SOME ISSUES IN ENERGY POLICY AND PLANNING

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Summary

In addition to its conventional meaning of "*preparing for future situations*", energy planning addresses policy making, in particular in situations where self-regulating markets are perceived as inadequate for reaching given policy goals. A general example for such a situation is given by the presence of non-monetary externalities, that is, costs or benefits that are not included in market interactions themselves. In the energy sector, one of the most important externalities is the environmental impact of energy conversion and use. To internalize externalities, policy making can influence energy market prices by taxes and subsidies, among others. These measures are so-called market instruments. Another group of measures is sometimes called "*command and control*". This term refers to rules and regulations such as labeling, building codes, and bans. The choice among several policies and measures aiming at the same outcome depends, among others, on the geographical level (global, national, local) of policy making. While the geographical level refers to the means available to policy makers, policy assessment is an instrument to guide the choice among possible options by evaluating criteria such as effectiveness and side effects. Throughout the energy planning process, uncertainty and its management are important aspects to consider.

1. Introduction

Despite a global trend towards energy market liberalization, there is – and will be – ample room left for energy planning. The natural domain of energy planning begins where markets approach their conceptual limits, that is, whenever non-market (non-price) costs or benefits begin to play a role. Conventionally, non-market costs are termed negative and non-market benefits positive *externalities*. Both kinds of externalities can arise on a global, a national, and a sub-national (regional, local) level. An example of an external global cost of fossil fuel use is the increase of atmospheric concentrations of greenhouse gases (GHG). An example of a possible local external benefit of hydropower generation is flood control. Both of these examples describe environmental externalities, but this need not be so. An example of a non-environmental externality is the generation of knowledge over and above the specific kind of knowledge that is protected by the rules governing intellectual property.

In the existing markets, one important task of energy planning is to address *market failures*. This term is used to describe situations in which a market transaction is not happening despite it being favorable in narrow economic terms, i. e., without considering externalities. The external costs involved in this example are associated with the acquisition of information. These costs are incurred by making a buyer aware of a more favorable opportunity than one actually seized. Although this kind of market failure could be interpreted as just a specific example of the general case, its frequent occurrence warrants separate mention. To the extent that this kind information could not have been provided through more conventional advertising – which usually is an internal cost factor – providing such information would be a suitable task for (public) energy planning.

Another kind of market failure is the non-existence of the theoretical premises that are postulated to assure the functioning of markets. One such premise is competition between the actors – buyers as well as sellers – in a market. This premise is violated in situations of monopoly and oligopoly, which were observed in the energy area. This particular kind of market failure has been addressed by recent efforts to “liberalize” energy markets.

Only theoretically, energy planning can be addressed in isolation. In reality, any energy system is embedded in – and closely interacts with – the overall economic system. Together with the environmental interactions just described, the combination of these three fields is often referred to as “E3”. E3 models are therefore tools used for the analysis of energy-economics-environmental systems. They are described in more detail in *Energy Planning Methodologies and Tools*.

2. A Conceptual Frame

While conceptualizing the energy system it is useful to recognize different levels of energy. Natural forms of energy such as coal, natural gas, or eolic (wind) energy are referred to as *primary energy*. *Secondary energy* is usually the result of a first step of conversion, for example refined oil products or electricity at the busbar of a power plant. *Final energy* is the form of energy bought and sold in the market to final consumers, e. g., grid-delivered natural gas or electricity at the point of a wall socket. It is important to note that these distinctions are primarily conceptual. Looking at coal or natural gas for example, there is no essential difference between the physical energy forms on the secondary and that on the final level.

These three energy levels are the basis for the consideration of energy conversion technologies. Aggregating identical or very similar technologies such as all coal-fired power plants or all gasoline-fueled passenger cars and adding all links between them, we can consider the *Reference Energy System* (RES) of an economy. Note that a RES is not uniquely defined, but rather depending on the level of aggregation considered in a particular analysis.

For energy planning purposes, it is important to add the concept of *useful energy*. In contrast to the three energy levels just described, useful energy is not represented by an energy carrier. Rather, it is the kind of energy that delivers an *energy service*, which cannot always be expressed in energy units. Examples of useful energy are the heat radiated from a residential heat source and the motion of a passenger car. These two forms of useful energy correspond to the energy services of a comfortable room temperature and passenger kilometers respectively. The importance of the concept of energy services for energy demand is highlighted by the fact that essentially the same energy service is provided by one car with occupancy of four as by four cars each carrying one passenger over the same distance. Obviously, final-energy consumption is drastically different in the two cases.

3. Means of Energy Planning

Although energy planning can be part of a business plan of a private company, the focus of the discussion in this section will be mostly on public energy planning.

