Sustainability Assessment of Swiss Hydropower
A Note on the State of the Art and Prospects for an Integrated Approach

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Abstract

The future of Swiss hydropower is a major challenge for sustainable development and decision making about the operation of and investments in hydropower plants. To address these challenges an integrated approach of sustainability assessment is required that matches the various social, economic and ecological goals of sustainability and development with stakeholder concerns in a coherent fashion and that provides better grounds for decision making. Such comprehensive assessment must also include a regional and value chain perspective. Regional impact analysis and SA as well as its translation to the corporate level (CSR assessment) are important tools in this respect.

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1 Introduction

The future of Swiss hydropower (HP) is a major challenge for sustainable development (SD), which is anchored as a national aim in the Swiss Federal constitution

HP is the most important domestic energy resource in Switzerland, and in some regions – particularly in Alpine areas – it constitutes an important local industry and backbone of the economy. It generates income and employment as well as significant fiscal revenues to cantons and municipalities, and maintains the regional economy in many remote areas (AEV, 2009; AG Wasserkraft, 2011; BFE, 2013; Rieder & Caviezel, 2006). At the same time, HP faces a series of new challenges that go along with the envisaged energy transition (Barry et al., 2015; Betz et al., 2016). These challenges involve the contemporary lack of profitability caused by the currently low prices on the European electricity market, and the related need to change the business model of storage and especially pumped-storage plants. In addition, Swiss energy companies and regions with HP plants are challenged by the imminent climate change and by the competing use of land and water resources between hydropower, tourism and agriculture (BFE, 2008; Beniston, 2012; Gaudard et al., 2013a, b; Gaudard & Romerio, 2014; Romerio, 2008). Moreover, the renewal/reversion of water concessions and the design of future water fee systems that might be more flexible, will induce a new era of HP utilization (SWV, 2012; Wyer, 2008) and bring about new institutional settings.

To be successful these settings must be designed and established on the basis of public-private partnership and governance models. This implies flexible water fees based on resource rents (Banfi et al., 2004, 2005) that would rely on future production technologies, environmental regulations, market structures and energy prices. Thus, there will be mutual interaction between energy policy and institutional arrangements, on the one hand, and HP operation and investment decisions, on the other. The latter are the core subjects of two complementary projects within the research cluster “The Future of Swiss Hydropower: An Integrated Economic Assessment of Chances, Threats and Solutions” (“HP Future”). Moreover, decisions on HP operations and investments will have economic, social and environmental impacts in the regions directly or indirectly affected by those plants. In order to be adequately taken into account by decision makers, these impacts must be comprehensively evaluated, compared and weighted, and then integrated into the decision making process.. The outcome must be fed back to the other projects and communicated to the various stakeholders involved in the process (→ stakeholder participation; → translation to corporate level).

Moreover, HP is part of a complex, dynamic system (…). It involves synergies and trade-offs across economic, social and environmental values that need to be carefully evaluated in order to optimize HP projects and their operation. The latter have impact on various domains along the entire value chain of hydro-energy, ranging from effects on socio-economic development in mountain regions, over impacts on ecosystems, landscape and downstream water flows, to overall market and institutional impacts. The stakeholders involved include energy companies, investors, politicians, public administrations and non-governmental organizations as well as local citizens and businesses that are variously involved in decision making about the future of HP.

Informed decision making requires comprehensive assessment that takes the various impacts and stakeholder concerns along the entire value chain and in their spatial context into account. For this purpose, regional impact analysis and sustainability assessment (SA) provide useful methods and tools that have been developed by different institutions and in various contexts (see Section 2). These methods and tools go beyond traditional approaches of environmental impact assessment and economic project appraisal, such as computable general equilibrium models, cost-benefit analysis, non-market valuation and life-cycle assessment.

To address the challenges of SD, which is anchored in the Swiss Federal constitution, an integrated framework is required that allows us to match the various social, economic and ecological goals of sustainability and development with stakeholder concerns in a coherent fashion and that provides better grounds for comprehensive, flexible and transdisciplinary SA (Scrieciu, 2007). This must particularly enclose an inquiry of the economic, environmental and social impacts of HP projects and operations in a given spatial context and the evaluation of the respective results in a SA framework – i.e., the integrated appraisal from a SD perspective. Stakeholder involvement in this process will foster a critical dialogue about and higher acceptance of the particular HP projects.

