

# Promotion of Solar Heat in Industrial Processes: Policy and Law Analysis Method Proposal with Focus on Turkiye and Germany

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## Abstract

In this research paper, we propose a method to examine the policy and legal framework for solar heat in industrial processes (SHIP) in Germany and Turkiye with a comparative analysis. To enable industry actors to make use of the large growth potential of SHIP with its numerous application areas, targeted policies and legislation are to be adopted. For this reason, this research paper aims to fill the respective gap in analyzing and designing renewable energy law and policy frameworks for SHIP. A comparative analysis explores potential approaches to promote SHIP in Turkiye and Germany. To this end, the paper proposes a step-by-step method to pursue research milestones of both academic and practical interest by examination and comparison of the current extent of deployment of SHIP technologies and the current status of SHIP policy and law frameworks in both countries. It is an attempt to develop a method to compare two different and complementary contexts with an analysis of law and policy frameworks. The method includes five steps of (1) Literature review- State-of-the-art (2) Stakeholder Mapping (3) Status of SHIP applications (4) Status of Policy & Law (5) Future of Policy & Law. This method mainly serves to impose policy proposals for SHIP applications in both countries.

*Keywords: solar heat, renewable energy, law, policy, comparative study, method, industrial prosumer, border tax adjustments, Turkiye, Germany, , SHIP*

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## 1. Introduction

Solar thermal energy can meet a large amount of thermal demand in industrial processes in any given country and regardless of the geographical position, an analysis under the aegis of the International Renewable Energy Agency has found (IRENA 2015). Several industrial sectors (e.g. the textile, concrete, and food manufacturing industries) can benefit from this energy source given their demand for hot water and steam at temperatures of up to 400°C for processes such as curing, drying, dyeing, washing, boiling, pasteurization and sterilization. Solar Heat in Industrial Processes (hereinafter SHIP) systems may also contribute to a stable energy supply if the problem of volatility of solar energy is adequately dealt with. To this end, SHIP applications may also include heat storage units. For small and medium-sized enterprises, solar process heat may minimize the reliance on unpredictable fossil fuel prices. Despite the technological potential as well as the potential economic advantages of using solar heat in manufacturing, the current extent of deployment remains relatively low. This is for a number of reasons, among which the infant industry effect, inappropriate legislation, lack of awareness, and problems in the legitimization of the technology feature prominently.

As countries always seek to have clean energy solutions for industrial growth, the paper focuses on green energy production as a mechanism for generating income and improving industrial competitiveness. In order to improve green industrialization, "industrial prosumers" comes up, which is new for Turkiye. The United Nations Industrial Development Organization (UNIDO) defines "Industrial Promoter of Renewable Energy" as an industry that produces and uses renewable energy sources such as solar, wind, bioenergy and other renewable energy sources (UNIDO, 2015). Promoting industrial prosumers is essential worldwide, but it is crucial for countries with energy-intensive industries such as Turkiye and Germany. Over the last couple of years, the share of solar energy prosumer has increased rapidly in Germany. Despite the fact that Germany, which is one of the countries with the best technology position in the world, has a lower capacity in terms of solar energy potential compared to Turkiye, it has more than 40,000 MW of installed power (Keskin, 2019). In Germany, the rapid transformation of the energy sector has been boosted by the formation of hundreds of thousands of small "prosumers" within the stable, long-term policy structures.

Turkiye has large domestic markets and strong industrial capacities for domestic solar thermal hot water technologies. The prosumer term can be a new pattern to provide a win-win approach for companies and governments to support the actions for climate change and sustainable growth by combining clean energy sources into their power supply as well as their heating and cooling needs. Solar thermal energy can meet a large amount of thermal demand in industrial processes in any given country regardless of geographical position. In developing economies, solar thermal energy can provide about half of this energy consumption theoretically by providing hot water and steam at temperatures of up to 400°C. In particular, agriculture, the textile, concrete and food manufacturing industries are important industrial sectors, solar thermal energy can supply hot air and hot water required for curing, drying, dyeing, washing, boiling, pasteurization and sterilization. The SHIP system may also include a heat storage unit that can be used to increase the time of day when the heat is supplied to substitute for fluctuations in the solar resource. For small and medium-sized industries, solar process heat may minimize the reliance on unpredictable fossil fuel prices. Despite the technological potential as well as the potential economic advantages of using solar heat in manufacturing, the current extent of deployment remains relatively low (ETSAP & IRENA, 2015).

