

a good or fairly good city for cyclists, 54% are satisfied with the number of bicycle paths, but only 26% find the maintenance of the bike paths to be anywhere near good. A similar low number of cyclists find the snow clearing in winter-time satisfactory.”

- **Bike-Friendly Taxis**³³

“Taxis in Copenhagen, Denmark, are required to carry bicycle racks.”

An excellent example of AREA implementation. The taxi owner covers the cost for the rack installation. He helps to reduce pollution-creating traffic by giving commuters a choice to carry their bicycles along. Attracting a new group of customers rewards taxis: bike-riders.

- **Bike For A Better Community**³⁴

An example of how PPP and UPP related measures can reduce social cost as a by-product.

“An on-street bicycle lane project in San Diego is credited with reducing accidents and crime, and improving property values.

During the 1988-89 school year, nine accidents involving [cars] (one fatal) were reported along the affected road. During the 1989-90 school year, after the improvements, just three non-fatal accidents were reported. Also, area residents have reported a decrease in daytime burglaries. A community leader attributes this to the fact that thieves are no longer able to park get-away cars on the street in front of the housing complex. The increase in property value is attributed to the improved appearance of the area. The street is no longer used for storage of cars and boats on trailers, or as a dump for junk cars and display of cars for sales.”

Examples regarding transportation control measures (TCM) and transportation policy³⁵

- **Transportation Control Measures (TCM) in the United States**

TCM measures promoted by the United States are an excellent example of how a combination of internal managerial tools for use within organizations and external taxation tools (road-tolls) can provide a very powerful management concept.

“For more than a decade the U.S. Environmental Protection Agency has promoted various transportation control measures (TCM) to clean the air. TCM is also known as transportation systems management (TSM) and transportation demand management (TDM). Featured in the 1990 federal Clean Air Act reauthorization, TCMs will soon be familiar in the states, for under the law, states with ozone and carbon monoxide non-attainment areas must submit State Implementation Plans that detail how their 15 percent reductions will be achieved.

TCMs include employer-based transportation management; improved public transit; park-and-ride lots and fringe parking; parking management programs; ridesharing (car- and

³³ Source: The Bicycle News Agency, Editor Ernst Poulsen

³⁴ Source: The Bicycle News Agency, Editor Ernst Poulsen

³⁵ Sources:

- AT&T and State of Arizona Telecommuting Pilot: A Collection of Program Materials, February 1991. Arizona Energy Office/Department of Commerce. 3800 North Central, Suite 1200, Phoenix, AZ 85012, (602) 280-1410.
- California's Energy Plan. 1991. California Energy Commission. Biennial Report.
- Morris, David, "Information Highways." Utne Reader, September/October 1991.
- Perlman, Jeffrey, "Telecommuting Called Key to Cutting Pollution", The Los Angeles Times. July 16, 1991. Metro, Part B, P. 4.
- Sissine, Fred, Telecommuting: A National Option for Conserving Oil. November, 1990. Congressional Research Service Report for Congress. (202) 707-5700.
- Telecommuters Go to Work Without Leaving Home. August, 1991. Illinois General Assembly Legislative Research Unit: First Reading, Volume 6, No. 7. 222 South College, 3rd Floor, Suite A, Springfield, IL 62704.
- Telecommuting: A Feasibility Study. A Report in Response to House Joint Resolution 77 of the 1990 General Assembly. November 1990. Virginia Employment Commission. P.O. Box 1358, Richmond, VA 23211.

van-pooling incentives); road pricing (tolls); traffic flow improvements; trip-reduction ordinances; voluntary no-drive days; and work schedule changes.

TCMs not only reduce emissions and congestion but also save energy and money. Those savings have been demonstrated in the Los Angeles basin, which suffers from some of the worst air quality conditions in the nation. The area continues to grow, and in the next 20 years is expected to add as many people as now live in the entire San Francisco bay area. Consequently, the South Coast Air Quality Management District (SCAQMD) aggressively implements TSM.

For example, Regulation XV, adopted in December 1987, requires all employers with 100 or more workers at any single site to implement trip-reduction programs tied to specified peak-period target reductions. As of November 12, 1991, 7976 plans were received. This includes 6038 initial plans (4792 have been approved by SCAQMD), 1769 first-year updates (1543 approved), and 169 second year updates (29 approved). Recently, Santa Monica and Irvine have enacted trip reduction ordinances similar to Regulation XV, but these programs have not yet begun. Any combination of TSMs may be used to meet the goals. Employer programs will be monitored and updated each year, under threat of penalty.

California's 1991 Energy Plan, released by the California Energy Commission, advocates reduced traffic congestion and reduced vehicle-miles-traveled to improve efficiency in transportation. HOV lanes³⁶, transit fare allowances, vanpooling allowances, rideshare matching and subsidized travel time combined with reduced or eliminated subsidized parking, are among the most effective ways to achieve these goals."

- **Telecommuting³⁷**

Telecommuting is an example for how re-thinking and re-design can substantially reduce the extent of a pollution chain. As in this case the PPP and UPP tools are mostly designed as internal tools, it is important to offer incentives and administrative support in form of a government policy and examples.

"There are two main forms of telecommuting. The home-based telecommuter works at home and thus avoids commuting to and from the office. The regional-based telecommuter commutes to a regional center set up close to home, and ideally will be able to travel to work by bike or on foot.

The USA federal government initiated a nation-wide pilot program entitled "Flexiplace" in early 1990. A number of agencies have participated. Congress provided a waiver from a ban on the government paying federal employees' home telephone expenses. This allows agencies to pay for these services for telecommuting employees.

The Southern California Association of Governments (SCAG) undertook a successful telecommuting pilot with its employees, averaging net travel savings of 41 person-miles per telecommute. In 1989, it began another telecommuting initiative to reduce employee work-related vehicle-miles-traveled (VMT) by 20 percent.

The state of California is also promoting telecommuting. With a fivefold increase in state congestion likely by 2005, California faces losing two million vehicle hours each day in traffic jams.

³⁶ High occupancy vehicle (HOV, antonym = SOV, Single Occupancy Vehicle) lanes are:

- Traffic lanes that are reserved for vehicles that at least use 50% of the provided passenger seating capacity.
- Toll-way lanes that differentiate toll fees according to used passenger seating capacity. The higher the occupancy, the smaller the fee to be paid.
- Toll roads on which single-occupant vehicles are charged an increased price during peak commuter periods (congestion pricing).

³⁷ For more detailed information regarding some traffic facts that lead to this approach, please see in the appendixes, chapter A1.

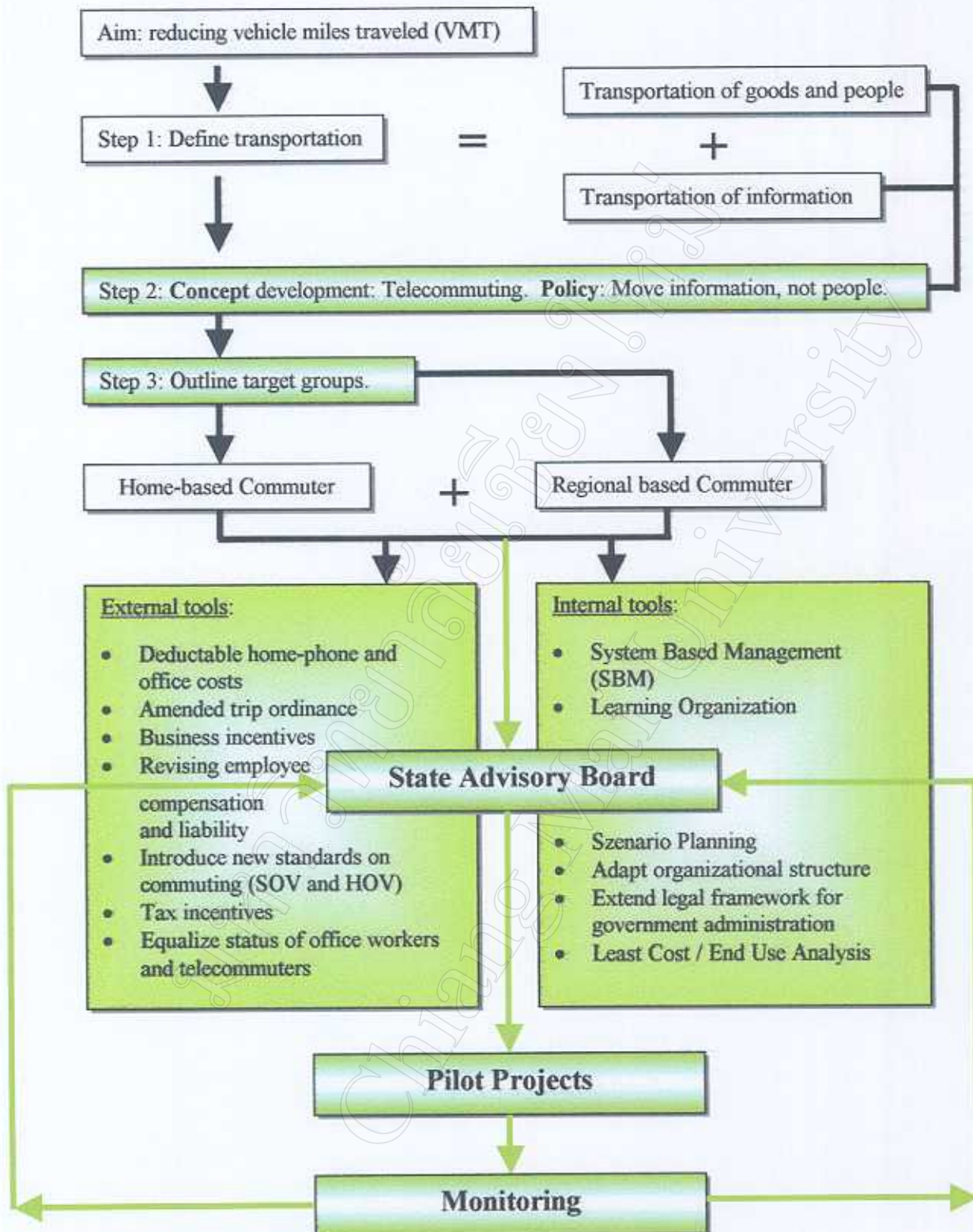


Figure 3: Structure of telecommuting implementation

Beginning in the mid-1980s, the state launched an ambitious telecommuting pilot, initially for Sacramento-based employees. Participants from 15 state agencies are now telecommuting.