2 Sustainability assessment

Stipulated by the requirement of incorporating sustainability concerns into the policy formulation process, the search of SA methods and tools that best evaluate and integrate the trade-offs and interactions between the economic, social and environmental aspects of development has gained much attention in recent years. Around the world, SA is emerging "as a key decision-making tool, coinciding with the establishment of national sustainable development strategies" (Bond et al., 2012). It offers a complementary approach to other established methods and tools of impact assessment and project appraisal. SA "offers a specific assessment of impacts from the sustainable development perspective" (ARE, 2004) that is based on a systematic evaluation of the environmental, economic and social impacts going along with specific projects and undertakings now and into the future. From this point of view, SA might be combined with other approaches and particularly include a regional impact analysis. Moreover, it should be tailor-made for context and encompass some kind of stakeholder engagement (Bond et al., 2012; Pintér, Hardi, Martinuzzi, & Hall, 2012; Toman et al., 1998).

In the literature, various methods, tools, models and processes of SA have been discussed and proposed (cf. Bond et al., 2012, 2015; Gasparatos & Scolobig, 2012; Gibson et al., 2005; Gibson, 2006; Pope et al., 2015; Singh et al., 2012; Taisch et al., 2013). However, what might surprise is the fact that, despite a strong focus on general and methodological issues of SA, there is not a clear and uniform body of theory and methodology behind the majority of these approaches. Rather, most contributions are based on different disciplinary and epistemological realms, and they primarily focus on specific aspects of SA, such as extensions and applications of environmental impact assessment (Pope et al., 2004), life-cycle assessment (Finkbeiner et al., 2010; Pehnt, 2006), general equilibrium models (Böhringer & Löschel, 2006), integrated assessment models (Rotmans, 2006), or multi-criteria approaches (Maxim, 2014). Only few studies apply SA in a regional context (Graymore et al., 2008; Hermans et al., 2011; Munda & Saisana, 2011) or to HP projects (Liu et al., 2013, McNally, Magee, & Wolf, 2009; Morimoto, 2013).

The International Hydropower Association (IHA, 2010) provides a practical SA framework (protocol) for HP development and operation: the Hydropower Sustainability Assessment Protocol (HSAP). It encompasses assessment tools for decision support at different stages of a project (early stage, preparation, implementation, and operation). The protocol provides a "list of issues that must be considered to confidently form a view on the overall sustainability of a HP project at a particular point in its life cycle" (IHA, 2010). With a strong structure, it provides comprehensive assessment guidance at different stages of a project and has been applied, amongst others, to the evaluation of the Three Gorges Project in China (Liu et al., 2013). While offering one of the most comprehensive guidelines for best practice in the HP sector, the HSAP is not based on the same theoretical foundations as the

World Bank's and other approaches to measure SD (cf. Neumayer, 2013), and does not provide a strong and systemic tool for sustainability assessment of HP projects.

In contrast, ARE (2004, 2008) provides a comprehensive and coherent SA method that has originally been developed for the evaluation of federal projects and undertakings in Switzerland. It is based on the concept of "sensible sustainability" (Serageldin, 1996), a capital-theoretic approach that explicitly accounts for critical limits in three dimensions of sustainability (economic, environmental and social dimensions). It fills a gap between the opposing paradigms of weak and strong sustainability (Neumayer, 2013) and provides a "sustainability-based social value function" (Hediger, 1999b, 2000) that anticipates irreversible changes at boundaries of the opportunity space for SD, which is confined by the above mentioned critical limits. It implies higher values associated to the trade-offs between the different compartments of capital than a purely preference-based evaluation does. Accordingly, the anchoring in the sensible sustainability approach constitutes one of the strengths of the ARE approach. Another one is its pragmatism and practicability that has been proven with various applications in policy and project evaluation at the federal and municipal levels (ARE, 2014). Finally, the ARE approach is embedded in the Swiss Federal Council's (2012) Sustainable Development Strategy, which set out the government's main policy focus areas for SD in Switzerland.