Drawing on these many advantages, having great potential and considering the growing attractiveness of solar thermal technologies to industrial consumers, it is time for policymakers to begin to realize the significant potential that exists for industrial prosumers to contribute to the green and circular economy. The development of the right policy and regulatory frameworks for this to happen would be a fundamental step. Research and development must also be recognized as an industrial policy measure. German energy research is a strategic component in German energy policy and is crucial for the energy transition's long-term success. Additionally, German producers are global technology leaders in the field of renewable energy and energy efficiency. There is an opportunity to take lesson-learn and generate components of Turkiye's modern energy supply system (ETSAP & IRENA, 2015). That is why market creation and comparison have to go hand in hand in facilitating the development and implementation of these technologies with law and policy frameworks.

Among the industrial policy measure, research and development must also be recognized. German energy research is a strategic component in German energy policy and is crucial for the energy transition's long-term success. Additionally, German producers are global technology leaders in the field of renewable energy and energy efficiency. There is an opportunity to take lesson-learnt and generation of components of Turkiye's modern energy supply system. For the reasons mentioned above, this paper proposes a Policy and Law Analysis Method” with a focus on the promotion of solar heat in industrial processes with a comparative analysis of Turkiye and Germany.

## **2. Literature Review**

As we look at the literature, we can see that the legal scholarly literature on the promotion of green energy is rich. Firstly, there are several editorial books which directly deal with the issue. Hancher, Hauteclouque, Salerno (2017), and more recently Hunter et. al (2020) offer a valuable introduction to the state aid and regulation for the green energy sector. German legal literature is promising as well. Pritzsche and Vacha (2017) and Steinbach (2017) both offer introductions to the field. On the Turkish side, Çakmak (2018) is the prominent book on green energy promotion. However, legal literature that directly deals with SHIP applications is non-existent. This paper is an attempt to compile the first pieces of legal literature to form a method proposal for policy and regulation analysis. As the method is developed and implemented in further studies, it adds value to the legal framework analysis in renewable energy and specifically in solar heat in industrial processes.

Beyond the doctrinal legal literature, there are policy-related sources from various governmental organizations, especially in Germany. German Federal Ministry for Economic Affairs and Energy (BMWi) regularly publishes reports on the development of the Energiewende process (BMWi, 2018 and BMWi, 2019). On the Turkish side, the strategy paper of the Energy and Natural Sources Ministry (ETKB, 2019) covers the energy transition policy between 2019-2023. The energy efficiency strategy paper (ETKB, 2012) for between 2012-2023 offers insights into the Turkish energy efficiency policies.

The research method of the paper includes desk research of documents (papers, report, legal document, policy proposals, related funding programme calls) to propose the method of law and policy analysis. This method is to design including document scanning (desk research) as well as collaborative meetings to interact, communicate and exchange knowledge and experience between researchers for proposing legal and political documents specific

to SHIP applications. It aims to take up prior research on innovation and law, power-to-x technologies/sector coupling, and the governance of renewable energy and energy innovations which so far has not specifically dealt