The California state government began the two-year active phase of its telecommuting pilot project for state employees in January 1988. The project was completed during the summer of 1990. The program showed an overall decrease in vehicle trips of 30%. More important, commute trips were reduced by 65%-75%. A permanent telecommuting program was established in March, 1990 because response from the pilot was so favorable. There are about 200,000 telecommuters in California today.

Those promising results are the foundation for SCAG's Air Quality and Management Plan. The plan calls on local governments to adopt or amend trip ordinances by January 1, 1990, making new development conditional on alternative trips. Developers would have to achieve a 10 percent reduction in work trips. SCAG's plan also includes state legislation requiring educational institutions - secondary schools, junior colleges and colleges - to evaluate home study as an alternative to classroom core curriculum courses.

SCAG is seeking to encourage telecommuting through a number of policy changes. Telecommunication would be accomplished more easily by: revising local government ordinances which regulate home offices and business-in-the-home; liberalizing state deductibility of home offices and work-related use of home computers; creating new business incentives for establishing local work centers and video conference facilities; revising workman's compensation and liability; and reducing federal and state restrictions on the definition of independent contractor.

By 2010, Southern California Air Quality Management Division wants at least 12% of the region's workers to telecommute, while SCAG is pushing for 20%.

To study the benefits and costs of telecommuting firsthand, many states, including California (AB 2963) and Florida (HB 967), have telecommuting pilot projects in their state agencies, departments and legislatures.

In addition, states such as Connecticut (HB 6003) and Virginia (Joint Resolution 77) are authorizing public and private organizations' ability to use telecommuting. Other states, particularly Florida (HB 2607), are developing advisory councils on telecommuting. A Florida pilot program started in 1990.

The state of Arizona teamed up with AT&T in 1990 to start a pilot telecommuting program. The pilot was prompted by a bill, which required that all businesses with 100 or more employees devise plans to reduce single occupancy commuting by 5% per year. AT&T's strategy included this telecommuting program, which the state joined. The pilot was successful and continues today. 134 employees at AT&T and in 4 state agencies work at home one or two days a week. Program directors are hoping to expand into more state agencies and to include regional telecommuting in the near future.

Other states are also adopting telecommuting measures. The Washington State Energy Office began the 1989 Puget Sound Telecommuting Demonstration Project, which ran from 1990 to 1991. The project studied 200 to 300 individuals from 10 to 15 public and private organizations. The project studied worker absenteeism and turnover, job attitudes, work performance and group relations, as well as issues of energy, traffic and air quality impacts.

In 1989, Hawaii's Department of Transportation established a "telework center" project to reduce traffic congestion in Oahu.

In February, 1990, the Virginia legislature passed House Joint Resolution 77 that directs the Virginia Employment Commission to study the potential benefits of telecommuting. The state has recently completed a feasibility study and has implemented a two-part program. The first part involves only state employees and began in 1991. The second part began in 1992 and will help coordinate and promote telecommuting in the private sector.

Some companies treat telecommuters the same as any other employee. For example, Travelers Insurance and the state of California give the same benefits and privileges to telecommuters as they give to other employees. In addition, they pay most of the cost of the home offices, including equipment, connections and software. In contrast, some other

companies treat telecommuters as independent contractors, paying by the project rather than by offering salary or benefits.”

- **Ridesharing, Van- and Car-Pooling and HOV Lanes for California³⁸**

An example of TCM measures in California. Once the main administrative body, here the US government, establishes a policy and PPP/UPP concept outlines, regional implementation can take any form that is best suited for the local pollution problems. Measures applied here include internal and external tools.

“Moving people, not vehicles has been the goal of ridesharing programs and high occupancy vehicle (HOV) lane construction over the past 15 years. This transportation combination is second only to rail and bus transit in alleviating urban gridlock and cutting energy consumption and air pollutants.

Air pollution can be cut substantially by ridesharing. Van-pools, for example, can achieve up to 80 percent reductions for hydrocarbons, carbon monoxide, particulates and NOx emissions over single-person auto travel.

Van-pools have become an especially popular mode of commuting. California encourages van-pooling through the Ridesharing Vanpool Revolving Loan Fund and Grant Fund by providing loans or grants to people to purchase or lease vanpool vehicles. (SB 1317). Connecticut is considering eliminating registration fees for vanpool vehicles (SB 73). Washington proposes a study of vanpool use (SB 5564).

HOV lanes are especially cost-effective VMT [Vehicle Miles Traveled] reduction options. HOVs cost far less than light rail transport. Compared to two recent light rail projects with a median cost of \$13 to \$16 million per mile, HOVs in 14 projects showed a median cost of \$6 million per mile. Houston's 10-mile contraflow lane cost only \$200,000 per mile, and LA's concurrent flow lanes cost \$250,000 per mile. Over 450,000 persons now use HOV lanes each weekday, saving an estimated \$150,000 million annually. Moreover, HOV lanes increased the total volume of car-pools by well over 100 percent, Los Angeles, Washington, D.C. and Houston have found.

California (AB 2132) establishes exclusive or preferential lanes on certain bridges for high occupancy vehicles. Virginia, (SB 858), Washington (SB 5562), North Carolina (HB 1206), Hawaii (HB 23, HCR 114, HR 123), Pennsylvania (HB 2049) and Connecticut (HB 6003) are considering the use of HOV lanes to promote ridesharing. The 1991 Hawaii (HB 492) legislature proposed using electronic or photographic devices to identify any violators of HOV occupant requirements. The violator would receive a citation in the mail and must then either appear in court or pay a \$100 fine. The legislature also has asked the Oahu Metropolitan Planning Organization to study the effect of single occupants in a vehicle paying an energy conservation fee (SCR 84, SR 67). In Illinois, legislation would designate rush hour periods when tolls would be cut by 50% for vehicles with 3 passengers and not charged to vehicles with 4 or more passengers (HB 1404).

The Los Angeles Olympics showed what could be achieved through a combination of ridesharing incentives, staggered or flexible work schedules and off-peak-hour truck delivery. Traffic volume decreased seven percent and traffic congestion 63 percent.

A number of innovative companies and government agencies have demonstrated what it takes to implement successful multi-passenger vehicle programs. High on the list are incentives, aggressive ridesharing media-awareness campaigns and flexible work routines.

These innovations promise direct benefits to employers, as well. A parking space costs in the range of \$15,000, depending on land costs and type of parking facility. An underground parking space in a central business district can run as high as \$20,000. Construction of a 300,000 square-foot downtown building might cost \$4 to \$5 million for parking spaces. Those costs are reduced when transit and ridesharing incentives or pedestrian amenities make parking spaces unnecessary. Operating an organized

³⁸ Resource: California's Energy Plan. 1991. California Energy Commission. Biennial Report.

ridesharing program can reduce employee parking demand by an average of 22 percent. Reducing just 10 spaces in a two-level underground parking structure could justify an annual expenditure of up to \$4,000 on a ridesharing program. Moreover, developers accrue higher returns on investment from increased floor space available for lease, as well as reduced daily operating costs for parking areas.

At least one state has plans to capture all these benefits. Pending California legislation (SB 2723) would require state offices to establish both flex-time policies and a 50 percent ridesharing goal for state employees.

California (AB 1463) allows a tax credit to employers who purchase or lease certain vehicles for an employer-sponsored ridesharing incentive program. Other states are considering tax incentives for those who purchase or lease certain vehicles. California (AB 1126, AB 703), Hawaii (HB 120), New Jersey (AB 4131), and New York (AB 4584) would provide the incentive for employers who provide the vehicles in a ridesharing program for employees. California (AB 703), Hawaii (AB 120), and New York (AB 4584) would allow personal income tax deductions for the employees' own costs of ridesharing.

In addition, California (AB 1463) allows a tax credit to employers for the costs of providing subsidized transit passes for employees. New Jersey (AB 92) and New York (AB 4584) propose providing monetary subsidies or tax incentives to employers and employees for mass transit use.

New Jersey (AB 1454, AB 1477), Vermont (SB 128) and Pennsylvania (SB 1061) would promote or require rideshare programs in their states. Connecticut (SB 44) and New Jersey (AB 1454) propose to provide state funds to construct or lease commuter parking lots and park-and-ride facilities to promote car- and van-pool use and use of public transportation.

Individual legislatures are considering innovative proposals regarding ridesharing in their states. Hawaii (HB 4) would amend the definition of ridesharing to include informal arrangements in which three or more persons ride together to work for three or more days a week. New Jersey (SB 352, AB 1476) would provide \$50,000 to the state Department of Transportation to develop and implement an aggressive advertising and marketing program to promote ridesharing. And New Mexico (HM 30) would request that legislators and legislative staff utilize ridesharing programs during the legislative session.