A crucial element of any SA is the selection of sustainability criteria or indicators. These are usually based on the OECD (1991) "pressure-state-response" framework that, on the one side, is seen as providing a useful way of organizing information about the elements of sustainability (Toman et al., 1998). On the other side, it is criticized for its limitations in performance assessments in the economic and social domains (Taisch et al., 2013). However, a pragmatic approach is to start with a set of standard approaches – e.g., the IDArio criteria (ARE, 2004) – and to critically review those under consideration of "community values" that are to be determined in an integrated stakeholder process (Toman et al., 1998).

Finally, SA is largely understood as a complementary approach to other established tools of impact assessment (ARE, 2004). This may involve methods of product-related assessment – including life cycle assessment – and/or integrated assessment – including environmental impact assessment, multi-criteria analysis, or cost-benefit analysis, risk-benefit analysis, etc. "The suitability of these methods depends on the subject of the assessment and the nature of impacts" (ARE, 2004: 31). They must be carefully chosen, as this selection carries practical and ethical implications that involve assumptions about the role of stakeholders and the value systems embedded in the tools. Building on this background, Gasparatos & Scolobig (2012) propose a combination of biophysical, monetary and indicator-based tools and approaches to merge their advantages. They emphasize that "the adopted perspective should be consistent with the needs of the affected stakeholders as well as their expectations about the final result and its particular implications" (p. 4). This is the best implemented by combining stakeholder involvement with expert information, which "provides the stakeholders with a sense of ownership and control in the project, and increases the prospects of implementation and success" (Toman et al., 1998: 8). This is completely compatible with the SA procedure of ARE (2004) that encompasses three main stages: a) relevance analysis, b) impact analysis, and c) assessment optimization (for details: ARE, 2004, 2008).

3 Regional impact analysis

The assessment of regional income and employment effects of industrial activities, such as HP operations and investments, is crucial in a regional development context. The income and employment effects are core elements in applied input-output analysis and in studies on the value-added of selected industries at regional or cantonal levels. The former is based on input-output tables (IOTs) that provide a detailed description of the inter-industry flows of goods and services within an economy (Miller & Blair, 2009). For Switzerland, IOTs have been estimated for the years 2001, 2005 and 2008 (BFS, 2014; Nathani et al., 2011).

For the assessment of HP operations and projects, it is important to have adequate analyses on a regional scale. Recent examples of applied research that include regional input-output analyses (Buser, 2005; Giuliani & Berger, 2010) with focus on regional development as well as recent studies in the energy sectors in the cantons of Berne and Grisons (Nathani et al., 2012; Plaz & Rütimann, 2010). These studies, however, are restricted to economic and socio-economic impacts; while environmental and societal impacts are not taken into account. Thus, the use of IOTs can only serve as a complementary tool with regard to the assessment socio-economic impacts. It must be complemented with additional sources of information, such as described in the above SA section.

4 Stakeholder participation

Stakeholder involvement and actor networks are crucial in the assessment process in order to reflect and validate the results, and finally for implementation in the decision process: "Participation by affected stakeholders constitutes a central, integral element of the very concept of sustainable development" (ARE, 2004). In this respect, Hermans et al. (2011) point out that "stakeholders not only assign different weights to the same set of issues, but more importantly they select a completely different set of regional aims altogether." Toman et al. (1998) provide a conceptual framework and convincing argument for stakeholder involvement in SA, which is illustrated in Figure 1. They emphasize the importance of "community" values in a situation where a "community" is concerned with its current and future well-being. Moreover, they accentuate that "each potential effect identified by a stakeholder is important to evaluating sustainability" and "each stakeholder should recognize that some effects are more important than others". To bring this in line with the concept of SD a combination of stakeholder involvement with outside expertise (model outputs, qualitative information, and expert judgement) is required. Combining the two perspectives in an iterative fashion allows various viewpoints to be considered effectively and differences to be better negotiated (Toman et al., 1998).