The prime instrument available to policy making to influence the quantities of different energy forms in the market is to influence prices of goods and services via the collection of taxes on their production and/or consumption. Since governments anyway need revenues to function, the question is often asked, why not tax dirty and exhaustible resources such as fossil fuels more and renewable resources such as human labor less. A partial answer to this question is that as any tax change creates a new kind of distortion of the economic "playing field", it is politically difficult and often infeasible to introduce a new tax without compensation for those who suffer new losses. Thinking of a significant carbon dioxide tax, for example, a realistic assumption is that major emitters of carbon dioxide would have to be compensated for their new financial commitments, which in turn would weaken the desired effects of such a tax. Another drawback of many environmental taxes – in particular in comparison to an income tax – is that according to many studies they are *regressive*, that is, consumers with lower disposable income would be taxed a higher share of it than consumers with higher income.

Both of these two reasons against an environmental tax have to do with distributional consequences of the introduction of new taxes. Distributional aspects are important for all kinds of policy measures. They are therefore a prime criterion in the assessment of policy options. This and other assessment criteria will be described in a separately below (see Section **Error! Reference source not found.**).

Subsidies are the mirror image of taxes. In the past years, it so happened that subsidies often enhanced the use of "dirty" fuels such as coal for power generation, therefore not always furthered the cause of the environment. Nowadays, subsidies are more and more granted also to renewable energy, often in the form of guaranteed selling prices. Subsidies are a typical instrument of national energy policy making and therefore described in more detail in the following.

Taxes are only one way of internalizing external costs. Another possibility is to issue emission permits, each of which allowing its owner to emit a certain amount of a pollutant. The emission of any amount of this pollutant is then allowed only if an equivalent amount of permits is held. The rules for the allocation of such permits are a separate policy issue, which will be discussed together with the examples described in the following.

In theory, a system of tradable emission permits is equivalent to emission taxes in the sense that a limit on total emission leads to the same effect as an emission tax set at the level of the shadow price of the emission constraint. In less technical terms, this means that an emission tax set equal to the marginal abatement costs – the costs of abating the last unit of emission to stay within the emission limit – generates the same economic costs and the same environmental benefits as a "command and control" emission limit assuming a corresponding number of tradable permits to be issued. In other words, analyzed to this depth, the two policies are equivalent in terms of economic efficiency. Ignoring for a moment that this equivalence does not include the differences between the transaction costs of both strategies, there are also very practical differences between the two. Emission limits aim at precise emissions, but incur uncertain costs whereas taxes incur unambiguous costs, but result in uncertain emission reductions. The circumstances in an actual decision situation will therefore have an influence on the question which of the two policies to select.

In an energy planning situation where the aim is to freeze emissions at a certain level, the so-called "grandfathering" is an often-quoted allocation rule. This rule freezes the status quo for each emitter. Obvious as this rule may seem at first glance, it appears at least questionable if applied to global carbon emission entitlements, because it would "award" the heaviest polluters by granting them the largest emission entitlements, hardly an equitable proposition. On a national level, if emission permits were granted to industries for example, grandfathering permits would have the additional disadvantage of working as an obstacle to new entrants into the market.

As an equitable rule for the allocation of permits, equal emission rights for each person have been proposed. This rule is tantamount to granting equal property rights (to a carbon-free atmosphere, for example) to everyone and therefore highly suggestive, but the re-distributional consequences of its application are so great (it would force the politically most powerful industrialized countries to reduce their emissions the most) that the likelihood of its actual implementation is sure to remain low for a long time.

Anyway, a carbon tax addresses the issue of economic efficiency, and the endowment with emission permits addresses issues of equity. Although it does not necessarily help actual negotiations, it seems worth emphasizing here that the two are separate issues that are largely independent of each other.

Another major class of means for energy planning comprises general organizational or legal measures. An example of a general organizational measure would be the establishment of binding or non-binding standards. An extreme form of standard setting is a product ban, a policy measure that was introduced in the "Montreal Protocol on

Substances that deplete the Ozone Layer", which prohibits the import/export of controlled substances from non-members and bans the export of relevant technologies to them.

A legal measure aiming at improving the information base of consumers is the mandatory labeling of energy-consuming goods. Labels on electric appliances, for instance, would inform consumers about the energy consumption and the environmental impact to be expected from the use of the item, thus enabling consumers to make educated decisions about the benefits (in terms of energy savings and a reduced burden on the environment during the lifetime of the item) of a possible higher purchasing price of an environmentally more compatible and less energy consuming alternative. Empirical studies have shown, however, that the discount rates calculated from actual consumer purchasing decisions can be much higher than market discount rates. In other words, higher purchasing prices of energy-consuming equipment must pay back in very short times to make the increased investment attractive to consumers. This observation has been made for individuals as well as for companies. The discrepancy between market discount rates and consumer expectations has been wide enough to encourage private entrepreneurs to establish energy service companies who take care of the energy services required by a company. These energy companies work for part of the discrepancy of the discount rates, thus still reducing total energy expenses of the client firm ("contracting").