A proposed regulatory incentive includes highway user fees, or "congestion pricing". This strategy would establish toll roads on which single-occupant vehicles would be charged an increased price during peak commuter periods. The California Department of Transportation has recently accepted four proposals from private vendors to construct and maintain segments of the state's highway system."

- **Parking Programs in the United States³⁹**

This example demonstrates the variety of implementation and management possibilities concerning one single item of the transportation-pollution chain and thus the flexibility of PPP and UPP.

"Roughly 57% of all off-peak trips and 70% of all daily trips are not work related. Free parking is prevalent due to local zoning practices that require developers of residential and commercial projects to provide free parking adjacent to their projects and because commercial and retail enterprises hope to attract business.

Travelers pay for their parking through indirect means such as higher retail and housing prices. If travelers were directly charged for their parking, they would realize that they could save money by driving less. Studies have shown that when shoppers pay for parking

³⁹ Cameron, Michael, *Transportation Efficiency: Tackling Southern California's Air Pollution and Congestion*. March 1991. Environmental Defense Fund and the Regional Institute of Southern California.

they are more likely to shop in a place where all of their stops are within walking distance of each other and they are less likely to drive from place to place.

Parking Offsets

Several cities have found that parking programs pay. For years, Chicago has granted a 10-percent reduction in required parking to buildings with a direct connection to an underground transit station. A 15-percent reduction is granted for providing underground pedestrian circulation. Sacramento grants a five-percent reduction for providing bicycle facilities, 15-percent for providing marked car/van-pool spaces and 60 percent for purchasing transit passes for tenants of new offices.

Preferential Parking

On-street preferential parking programs can encourage car- and van-pools. Among the incentives: poolers are allowed to park downtown all day at specific metered locations, are exempted from hourly parking limits and meter fees and enjoy spaces closest to building entrances. Portland and Seattle lead in on-street preferential parking programs for car-pools.

Parking Pricing

Free or subsidized parking encourages auto use. An estimated 75 percent of all cars driven to work are parked in free spaces provided by employers; free on-street parking raises that figure to 93 percent. Costly parking, on the other hand, encourages public transit or ridesharing. Successful strategies begin by eliminating free employee parking. Incentives for ridesharing by workers include pay increases commensurate with former parking subsidies and alternative transportation fringe benefits. Other strategies include eliminating parking subsidies for new employees, providing less employee parking and charging full prices for parking as new company facilities are built or leased. For full effectiveness, parking on residential streets on nearby free facilities should also be banned. The Canadian government increased its parking rates for federal employees in Ottawa, resulting in a 23 percent reduction in employees driving to work, a 16 percent increase in transit ridership among federal employees, an 83% reduction in single occupant auto use, and an increase in average vehicle occupancy from 1.22 to 1.41 passengers.

Preferential HOV pricing strategies are highly effective. Differential parking rates paid by the employer are applied, with single occupants getting 0% reduced rates, two-person car-pools 50%, three-person car-pools 75% and van-pools 100%. Montgomery County, Maryland has achieved over 75 percent use of HOV spaces. Seattle has achieved 95% HOV use in public spaces and 35% in private spaces.

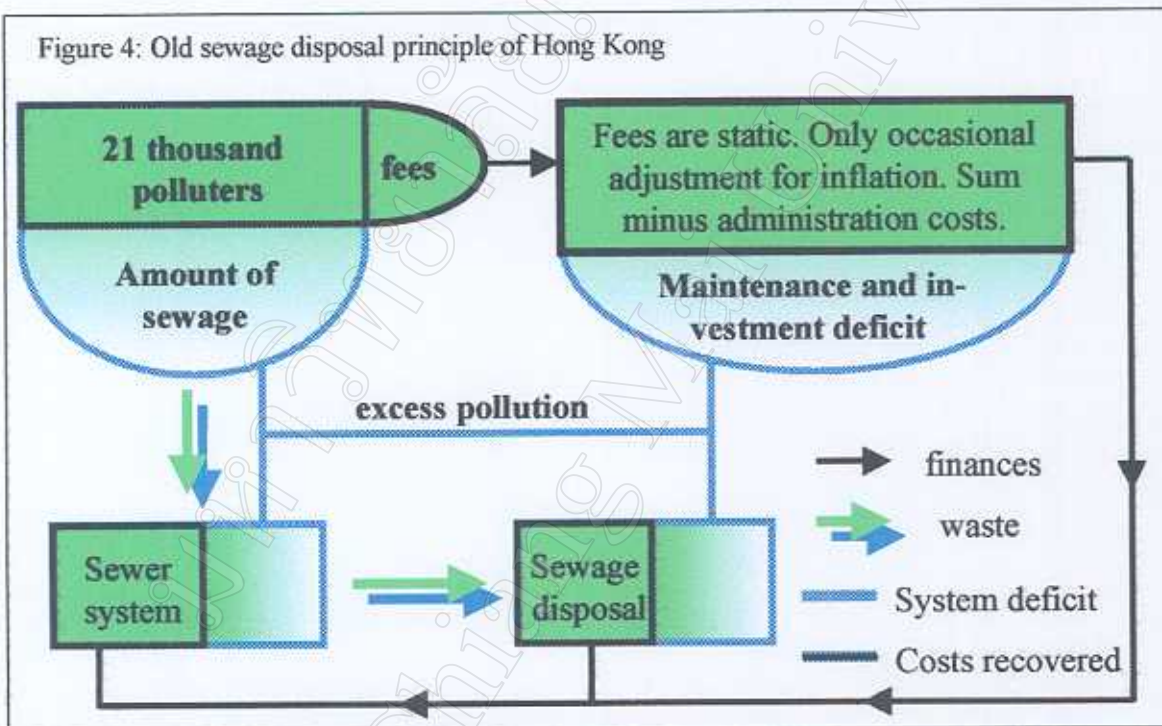
Delaware (HB 6) is considering legislation that would require employers of over 150 people in any one building to give priority parking to vehicles used in car- and van-pools.

One of the most successful employer-initiated transportation programs is operated by the Los Angeles based ARCO for its 2,200 employees. Employees have **transportation choices**. If they are commuting alone, they pay half the monthly parking fee for a space owned or leased by ARCO. Other transport modes are subsidized by ARCO at 75 percent for two-person car-pools and 100 percent for three-person car-pools. By 1982, approximately 56 percent of ARCO employees were HOV commuters.

The Southern California Association of Governments' Air Quality and Management Plan goes even further. By 1991, all employers with over 100 employees were to **eliminate subsidized parking** and implement preferential rideshare parking. Free parking for non-residential developments would be eliminated by 1994."

Examples regarding wastewater and sewage disposal on the example of Hong Kong⁴⁰

Until the hand-over to China Hong Kong had only a limited area of natural resources available for utilization. This constituted an acute problem for the city's water supply and its sewage disposal, especially during its expanded and strong industrial growth over the last three decades. An additional problem was created by the yearly rainy season with the huge amount of rainwater flowing into the city drainage and sewage disposal system. Repairs to and extensions of the system were a constant necessity, constituting a considerable expense to the city administration. On the other hand water related fees were static and charged consumers per cubic foot of water consumed and cubic foot of water discharged. The industry, with varying times of high and low disposal rates from their factories, was charged as much as any average household. However, this consumer group was considered the main polluter or consumer, as their production related water discharge would regularly overload the system, especially during the rainy season. As the rainwater would mix with the sewage, any sewage system overflow would directly pollute the city and its scarce natural lands, thus sewage disposal was considered a special problem. The collected fees were not sufficient to cover the costs created by the system in place. The following graph shows the situation of the old sewage disposal system in regard to consumption, system capacity, costs created, and costs recovered.



To solve these problems, in 1995 Hong Kong introduced a new waste water policy based on PPP and UPP. "...Under the application of this principle, the government [...] instilled the concept of responsibility into its anti-pollution strategy. Those who generate more pollution [are] required to contribute financially to the part of the government's program and therefore charges [are] modest for households while industry [pays] more."

⁴⁰ - Assessing Hong Kong Government's Environment Scheme and Polluter Pays Principle, <http://user.hk.linkage.net>, here under < /~greenpow/essays/summit12.htm >