The comparative approach taken in this research and the selection of Türkiye and Germany as countries of reference are particularly well suited to contribute to the overarching research goal for a number of reasons. Most importantly, the research design fosters mutual learning. Learning from the individual experience of each country may facilitate the successful deployment of SHIP applications supported by appropriate policy measures, which in turn is pivotal to reducing fossil fuel reliance and related carbon emissions in both developed and emerging economies. The focus on Germany and Türkiye and the collaboration of researchers from both countries promise particularly fruitful insights. Regardless of the substantial differences in economic development terms, both countries offer significant potential for growth for renewable energy deployment. On the one hand, Türkiye's green energy sector has been rapidly developing in a "solar boom", and the country features strongly in research promoting energy from solar sources. Among other factors, this leads to a reduced cost of renewable energy sources in Türkiye compared to other (European) countries, and in particular Germany. Also, research from the Turkish institutions involved has shown great potential in expanding the utilization of PV and solar-thermal systems as energy sources. Germany, on the other hand, has been a frontrunner and role model in promoting renewable energy. Germany's approach to promoting renewable energy in the "Energiewende", a term coined already in the 1990s, has since gained significant momentum abroad. The experiences of both countries are thus complementary. Combining the perspective of both German and Turkish researchers in a comparative approach helps to make sure that the potential for creating synergies in knowledge is properly made use of when SHIP promotion policies are designed.

### **3. Method and Material**

First of all, this paper put emphasis on researching the potential of promoting the deployment of SHIP applications through dedicated law and policy making. To date, the topic is widely under-researched, despite the clear potential of SHIP to contribute to a more stable, secure and sustainable supply of energy in order to partly cover the high industrial energy demand. The potential of SHIP has been highlighted mainly from a practical, technology-oriented perspective. With regard to reasons why the potential remains underexplored, the high costs of SHIP appliances and their maintenance compared to conventional energy sources are deemed to be the main limiting factor (see IRENA 2015 and cited literature). However, due to their limited scope, prior analyses on the subject do not altogether or at least not sufficiently explore how this hindrance can be overcome by means of policy measures. Hence, there is a fundamental gap in academic research from a policy-oriented perspective – including legal issues – that the paper seeks to fill through cooperative research.

The paper seeks to make a significant contribution to research in the European Research Area on a topical issue in line with current European policy and legal framework developments. In particular, the paper examines a technology that is able to build a bridge between high standards of environmental protection and climate action on the one hand and economic growth on the other. The focus on Türkiye, which is not only an important trade partner to Germany but also a rapidly emerging economy, is furthermore worthwhile considering the EU's aim for global leadership in tackling climate change by means of creating technological innovations and progress and exporting them worldwide. Due to its comparative and cooperative approach, the method to be developed aims to substantially strengthen the relations between these two countries at the institutional and implementation level.

### **4. Preliminary Analysis and Prospective Research**

First, the paper aims to address a particular academic literature gap. The policy and law of SHIP are not appropriately dealt with to this date, the paper proposes a method that begins with prior research on innovation and law, power-to-x technologies/sector coupling, and the governance of renewable energy and energy innovations. Especially the interdisciplinary approach to SHIP including legal scholars is novel. Second, the paper produces a policy proposal method, contributing to both countries' policymaking processes.

Examining SHIP policy and law in Germany and Türkiye from a comparative perspective facilitates the transfer of knowledge and experience on the issue. The authors (two of whom are studying in renewable energy diffusion in Türkiye, and one of them is studying the same issues in a comparative perspective of Germany and Türkiye) pool their findings and compile texts together by scanning the legal framework documents in the original language.

Additionally, planned research visits form cornerstones of the research since they will further ensure knowledge transfer. The outcomes of the joint research (with the further works of one policy report and at least one scientific paper) will benefit stakeholders, policy-makers, and legislators in Türkiye and Germany. The policymakers will be able to refer to our policy report in developing new SHIP promotion strategies. On the other hand, the stakeholders will be able to refer to our policy report in their future projections and communications with the policymakers. Our scientific papers will serve as a starting point for social scientists who aim to work in the SHIP field specifically for Türkiye.

## **5. Conclusion: The Method Proposal**

The paper is ongoing research and is first presented in Eurosun 2022. The research is being done by an interdisciplinary team and in close collaboration between Middle East Technical University (METU) and Hacettepe University (HU) from Türkiye. Dr Erden Topal (the corresponding author) has extensive experience in researching renewable energy policymaking. She has been closely collaborating with Professor Dr Derek K. Baker (METU and ODTU GUNAM – Center for Solar Energy Research and Applications) on several EU Projects and National Initiatives for Concentrated Solar Thermal Technology (CST) Development, Diffusion and Policy Making (ODAKTr). Prof. Baker specializes in CST technologies including SHIP applications and provides his technical expertise and experience in the field of solar energy technologies. MSc. S. Deniz Akdemir (Co-author and MSc Student of Professor Baker) is an environmental engineer on the Turkish side and completed her Master of Science Thesis about SHIP in Türkiye in 2020. Dr Onur Cagdas Artantaş (co-author) is completed his Ph.D. on Renewable Energy Law in Türkiye in comparison with Germany under the supervision of Prof. Fehling in Bucerius Law School/ Germany.