Aiming at more transparent and more accessible project evaluation processes that promise higher levels of acceptance among the relevant stakeholder groups (Siebenhuner, 2004), various methodological approaches for stakeholder inclusion have been suggested over the past decades. Amongst them, participatory methods of action research and social network analysis are often used to facilitate, analyze and optimize such processes (Bergold & Thomas, 2012; Kowalski et al., 2009; Reed, 2008). Stakeholder participation may help to improve the acceptance of scientific results, and to agree upon joint targets that are based on these results and the mutual dialogue. Moreover, participatory approaches allow the collection of information about community values and preferences, and by this means to provide information that can be integrated in the SA (e.g., in the form of values and weights of utility).

The stakeholder dialogue is a form of a participatory approach that involves all types of stakeholders in decision-making and implementation efforts (CommGAP, 2009). It involves all interest groups of a private or public undertaking in a discursive (two-way) communication process that aims at increasing the mutual understanding and relations among stakeholders. Pedersen (2006) uses the term "stakeholder dialogue" to describe the involvement of stakeholders in the decision-making process that concerns social and environmental issues. A stakeholder dialogue can contribute to effective self-regulation of a company (Kaptein & Van Tulder, 2003) but also in promoting good and accountable governance by helping government institutions communicate better with their citizens (CommGAP, 2009). Thus, a stakeholder dialogue is not restricted to either private or public undertakings (businesses or investment projects). It can ideally support a process of public-private partnership.

Important for a dialogue to be productive and participatory are inclusion, openness, tolerance, empowerment and transparency (Pedersen, 2006). However, this does not imply that stakeholders have the right to be involved all decisions, but a stakeholder dialogue can be the beginning of a new “social contract” (Kaptein & Van Tulder, 2003). Important in this regard is the identification of perspectives and stakeholder selection (Cuppen, 2012; Schlange, 2009; Wheeler & Sillanpää, 1998). Being largely in line with the conception of corporate social responsibility (see Section 5), the inclusion methodologies invariably cover, though in differing extent, features of stakeholder scanning and identification, stakeholder consultation, and stakeholder engagement.

Actor network analysis is an important prerequisite that complements the stakeholder inclusive process by bringing in a dynamic, action-oriented perspective. Amongst others, the specific phenomenon of actor networks has been gaining attention from scholars in the fields of industrial marketing management (Corsaro et al, 2011; Jüttner and Schlange, 1996) as well as regional development and governance (Albrecht et al, 2014; Ingold, 2014; Ingold, and Balsiger, 2013), and energy policy (Smith et al, 2005; Späth & Rohracher, 2010). The main purpose of an actor network analysis lies in supervising the implemented process in order to facilitate, analyze and optimize it. From a meta-level point of view, actors’ positions, their interests and aspirations, as well as potential strategic activities, are monitored, reflected and continuously fed back into the process in order to safeguard its successful completion.

Altogether, an enhanced stakeholder involvement (participation) can foster a critical dialogue and improve regional acceptance of particular HP projects, and provide better grounds for comprehensive, flexible and transdisciplinary evaluations.

5 Sustainability assessment and corporate social responsibility

In a business context, corporate responsibility, transparency and accountability are core sustainability principles (IHA, 2010). This particularly involves the concept of corporate social responsibility (CSR) that is generally defined as the business’s commitment and contribution to SD (OECD, 2001; WBCSD, 2002). McWilliams & Siegel (2001) define CSR as “actions that appear to further some social good, beyond the interests of the firm and that which is required by law.”

One stream of literature on CSR is intimately linked to strategic management (e.g., Baron, 2007; Porter & Kramer, 2006), the other one deals with the welfare economic foundations (e.g., Beltratti, 2005; Heal, 2005). Building on the latter and starting with a Paretean view of the firm, Hediger (2010) provides the analytical link between the concepts of CSR and SD, and thus the basis for translating the findings of the regional SAs to a corporate level. He presents an approach that integrates the corporate perspective to the evaluation of a firm’s opportunity costs with the societal perspective of evaluation at the SD indifference curve that satisfies the requirements of sensible sustainability (Serageldin, 1996; Hediger, 1999b, 2000). Formally “we get the overall value of a company’s contribution to society that consists of the internal value of the overall profit from a shareholder perspective and the external value of its direct and indirect contribution to society” (Hediger, 2010).