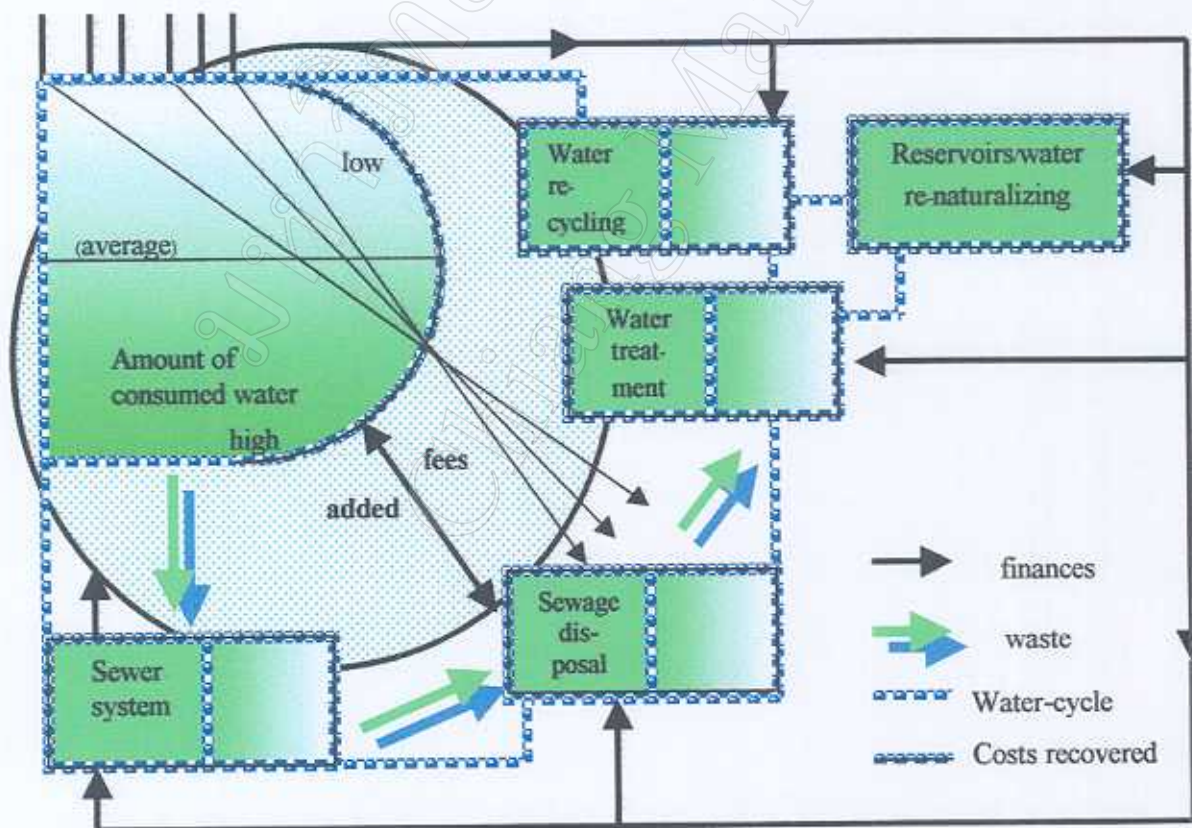
- A case for Polluter Pays Principle, <http://user.hk.linkage.net>, here under < /~greenpow/essays/gfspeech.htm >

Consumers are divided into different groups according to characteristic (household, gastronomy, industry, etc.) and according to average water discharge. A different fee rate per cubic feet of water is assigned to each group, e.g., households are in the first group with the lowest basic rate, professional consumers of water, like the industry, are in the last group with the highest rate. The more water each group consumes, the higher the added fee. As the fees increase exponentially, even small savings of water can constitute a financially large saving. The cost recovery for the city administration is 100 per cent and the available budget collected via the fees rises and falls in accordance with the actual needs of the city's water department. However, as the assessment of the system states, '...Though the charges imposed on the polluter can act as a deterrent to them, the definition of the term responsibility, as well as the relation between the charges and the degree of responsibility held by polluters, has arouse much controversy. There is no fixed and unanimously agreed standard to measure the extent to which the polluters have polluted the environment. Personal perception varies, and no wonder why there is injustice and bias in these charging schemes. Owners of small local restaurants have already expressed their grievance and outrage...In view of this, the government should make a declaration on how the charges are made and upon what principles they are based. Public consultations and an exhaustive investigation into the issue are needed to see if the present charging schemes should be highlighted and the charges should be adjusted accordingly as the situation changes. These charging policies should be made less interfering to the government's fiscal policy as much as possible, as promoted by the approach of transition.'

Figure 5: New sewage disposal principle of Hong Kong

21 thousand polluters divided into different consumer-groups:

1 2 3 4 5 6



Regarding PPP and UPP strategies for agriculture on the example of New Zealand⁴¹.

New Zealand faces a multitude of environmental land-problems. Especially erosion and pollution of a fragile eco-system through agriculture related activities and resource consumption. Part of the reason is seen in subsidies given by the government to programs that are contrary to PPP principles, but were seen as a necessity to fight longstanding environmental degradation, for example to fight the wide spread rabbit infestation.

The approach chosen by New Zealand to solve those problems is directly based on UPP, e.g., its new policy holds every consumer of any resource equally responsible. To achieve a proper implementation of the principle, the foremost attention was given to establishing standards that in their sum would be able to outline pollution in general and provide a basis for the complete internalization of environmental costs. The very necessity to develop those standards was, for example, understood to be a result of pollution and thus, the cost of standard development was included in the list of internal costs. Similarly, all administrative costs regarding environmental management were included. Also pest management, flood control and land drainage programs. This is part of a wider movement in the New Zealand government towards UPP and aims at principally requiring payment for services from those who benefit from them, or from those who generate the costs. '...This ensures that services are not demanded until fully justified, and that the community does not pay for [environment related] services required by an individual or a small group. Both objectives are consistent with the Polluter Pays Principle...'

Defined by the standards, ecological change due to land-utilization is divided into four categories. Each category has a different impact level on its surrounding environment and a variety of incentives are linked with each level:

Standard 1: Agriculture based on this standard is entitled to ecological subsidies and receives all administrative services to uphold/upgrade the ecology for free. Some outside resources are available for lowest possible or no cost.

Standard 2: Agriculture on this level is not entitled to subsidies and is responsible for all occurring change/damage of the ecology. Administrative services are not free. All outside resources have to be paid plus surcharge for waste of resources.

Standard 3: Agriculture on this level is not entitled to subsidies and is responsible for all occurring change/damage of the ecology. Administrative services are not free. All outside resources have to be paid plus surcharge for waste of resources. Prices of outside resources rise exponentially with mismanagement of resources/damage to ecology.

Standard 4: Outright environment destruction. Illegal, forced closure, prosecution.

The basic aim of the New Zealand PPP/UPP policy is to establish responsibility for the local and "personal" ecology of each individual in regard to land-use and related issues. This principle is implemented by introducing standards. Any deviation from the environmental standard that makes administrative services necessary have to be paid for by the polluter and user of this specific part of the ecology:

"To date, no government agency in New Zealand, either at central or local level, has required polluters or other resource users to compensate the public for environmental damage that is allowed within standards (residual pollution). There are two main reasons for this. First, such a policy is contrary to some landholders' perceptions of existing use rights, and second, it is technically difficult to determine an appropriate level of payment without causing suspicion that such charges would be used as general revenue-raising devices. Nonetheless, the use of environmental user-charges is under discussion in New Zealand, and resource rentals are

⁴¹ Data source: Agri Environmental Programmes in New Zealand – IV. Polluter-Pays and User, <http://www.maf.govt.nz>

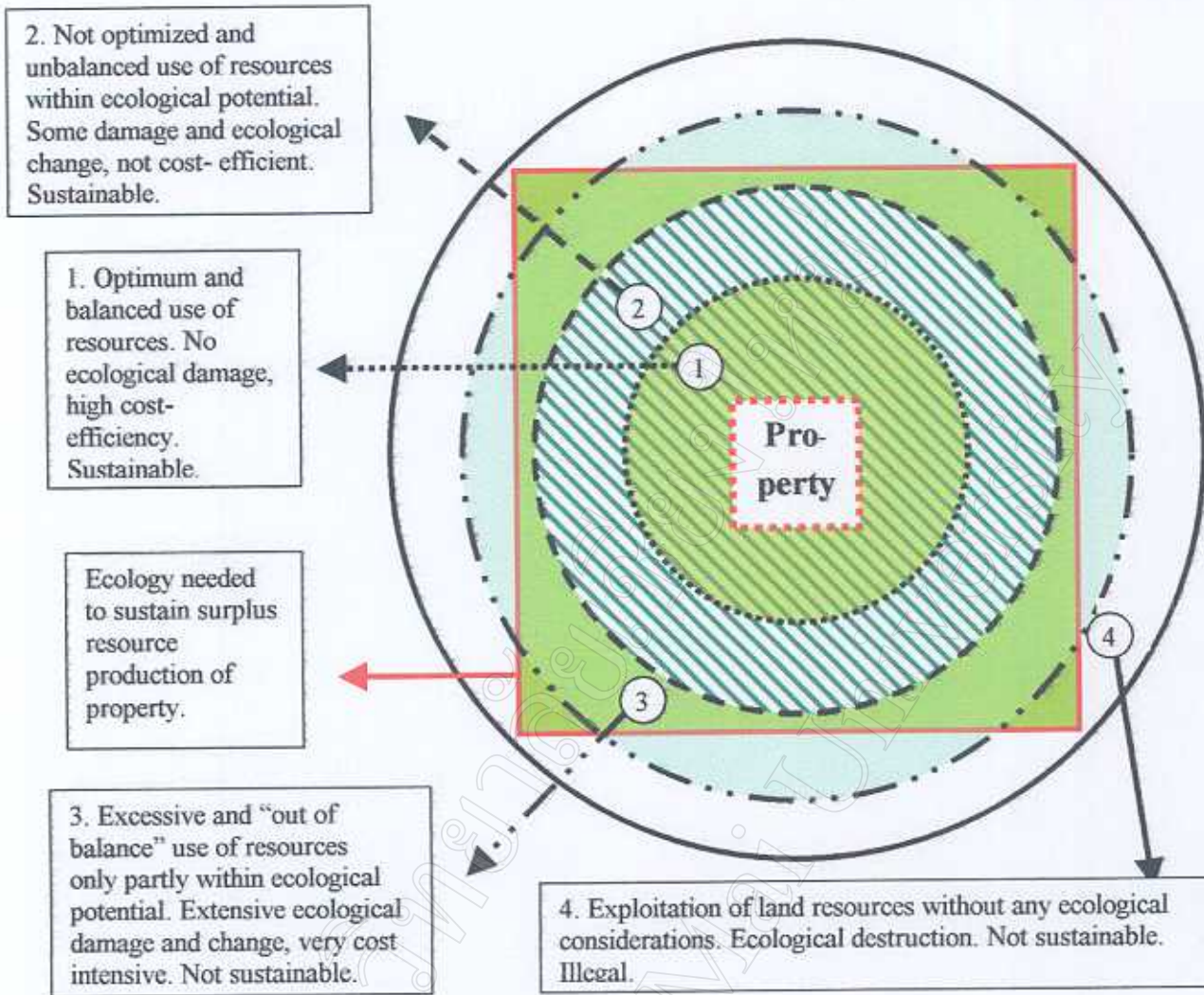


Figure 6: PPP in New Zealand's agriculture

being charged in some regions for use of the marine coastal area for marine farms and boat moorings. Though resource rentals are not compensation for environmental damage in a theoretical sense, their implementation faces the same practical difficulties.