With this interdisciplinary team, we propose a method for designing proposals and possible implications of legal and policy frameworks. The case studies are to be Germany and Türkiye as a comparative case study exercise. This proposed method for the promotion of SHIP is a stepwise approach and made up off the steps of:

### **STEP 1: Literature Review- State of the Art (in SHIP Policy and Legal Frameworks)**

The first step will be a thorough analysis of the existing literature regarding (i) the functioning and potential of SHIP technology more generally; (ii) the current status of deployment of SHIP in Germany and Türkiye; (iii) economics, policy, and law relevant to the promotion of SHIP in both countries. This measure will reveal the state-of-the-art in these three areas on which the method proposal and the analysis is accrued by using this method that is built on. The researchers will define the exact scope of the method based on the findings in this step. Here, the scope is the key target to reach to define the framework and borders of the research.

### **STEP 2: Stakeholder Mapping (in Germany and Türkiye's SHIP Landscapes)**

The second step will involve examining the current situation and general conditions of energy, Concentrated Solar Technologies (CST) and the SHIP industry in Germany and Türkiye scanned in the first step of the method. In this step, the first finding of the H2020 Horizon STE Project - Implementation of the Initiative for Global Leadership in Solar Thermal Electricity (GA No: 838514) deliverable titled Integrated Country Report (submitted on July 30, 2022,;j and now is available after EU Approval) is benefitted. This report is a comprehensive document that includes both Türkiye's and Germany's (in addition to Spain, Italy, Portugal, France, Greece, Denmark, and Belgium) outlook in CST technologies countries The relevant stakeholders will be mapped out in each country according to their connections with each other. This includes industry actors as well as institutional or university actors, e.g. in the field of engineering. This "stakeholder map" helps to prepare the research and networking activities in further steps in this specific technology area of SHIP to further develop legal and policy frameworks.

### **STEP 3: Status of the SHIP Applications**

The third step aims to deepen the overview of the current status of SHIP deployment in Germany and Türkiye gained through the former steps. To this end, further information will be collected from the regulators and industry stakeholders in each country. Here can be seen as field research conducted with a sample of stakeholders in each country determined in the second step. The aim is to compile a preliminary report, which will be used in later research phases with first-hand data of expert interviews in each country. The report will discuss the current technological level, the structure of the SHIP sector and of the relevant industry branches, financial endowment,

and the percentage of local equipment used in the SHIP applications from the perspective of key stakeholders in each country.

#### STEP 4: Status of SHIP Policy & Law

The fourth step contributes to one of the two focuses of the paper as the current status of the SHIP policy and law in Germany and Türkiye. The previously collected information (e.g., state-of-the-art, stakeholder map, the status of the SHIP applications) will be utilized here at a different level. All relevant policy documents and legislation will be examined in detail to assess their strengths and weaknesses in promoting SHIP mainly in Germany, and to take the lessons learnt from the German case to further develop the Turkish case in SHIP applications.

#### STEP 5: Future of SHIP Policy & Law (Proposals on Policy and Legal Frameworks)

This step contributes to the second of the two research aims. In this step, different scenarios of policy development will be examined against the background of stakeholder needs, the desire to further technological development and the emission reduction targets of the EU. This may include a "Business as Usual" (BaU) and a "Successful Promotion of SHIP" (SPoS) scenario. It will be presented how the SPoS diverges from the BaU route in terms of reduction of power consumption, emission mitigation and estimated added financial value. Policy proposals for the SPoS route will be made, including recommendations for amendments in legislation.

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