Life-cycle based methods (cf. Finkbeiner et al., 2010; Klöpffer, 2008; Pehnt, 2006; Zamagni, 2012) can be used to complement the above approach in order to assure that whole life of a product “from cradle to grave” is taken into account if this proves relevant. However, life-cycle assessment (LCA) is focused on products, and less on regional impacts that are important in the case of HP investments. In addition, LCA provides well established tools for the assessment of environmental aspects, but the integration of the economic and social dimensions still need further development (Finkbeiner et al., 2010). Thus, the above method of translating SA results to the corporate may contribute to improve life cycle sustainability assessment (LCSA) on the basis of solid theoretical grounds and with empirical data.

6 Conclusion

Facing the challenges of energy transition and climate change and given its socio-economic importance in mountain regions, HP will continue to play a key role in our energy system. Since SD is the overarching principle in the Federal Constitution, future HP operations and investments cannot exclusively be based on economic considerations. Rather, the comprehensive assessment of HP's contribution to SD – from a regional and value chain perspective – will enable better informed decision making when it comes to the investment in new and retrofitting of existing HP projects, respectively, but also better informed decisions in the operation of HP plants. Regional impact analysis and SA as well as its translation to the corporate level (CSR assessment) are important tools in this respect.

Since SA of HP is a new field of application in Switzerland, an extension and refinement of existing methods is required for dealing with the specific circumstances of HP in a regional context. This is perfectly in line with ARE (2004) saying that "the conceptual framework should be tested and refined using specific case studies." This is the most usefully performed with a case-study approach. Moreover, the combination of the SA method with a stakeholder dialogue in each case study region will help to improve the validity and acceptance of the SA results and contribute to the optimization of HP projects from an economic, social and environmental perspective. Figure 2 gives the conceptual framework of such an approach that is based on a continuous process, which iterates between a more "technical" approach of SA and a dialogue with stakeholders. The former involves a comprehensive mapping of interdependencies and interactions of main variables in a systemic way. The latter helps to integrate community values as well as a comprehension and mapping of the main interdependencies and interactions from a stakeholders' perspective. Altogether, this allows for the elaboration of an integrated stakeholder process that is based on scientific information and community values. On the theoretical side, the respective values must be in line with Serageldin's (1996) concept of sensible sustainability, which can formally be transferred into the sustainability-based social value function of Hediger (2000) and finally be transferred to the corporate level (Hediger, 2010).

Given the importance of HP in Switzerland and especially mountain cantons – where HP is an important employer, purchaser, export industry and taxpayer in many municipalities –, the respective results of the regional SA and impact analysis are of particular significance to economy and society who will particularly benefit, especially if the information is provided to support decision making in energy utilities, HP municipalities and cantons, and on the federal level. In other words, it should contribute to SD and social well-being in the HP regions and will help private and public decision makers to better integrate SD concerns in HP operation and planning.

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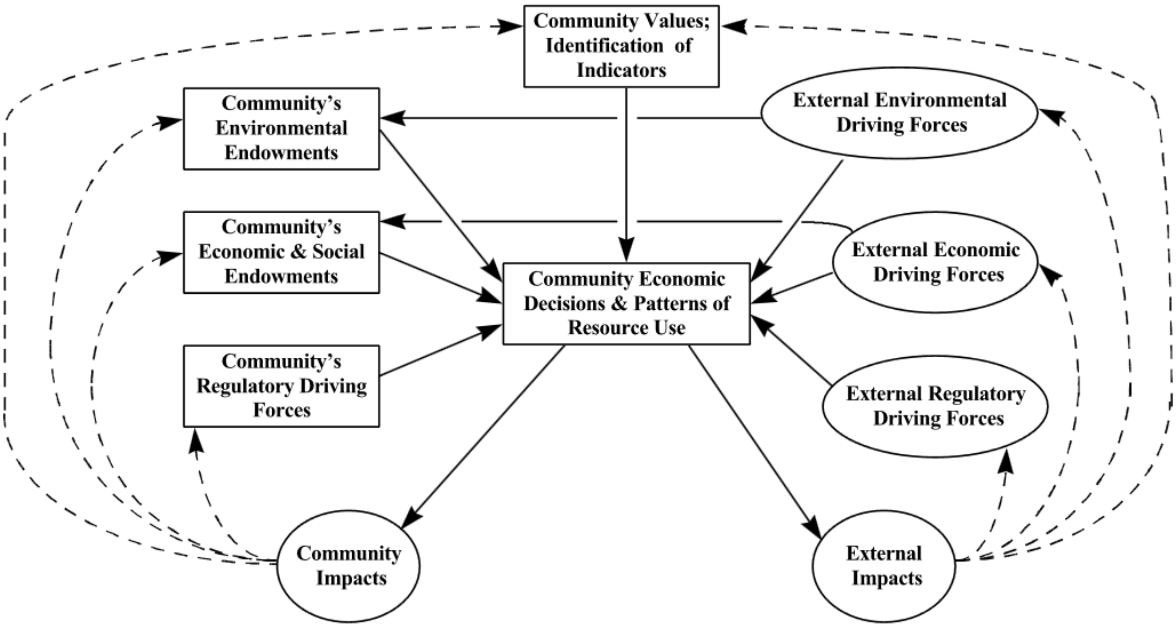