Implementation of user-pays and polluter-pays policies is also conditioned by the existence of market failure for public goods. It is not always possible to charge the user or polluter to prevent free-riders (i.e. the good is "non-excludable"). In other cases it would be inefficient to do so, because charging would discourage use of a "non-rival" good (i.e. one person's use does not compete with or detract from another person's use). For some services, such as quarantine controls, which protect society at large as well as agriculture, it may be impractical or inappropriate to implement user-pays. However, in New Zealand and elsewhere, commodity and industry levies are being used to overcome these problems in funding research, promotion and management of agricultural pests.

In resource management, problems of non-point source pollution have some attributes of public goods (or public bads). Many regional councils in New Zealand are trying a "land care" approach to overcome these obstacles, encouraging landowners and others who share a common problem to take collective responsibility for addressing it. This recognizes that those closest to an issue are often best placed to devise a solution, provided they have access to

information, and is consistent with community expectations regarding the polluter-pays principle.”

However, some controversial issues remain for the implementation of the system. For example varying standards; a sometimes-abrupt introduction of the system is very unpopular and considered to be a form of indirect taxation to raise general revenues. Other problems relate to the status quo outlined by the different standards and how to define it for an ecology that has been used by agriculture for some time and some feel that more detailed knowledge of the ecology is needed to provide correct standards.

3.1.c Possible Conflicts and Problems in PPP and UPP Implementation

- **The implementation of PPP and UPP is based on economic internalization of environmental costs.**

In the short run, this creates a paradox: the increased use of resources in order to save resources. As costs for consumers increase, they need to spend more financial resources to maintain their current consumption habits. The saving of resources in the natural environment is not instantly perceptible. The reduction in the burden of social costs⁴² for a society is only obvious when newly created PPP and UPP funds are also used to replace old funding sources that have covered social costs in the past, which would in most cases be taxes or other fee related services.

- **All external PPP and UPP tools depend on an external enforcement agency.**

A change from externalization to internalization involves the handling of finances. It is therefore important that an enforcement agency does not only push for the implementation of new measures, but also controls the newly created flow of capital resources and is in itself controllable. On a nationwide level an open book policy of the government on environment related fiscal spending helps to promote trust in the new policy within the industry and households. On a local level, participation of all parties involved in the new measures and/or all parties subject to impact of the new policy should play a role in creating an independent body as enforcement agency.

- **PPP and UPP are problem-specific and locality-specific environment management concepts.**

Due to this characteristic of the concepts, all implemented measures should be applied only for the region with the specific problem to be solved. Successful measures in one locality might not be successful in another, even if the problems look identical. PPP and UPP measures have to be newly created each time they are applied.

- **PPP and UPP acceptance depends on education and promotion.**

The benefits of PPP and UPP implementation are in most instances not easily perceived and as increased costs for consumers are part of the impact, initial resistance to the concept occurs at times. However, this attitude changes quickly when information and education regarding environmental costs are made available to target groups. Promotion of the principle by responsible parties is important to help target groups refocus on their local environmental concerns and make them understand the character and advantages of the measures to be implemented.

- **PPP and UPP acceptance depends on active participation of the target groups.**

Internal tools are directed at the consumption habits and structures of individuals or groups and external tools provide a necessary framework or strategy. Participation of target groups in the use of both tool categories keep the system understandable and open to change through

⁴² The price difference between resources in the externalized market and resources in the internalized market.

experience. No system devised is perfect from the start and without target group participation it is very difficult to correct initial errors during the conception of the measures to be implemented.

- **PPP and UPP acceptance depends on standards.**

Standards are the 'Terms Of Reference' of PPP and UPP. Standards that are not clear or do not reflect reality as perceived by the target groups will hinder the implementation success of proposed measures and acceptance by the affected population. The form of standards selected should also be in accordance with consumer groups, e.g., ambient standards for local measures, and technical and benefit standards for the industry and administration. Sometimes a mix of all three forms of standards is advisable, depending on the problem at hand.

- **PPP and UPP acceptance and success depends on a gradual implementation.**

A shift from an external market to an internal market will create additional costs for the target groups. Through a gradual implementation negative economic impacts can be avoided by giving people sufficient time to adapt and change their consumption behavior. As internalization creates benefits for low consumption, affected groups can take advantage of them once the system is fully installed and consumers have adapted.

- **PPP and UPP success depends on promotion and active participation by administrative and government agencies.**

Whether internal or external tools are used, to some extent administrative and government bodies will always be part of the implementation to some degree. By giving examples and encouraging people to make the best of the newly applied system they can create an atmosphere of positive anticipation and further a widespread acceptance. Open-mindedness and active listening to affected target groups will help to eliminate administrative obstacles. PPP and UPP are concepts of good governance and an opportunity for the government to increase effectiveness in communication and administration.

- **PPP and UPP success depends on a holistic approach in environment management.**

Even though PPP and UPP are most often used to solve local environmental problems, the theory of internalization concerns all of 'The Commons'. The more proposed measures are based on an understanding of the ecology, locally, regionally, countrywide and worldwide, the easier it is to expand measures later on and find solutions to problems arising during implementation. The main purpose of PPP and UPP is not to create additional funds, but to lower consumption of resources. However attractive the idea of quick fund creation for environmental damage repair may be, if the measures are not derived from ecological principles and with the aim to better the environment, results in form of improved ecological conditions cannot be achieved. Target groups will feel disappointed and cheated, as betterment of the common good will not be visible. As a consequence, PPP and UPP will lose support, because it has been downgraded to a new instrument of taxation.

- **PPP and UPP success depends on stakeholder cooperation**

Different stakeholders have different interests and different influence. External tools in particular always address a multitude of target groups. Cooperation between the stakeholders guarantees the most accurate situation assessment and basis for PPP and UPP measures.

- **PPP and UPP success depends on correctly gathered data and detailed information**

All standards, measures and tools are based on data and information. If their content is not correct or does not reflect the actual situation, conflicts during implementation are pre-programmed. The utmost care and patience is therefore needed to build the database on which PPP and UPP implementation rests.

- **PPP and UPP success depends on the recognition of local economic conditions**

Especially when PPP and UPP implementation is achieved by defining ambient standards, the method of economic internalization must be based on a local economic basis. Standards that try to achieve change that is beyond the economic capacity of the implementation area will fail. Ambient standards therefore often represent a compromise between what is ideally achieved and what can actually be done. On the other hand, PPP and UPP will in the long term free additional resources and improve overall economic conditions. Thus, standards can be gradually adapted to reflect the improved overall resource conditions, and step by step approach the long-term objectives defined during the outset of the implementation.

- **PPP and UPP success depends on the recognition of cultural specifics for a given implementation area**

Over time, every human population builds a culture that reflects the condition of its physical and social resources and the access to them by their population. Cultural traits normally reflect mechanisms that have been the most successful in retrieving available resources for society as a whole. That PPP and UPP are concepts to rearrange resource consumption, does not mean they are instruments to change a culture from outside (top-down approach), but rather from within by defining standards (bottom-up approach). By incorporating cultural traits into the internalization measures, PPP and UPP respect the basis of the population's behavioral mode. The inevitable change of resource consumption following the implementation will then promote change gradually and within the social capabilities of the population.

- **PPP and UPP success depends on the recognition of social and political opportunities and restrictions.**

Every existing human population already has an existing management system in place. It is not important whether ecological ideals approve or disapprove of this system. It is only important that this system is the initial framework on which PPP and UPP have to function. Ignoring the social and political opportunities and restrictions of any group subject to implemented measures, therefore, weakens the conceptual foundation for development. As opportunities and restrictions are different according to social strata within the target group, measures have to reflect the factual situation of all stakeholders and define an ideal compromise to achieve change from within the system in place.

3.2 Definitions

3.2.a Sustainability

PPP tries to achieve sustainability of human environments. All its measures and tools are implemented with this final goal. The first definition to be introduced is therefore that of sustainability. However, as traffic and its management regard more than just the ecological environment, definitions in the following chapter extend also to human societies, the market economy and finally to what is termed the environmental society.

A. Ecological definition

A system of organization that uses least of available resources for the most beneficial gain for current and future system maintenance or growth.

B. Human society definition

A system of human organization that takes no more potentially renewable resources from the natural world than can be replenished naturally [while] not overloading the capacity of the environment to cleanse and renew itself by natural process. (Sustainable living⁴³)

⁴³ Definition from the Glossary of G. Tyler Miller Jr., "Environmental Science", 1997, ITP publishing

C. Market economic definition

A system of resource-flow management based on economic principles that uses available resources and (economic) capital to produce sufficient capital gain for its own maintenance and / or growth.

D. Environmental society definition

A system of organization where human ecological, economical and political (social) measures enhance each other to maintain or develop a given environment at least possible cost to the Ecology, Society and Economy.⁴⁴

3.2.b Development

All consumed resources are utilized to introduce change to any given system in one form or another. The second theory of importance to PPP is therefore how resources are utilized for systems to develop. How development is perceived and understood shapes aims and goals in human activities. In this chapter we consider development in three different types of environment, the ecology, human society and the market economy.