Less an object of policy making, but more an example of energy planning, are voluntary action and voluntary agreements, which have become an important means to reduce negative environmental impacts. The propensity to voluntarily invest in environmental protection depends of course on values and beliefs held in a society. To influence value systems is a long-term energy planning task, usually addressed by education on all levels.

The specific kind of policy measure chosen for implementation depends crucially on the geographical scope of energy planning. In the sequel, we shall therefore discuss energy planning according to the geographical scale of externalities that it addresses.

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Bibliography

BP-Amoco's global emissions trading programme, 2000, in: "Pipeline", the magazine of the IPE (International Petroleum Exchange), Issue 25, January 2000. [This document describes BP-Amoco's global emission trading program and the motivations behind it.]

The Climate Technology Initiative, 1999, http://www.climatetech.net. [This is the home page of the Climate Technology Initiative on the world-wide web.]

Hausmann, J. A., 1979, *Individual discount rates and the purchase and utilization of energy-using durables*, Bell Journal of Economics **10**: 33–54. [This is a classical article reports on the implied discount rates derived from the observation of actual consumers' purchasing decisions.]

IPCC, 1996a, *Climate Change 1995, Economic and Social Dimensions of Climate Change*, Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change, Bruce, J. P., Lee, H., and Haites, E. F., Cambridge University Press, Cambridge, New York, and Melbourne. [Particularly relevant for this subsection is Chapter 11 of that report, which gives an overview of studies of the distributional effects of energy and carbon taxes.]

IPCC, 1996b, *Technologies, Policies and Measures for Mitigating Climate Change*, IPCC Technical Paper I, WMO and UNEP. [This Technical paper provides an overview and analysis of technologies and measures mitigate greenhouse gas emissions. In particular, it includes criteria for the evaluation of policies and measures.]

Klaassen, G. and A. Nentjes, 1997, "*Sulphur Trading Under the 1990 CAAA in the US: An Assessment of First Experiences*", Journal of Institutional and Theoretical Economics, Tübingen. [This article contains a description of the trading scheme and an assessment of the experiences made with it.]

Kopp, R., R. Morgenstern, W. Pizer and M. Toman, 1999, "A Proposal for Credible Early Action in U.S. Climate Policy", Weathervane, http://www.weathervane.rff.org/features/feature060.html. [The authors of this article propose a scheme for carbon emission trading that aims at combining the success of and the familiarity with sulphur emission trading with the cost certainty of an emission tax.]

McKibbin, W. J. and P. J. Wilcoxen, 2002, *Climate Change Policy After Kyoto: Blueprint for a Realistic Approach*, ISBN, Brookings Institution Press, Washington, D.C. [Proposal for a carbon emission trading scheme with maximum-cost guarantees.]

Munasinghe, M., and P. Meier, 1993, *Energy Policy Analysis and Modeling*, Cambridge University Press, Cambridge, United Kingdom. [Although focusing on tools, this book also contains a comprehensive description of a conceptual framework for policy analysis and an overview description of the Global Environmental Facility (GEF) and its activities.]

Ross, M. and Steinmeyer, D., 1990, *Energy for Industry*, Scientific American **263**(3): 46–53. [This article analyzes the strategies of firms with respect to the implementation of energy saving equipment.]

Royal Dutch/Shell distributed document, 2000, *The Shell Tradeable Emission Permit system*, www.shell.com/steps. [This document describes Shell's tradeable emission permit system and the motivations behind it.]

The World Bank, 2000, http://www.prototypecarbonfund.org. [This is the home page of the Prototype Carbon Fund (PCF) on the world-wide web.]

Biographical Sketch

Leo Schrattenholzer has been affiliated with IIASA (International Institute for Applied Systems Analysis) since 1973, after graduating from the Technical University of Vienna. Presently he is Leader of ECS (Environmentally Compatible Energy Strategies) Project at IIASA.

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Dr. Schrattenholzer received his master's degree in mathematics in 1973 and his Ph.D. in energy economics in 1979, both from the Technical University of Vienna. His Ph.D. thesis was on modeling long-term energy supply strategies for Austria. From 1972 to 1974, he was a research and lecture assistant with the Institute of Mathematics I of the Technical University of Vienna. He has worked as a consultant to the Energy Sector Management Assistance Program sponsored by the World Bank and UNDP, for which he conducted a major project assessing personal computer models for energy planning in developing countries. He has also been a consultant to governmental institutions on national strategies to reduce greenhouse gas emissions. Other consultancy work has included the design and implementation of a computerized information system about space heating demand in the city of Vienna. He has represented IIASA-ECS in international teams working for three major projects co-sponsored by the European Commission and has lectured at universities and other educational centers. He is a Lead Author of the IPCC's (Intergovernmental Panel on Climate Change) Second Assessment Report. He is also the member of editorial board of the Pacific and Asian Journal of Energy (PAJE) and the International Journal of Global Energy Issues (IJGEI).

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