Fig. 1: A Conceptual Framework for Sustainability Assessment with Stakeholder Involvement (Source: Toman et al., 1998)

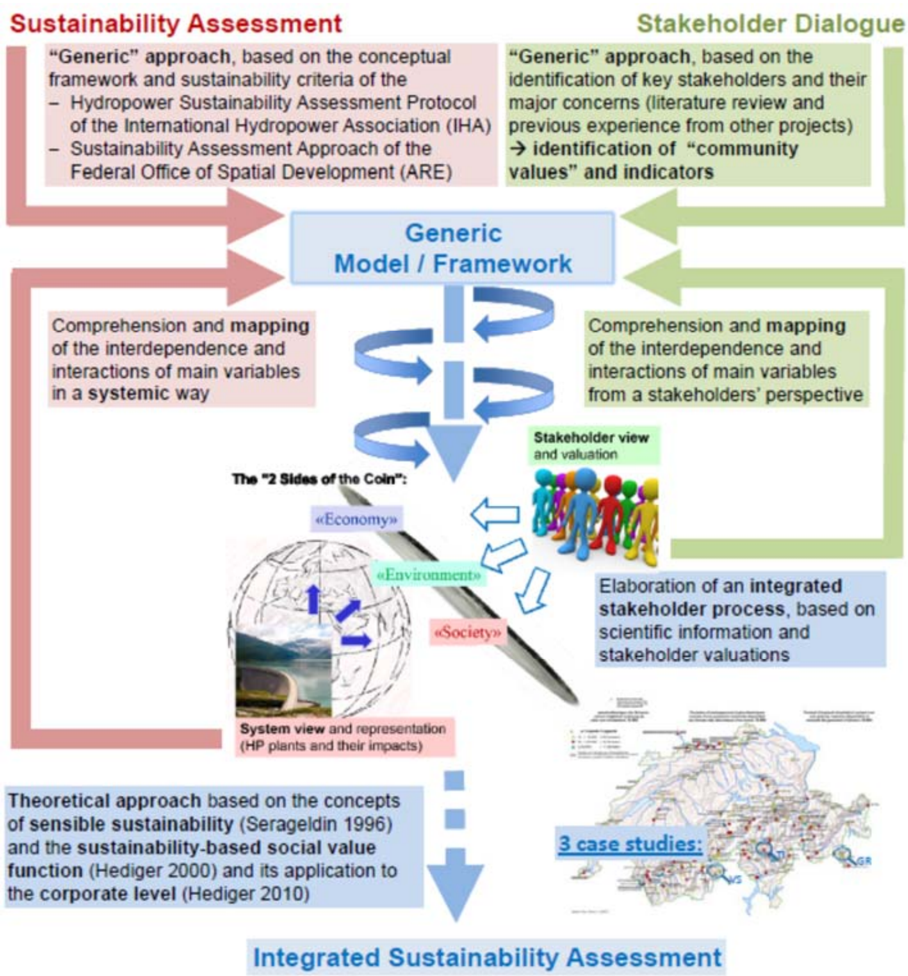

Fig.. 2: Integrating the scientific sustainability assessment and stakeholder dialogue