A. Ecological definition

Citing Webster's new world dictionary, to develop means "to make fuller, bigger, better etc.⁴⁵" Accordingly, development would mean the act or process of making something fuller, bigger, better etc., which is a change of form or status by means of work being performed in order to achieve a net-gain in form or status. Whenever work is performed, potential energy is lost⁴⁶ and available resources are consumed. Development is thus

- dependent on a supply of resources over the period of time it takes to complete a change and
- in the process automatically alters the distribution pattern of available resources of the environment it occurs in.

Therefore, although the characteristics of the development process itself are always unique and specific to the system of organization that achieves change, the development of one system affects the development opportunities of other systems that share the same environment, locally, regionally and globally. Looking at the earth's ecology, we can see that change is a common and constant phenomenon of our eco-sphere. This, however, does not mean, that all systems develop. A change that results in a net-gain (or positive change) for any system, depends on the availability of resources and their distribution pattern. Positive change for one system results invariably in a decrease of available resources for at least one other system sharing the same environment and resources. For those systems that face a decrease of available resources, a negative development or regression⁴⁷ will occur if they cannot shift to other pools of resources.

With millions of life-forms sharing solar and earth capital and interacting within the same bio-sphere it is close to impossible to determine the exact characteristics and consequences of the development/regression relationship for each life-form individually. Instead scientists summarize net-losses and net-gains in a group of systems in what is called the "natural equilibrium", whose characteristics and significance for the ecology is defined by the number

⁴⁴Compare: "Agenda 21" (Rio Conference 1992) or "Our Common Future" (World Commission on Environment and Development, Oxford University Press, 1987)

⁴⁵ Webster's New World Dictionary, 1985

⁴⁶Compare: ecological definition of work or transportation, chapter 3.2.e

⁴⁷Regression or negative change, as here, is a net-loss of form or status for any system, as contrary to development. (the author)

of systems selected for consideration over a period of time⁴⁸ and a predefined study- or ground-area in any given environment. Three categories are considered in describing equilibrium and not all are equally relevant for every system that is part of the studied environment. They are

- Physical development/regression
- Physiological development/regression and
- Organizational development/regression.

All three factors are inter-linked and represent different levels on which development can take place:

A physical factor in development is, for example, the availability of resources or the size of a population. Through a series of development and regression, a stable population is reached in form of equilibrium between increase and decrease of the number of individual life forms⁴⁹.

A physiological factor would be the bodily response of a living organism like, for example, an insect to environmental factors like an insecticide. Or, the embryonic growth of an organism before it is born. As a general rule it can be said that the more complex the organism is, the slower any physiological development.

An organizational factor is for example the behavioral change or group response of carnivores towards hunting due to an increase or decrease in the number of pack-members or the number of prey.

We can summarize a general ecological definition of development as follows:

The process of physical, physiological or organizational change in or of a system or form of organization over a period of time that results in a net-gain in form or status, achieved through work and a change in the distribution pattern of available resources.

B. Human society definition

In having highly developed brains and hands, humans are different from other living organisms, as they can create their own environment with the help of tools. Physiological change for the complex biological organism of a human is slow and can take thousands of years and, for example, often much longer than we have written records of human societal development in history. It therefore does not concern us here. But to attempt a definition for development in the human environment, we substitute physiological factors, which are too slow to have an immediate impact, with psychological or attitudinal factors.

In the natural or ecological environment, the physiological make-up of a living organism sets the frame for physical and organizational change possible for that organism as it is the determining factor⁵⁰ of how available resources can be put to work, e.g. how energy can be extracted to perform work. In the social environment, the psychological make-up⁵¹ of a society and its individuals decide on how available resources are being used. One well known example is that the Hindus of India do not consume their cows but regard them sacred, while for a large portion of humanity the cow is an important source of protein.

Therefore human development, here, is restricted to physical and organizational development based on the overall psychological make-up of its individual members and centers on three main aspects:

⁴⁸ Development considered over a very short or shorter period of time is in ecological terms also often described as growth.

⁴⁹ G. Tyler Miller Jr., "Environmental Science", page 138 pp., 1997, ITP publishing

⁵⁰ The determining factor is also called limiting factor in ecology.

⁵¹ Human attitude towards the surrounding environment, based on the mind and emotional processes. (the author)

- As living beings, humans are part of nature and develop in accordance with opportunities provided in the natural environment, following ecological principles⁵². (availability of resources, physical development)
- As social beings using tools, they invent and shape their own environment, following human behavioral (cultural) principles⁵³. (psychological and organizational change)
- Using the economy as a tool to organize the resources of the natural environment, they introduce and create the economic environment to the eco-sphere, following economic principles⁵⁴. (redistribution of resources)

We therefore suggest the following definition for development in human societies:

The process of physical, psychological or organizational change in or of a human system of organization (society, culture) over a period of time that results in a net-gain in form or status, achieved through work and a change in the distribution pattern of available social and physical resources.

C. Market economic definition

Economics is the theoretical tool of describing the organizing of resources and their consumption or production that does not take the ecology but general human needs into account. The economy is the artificially created environment in which humans implement the economic principles and is not bound by ecological efficiency. We can therefore define development in economies as:

The process of physical or organizational change in or of a system of resource flow management over a period of time that results in the highest possible net-gain of available physical or (economic) capital resources, achieved through work in an artificial environment and a change in the distribution pattern of available physical or (economic) capital resources.

3.2.c Sustainable Development

A definition of sustainable development in the ecology, and human society can be very brief. We combine the definitions of chapter 3.2.a with those of the last chapter:

A. Ecological definition

The process of physical, physiological or organizational change in or of a system or form of organization over a period of time that results in a net-gain in form or status, achieved through least use of available resources and the least change in their distribution pattern.

B. Human society definition

The process of physical, psychological or organizational change in or of a human system of organization (individuals, societies, cultures) over a period of time that results in a net-gain in form or status, achieved through a process of work that takes no more potentially renewable resources from the natural world than can be replenished naturally while not overloading the capacity of the environment to cleanse and renew itself by natural process.

⁵² compare: the model of environmental determinism. Terry Rambo, *The conceptual development of human ecology*, Hawaii, 1981

⁵³ See also: "The Ambient Environment", from "Environmental Psychology", Francis T. McAndrew, pp. 51, Brooks and Cole Publishing Company, 1993

See also: BRUNSWIK, E. (1956), *Perception and the representative design of psychological experiments*. Berkeley and Los Angeles: UCLA Press.

See also: GIBSON, J.J. (1997). *An ecological approach to visual perception*. Boston: Houghton Muffin

⁵⁴ G. Tyler Miller Jr., "Environmental Science", page 168 pp., 1997, ITP publishing

C. Market economic definition

Contrary to ecological or human society systems, for various reasons, a sustainability definition for economic systems poses some problems:

A true-market economic definition of sustainable development does not need to take the principle of efficiency into account, unless it has a direct influence on its net capital gain. It aims at achieving the highest possible surplus of available resources for consumption by humans in the economic environment. The net capital gain in an economic system is defined by terms introduced by humans, for example, the act of collecting and transporting those resources follows the principle of efficient use according to economic accounting, as contrary to green accounting. Thus, economic development per se is set apart from ecological and human development on a sustainable basis. The very central idea of the human tool economics is to organize a surplus and take more resources out of the natural environment than can be directly consumed, in order to build an external storage pool and thus a permanent and uninterrupted flow of resources for human consumption. Not from the natural environment, but from the stores human societies have created. For non-human life-forms, though, there is no difference whether humans consume collected resources without time-delay (hunters and gatherers principle⁵⁵) or whether consumption takes place via external storage⁵⁶ facilities (agricultural settlements principle). Resources have not only been redistributed into a new pattern, but also taken out of the ecological system, e.g. they are no longer available for consumption by other life-forms. Re-introduction into the bio-sphere takes place only via defecation for biologically consumed resources and/or in form of waste for socially consumed resources (which are either bio-degradable or not).

Humans could develop societies and culture only because they were able to collect more resources than were actually needed to sustain the original human population. Through the introduction of external storage and trade, humans excluded more and more life-forms from their ecological environment, thus creating the human environment. Sustainability in an ecological sense is contrary to economics and thus cannot be applied here: The more resources can be stored, the more individuals can be fed, the more individuals can be fed, the more resources can be collected for storage and become non-available resources for other ecological systems and so on. Humanity, although consisting of many individuals, has the environmental impact of one single organism with an "unnatural" consumption need for available resources, with human societies consuming more than all single human individuals combined:

Being a human tool, the basic function of the economy is not the consumption of resources, e.g. potential energy is extracted to perform work, but the collection of resources to be stored and distributed, thus, the term (ecological) sustainability cannot be applied in either economics or economic development.

3.2.d The Cost of the Economic Environment: Linking Sustainability and Economics Through PPP:

After storage, the introduction of money (financial capital) is the next step in the development of the economic tool. Money acts as an indicator of how many available resources are stored for human consumption and are required for redistribution. Money becomes a substitute for the potential energy that would otherwise have to be consumed in order to give human individuals access to resources in a natural environment. It is thus a substitute for the resource

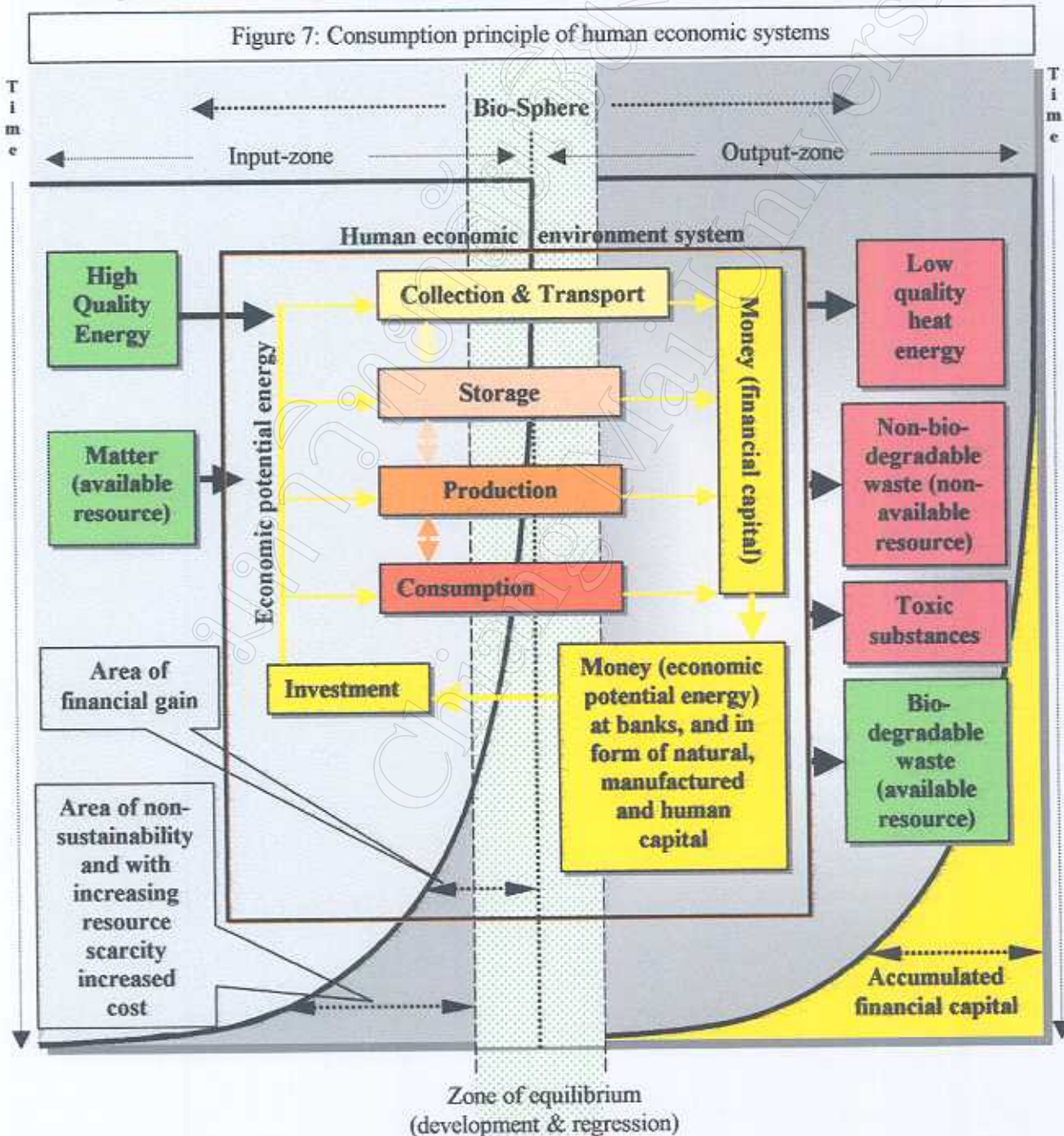
⁵⁵ compare: Jared Diamond, "Guns, Germs, And Steel", 1997, W.W. Norton & Company

⁵⁶ This storage is different from the one practiced by some other life-forms: For example, an acorn buried by a squirrel for later consumption is still available for other life-forms and only a small percentage of acorns stored can actually be retrieved and consumed. The squirrel changes the distribution pattern of available resources, but human storage practices turn available resources into non-available resources in the ecological sense.

itself and the act of collecting it and has become the major potential energy source of the human and economic environment. With a monetary system in place,

- available natural resources can be transformed into financial capital and thus
- can be stored outside of the physical environment of the human using the resource, and humans
- can very efficiently change an available resource that is useless to a system into a useful one (trade), and most important,
- resources do not need to be moved to become available for human economic consumption, but in addition can now be claimed by purchasing title deeds.

The introduction of a financial system has increased economic efficiency in collecting, distributing and providing consumable goods for humanity. As money itself has become a resource, it is possible for individual humans to store more resources than they could ever, either bodily or socially, consume in their lifetime. The cost of economic development for the ecology is therefore a rapid loss of available resources that are transformed into money at a



rate that transcends ecological need for the extraction of potential energy to allow the development and sustaining of living organisms. Simultaneously, ordinarily available resources are transformed into non-available resources, e.g. the waste created by humans.

Socially, we can observe a similar consequence. Development comes to a standstill for those societies (organized groups of humans) that lose their access to resources directly convertible into potential energy via bodily consumption and that do not have the financial resources to acquire them in the economic environment. Ironically, the very source of humanity's wealth in available resources, the economic tool, has now become the source of poverty for most of humanity, as more and more humans are forced to live in environments that have been previously and are still being depleted of most of their available resources only to be stored externally in either their physical shape or in form of financial capital. As long as humanity uses economic principles to guide human society development, there can be no sustainability in the ecological sense and as humans conquer more and more available natural environments also in the social sense. The amount of available resources is limited and with all physical areas of the eco-sphere claimed by humans directly through consumption (use) or indirectly through purchase, economic development must come to a stand-still. We show the consumption principle of human economic environments graphically in figure 7.

Economics is but a very efficient tool of humanity to direct resource flows. Its aim is to create a constant surplus of available resources, which is the basis of human social development. Economics has to make the most possible use of resources in order to create the largest surplus possible and thus the largest basis for human society development. With the introduction of a monetary system, those surpluses can be exchanged into money, the potential energy of the economic and human environment. On the other hand, ecological sustainability always aims at the least use of resources in order to avoid depletion, so as to sustain a life-form as long as possible. Because of this contradiction in terms it is not possible to define sustainable economics in an ecological system. However, we can define the extent to which humanity uses a tool and improve on its design. Sustainability for humanity can therefore be achieved through introducing principles supporting ecological sustainability while implementing human development itself either

- ⇒ within the theory of the economic tool by internalizing ecological costs, e.g., linking principles of ecological sustainability and development to those of economic development (PPP/UPP), and/or
- ⇒ within the human environments that are created and/or
- ⇒ within the system that links those environments or sub-systems therein, which is the transportation environment.

3.2.e Transportation Definition

We can distinguish two different types of transportation, one that occurs naturally and one that is man-made. They are different in character and structure. Contrary to the natural phenomenon of transportation (movement, work), all man-made transportation, except for walking, within human societies is completely dependent on tools and therefore man-made in character. Human transportation has to create its own artificial environment blended over or built into the natural environment in order to take place. Having an environment removed from nature, it nonetheless represents a system of organization within the natural environment and is thus automatically linked with the earth ecology. The following definitions each focus on a different aspect of transportation: the ecology, humans and the human transportation environment, and the economy.

A. Ecological definition

The moving of objects from one point in space to another achieved through a loss of potential energy. (Work⁵⁷)

B. Human society definition

The moving of at least one human from at least one pool of resources to at least one other achieved through a loss of potential energy, based on the consumption of earth capital.

C. Economic definition

The moving of physical resources⁵⁸ from one point in any given environment to another achieved through creating an artificial environment and a loss of (economic) capital.

D. Sustainable Transportation Definition

The moving of resources and / or humans from one point in space to another through a man-made environment at least possible cost for the Ecology, Society and Economy alike, within a system of organization that is in itself sustainable and aims to integrate an optimal mix of nature with human habitation and economic utilization of land.

The 'sustainable transportation definition' above is based on a few key words, which are used specifically and have to be considered in more detail to clearly understand the sustainable transportation principle:

- **Resources:** All resources that are needed to maintain the man-made environment: natural capital, manufactured capital and human capital.
- **Humans:** Representing humans, knowledge and all other resources that are not material in character but emotional and social and are needed to sustain human cohabitation. They do not exist without humanity and express themselves in art, culture and human relationships.
- **Man-made environment:** Any system of organization introduced by man into the natural environment.
- **Least possible cost:** The smallest possible loss of potential energy or available resource.
- **Ecology:** All natural systems of organization⁵⁹ depending on or representing solar and earth capital.
- **Society:** The human system of organization, based on emotional and social needs.
- **Economy:** A human tool and system of organization to take resources from the ecology for consumption or production in order to maintain society.
- **Integrate an optimal mix of nature with human habitation and economic utilization:** As solar and earth capital can neither be made nor destroyed, human interference with the natural environment can only change the distribution pattern of available resources⁶⁰. Optimal mix, as here, would mean to deprive none of the three systems of organization (the ecology, society, and the economy) of available resources to such an extent that future maintenance and growth of either are at risk. Integration, as here, means to build a unified system of organization where human ecological, social and economic measures enhance each other to sustain all sub-systems of organization equally within the eco-sphere.

⁵⁷ G. Tyler Miller Jr., "Environmental Science", page 53, 1997, ITP publishing

⁵⁸ Knowledge resources are not addressed here. However, because physical movement of human capital is often aimed at reaching a knowledge pool, such resources are an important aspect of transportation. (See definition of sustainable transportation and chapter 3.1.b, under "Telecommuting")

⁵⁹ This includes the "human ecology"

⁶⁰ See appendixes chapter A9, under "Cost of transportation"

3.2.f Development, Transportation and Environment in Human Ecological Systems: Dimensions of Infrastructure.

If we consider the ecological definition of transportation from chapter 3.2.e, “the moving of objects from one point in space to another achieved through a loss of potential energy”, we realize that work is being performed and in the process, change achieved. The system that initiates the change experiences a net-gain in form or status and the eco-sphere a net-loss in form of heat-waste. (development/regression relationship). From an ecological point of view, thus, the environment created by humans equals development based on transportation and we can state that

- transportation is a form of development and vice versa, and
- that transportation and development, while taking place, have to create some form of pollution.

However, while natural pollution (as opposed to man-made) through naturally occurring forms of transportation and development take place, the ecology provides other systems of organization for which the pollutants created represent available resources. A perpetual cycle is closed which revolves around the zone of equilibrium established between the in-put and out-put zones of the biosphere. As every environment (human and natural) is based on transportation/development, all environments must have this zone of equilibrium.

Contrary to nature, man-made environments based on economic principles do not have their equilibrium placed within the ecology, but within the economy and within the social environment. However, they, too, follow the principle of net-gain and net-loss, whenever transportation or development occurs. The fact that net-losses resulting from gains of any social development⁶¹ do not automatically result in a new pool of available resources for other human members of the same environment, is the source of conflicts in human societies. The emergence of human ecology as a field of study is one attempt to understand those conflicts better and propose solutions.

The paradigms of human ecology are built on two basic principles, environmental determinism and environmental possibilism. They describe the same relationship, but chose a diametrically opposing perspective. While the determinist model sees cultural form developing due to the external influence of geography, topography, climate and natural resources, the possibilistic model sees cultural traits as having developed independently of the environment and only later being screened by environmental factors⁶². Other models have been added, like the model of cultural ecology, the eco-system based model, the actor based model and the systems model of human ecology. All those different systems share the aim to place human development into a relationship context between all the individuals of a society and the environment they exist in. However, all models cannot more than generalize trends in human behavior:

Relationships within a group of twenty people involve only 190 two-person interactions⁶³ (twenty people times nineteen, divided by two). So we have to consider at least 390 different factors shaping an environment, which are 200 single human-environment relationships and 190 group environment relationships. But, we also have three-person interactions and more. If

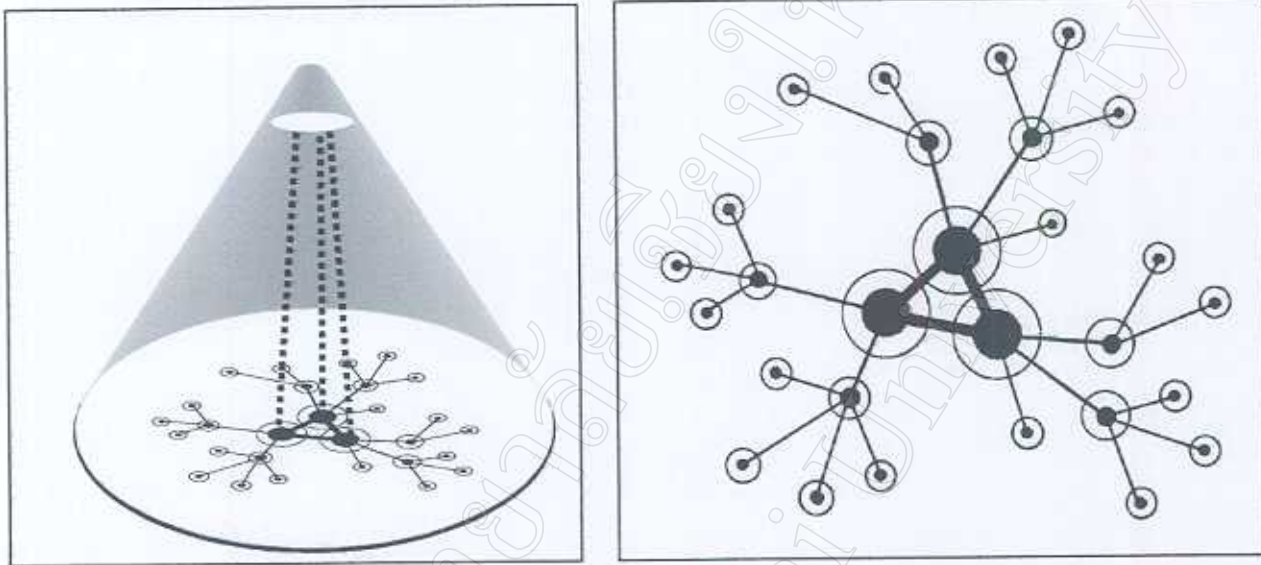
⁶¹ Development within a man-made environment

⁶² *Conceptual Approaches to Human Ecology: A Sourcebook On Alternative Paradigms For The Study Of Human Interactions With The Environment.* Edited by Terry A. Rambo, East-West Environment and Policy Institute, Honolulu, Hawaii 96848, April 1981

⁶³ Two persons being considered the minimum to demonstrate environmental and cultural change by a group: person A and person B shape their environment independently from each other and have their own personal sets of attitudes towards the change they induce. The relationship between A and B, linked through social interaction shaped by their combined attitudes, represents the third factor changing the environment. (the author)

we consider a group of two thousand people, there would be 1,999,000 dyads on the two-person relationship level alone.

The number of possible conflicts in such a group is large and people introduce rules and laws to avoid those conflicts and to govern their group behavior and interaction. Human ecology tries to generate models of how factors turn into self-imposed rules and to determine the effect they have on human environment creation. Rules and laws create hierarchies, e.g. lists of priorities of which social factors take precedence over what others. Figures 8a and 8b give a graphic representation of a social hierarchy, the biggest circles representing factors being of more importance to a human environment than the smaller ones, but all are equally linked to and depending on each other⁶⁴.



Figures 8a and 8b: A model of hierarchy

The size of the circles can also represent the number of times a factor is invoked in order to rule over another one. The most important ones will be those used most often in organizing a human environment.

It is not the theories of scholars or the financial prowess of economies that introduce physical change to areas that are used by people, but it is always the human hand that shapes the human environment, uses a tool or puts a theory into practice. The way we live socially as a group, the way we "handle" the hierarchy of environmental factors, is therefore always expressed physically in the way we alter the natural environment. We find that any characteristics of a human environment is expressed in its road-system, architecture, art and all other physical alterations to the original natural environment. Looking at figure 8b, we can easily imagine the shown pattern of social hierarchy representing a transportation environment, physically connecting the location of different factors in a society according to their perceived importance.

Going back to our definitions of transportation at the beginning of this chapter and realizing that transportation equals work, and work is always achieved through a loss of potential energy, we conclude that human social relationship interactions in requiring work to take place, follow rules indicated by the principles for physical transportation. For this very reason we can find that man-made environments always result in a physical manifestation of our

⁶⁴ As the number of important factors, e.g. those that take precedence, is always smaller than the number of less important ones, we could also represent this graphic as a triangle, as is in fact done in many publications concerning social hierarchies.

social behavior. Additionally, as efficient consumption of available resources in the ecology is always determined by physiological or limiting factors, analogue the created human environment always reflects social and political limitations and rules of a system, determined by the psychological make-up of a society. We can thus state that, the more ecologically efficient transportation (work) is being performed, either physically or mentally,

- ⇒ the better resources are used and
- ⇒ the better development can take place in a human society, as the amount of available resources reaches a maximum.

It is therefore possible to describe the development potential of a society and its social and ecological sustainability by analyzing the efficiency with which all forms of movement in its widest sense are arranged. Furthermore, in order to create a sustainable human environment, we only need to implement a sustainable transportation environment on all levels where movement takes place. This includes the movement of knowledge and ideas. For PPP to be most efficient, it is therefore important to provide a basis of free exchange of ideas and have (ideally) the complete intellectual participation of all members of the population where PPP measures are implemented.

Within such an environment a society will move itself and its resources efficiently and sustainable, provided the individuals' environmental perception of that society is able to recognize the personally most efficient mode of transportation (work) from a variety of choices offered. Therefore, education must be a compulsory part of any physical environment planning: Humans' large brains in combination with hands to use tools have replaced the physiological component of physical limitations due to body-shape with a psychological component of environment perception. The environment perception enables people to invent tools to overcome bodily restrictions.

This combination of brain, hands and perception gives humans an advantage over other living beings. However, it comes at a price and humans do know and understand their environment less automatically, as their instincts are only developed rudimentary when compared with other living organisms. After birth they have to go through a very extended period of learning in order to develop their environmental perception sufficiently to live in the natural world. The more choices that perception enables a human to make, the more successfully and efficiently it can survive, that is, to close the circle, if the human environment it lives in allows for a maximum realization from all those possible choices available for implementation.

To allow for sustainable human environments we, thus, have to consider the following:

1. In order to sustain an equilibrium in a changed human environment, we need to adapt
 - ⇒ the physical resources,
 - ⇒ the psychological and social resources, and
 - ⇒ the organizational resources of this environment to that change.
2. In order to guarantee a continued sustainable development of a changed human environment, we need to take measures to
 - ⇒ sustain the ecological environment that is the basis of the human environment within its natural zone of equilibrium,
 - ⇒ sustain the social environment within the human social zone of equilibrium,
 - ⇒ sustain the economic environment that supports those zones of equilibrium by redesigning the economic tool used to extract available resources to support the ecological and human environment in accordance with ecological principles, and

- ⇒ sustain a back-flow of financial capital to the area that supplied the available resources that were transferred into financial capital⁶⁵.
3. In order to allow for the most efficient implementation of points 1. and 2., we need to
- ⇒ build a transportation environment that provides efficiency for all forms of physical and non-physical movement in its widest sense in the human and ecological environments,
 - ⇒ build a transportation infrastructure that provides a sustainable choice, and
 - ⇒ train and educate the environmental perception of people in the ground area of the concerned environment.

⁶⁵ Analogue to the ecological principle that waste generated through consumption always represents a potential resource for another life form. (With the possible exception of heat-waste.)