



ELSEVIER

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Application of solar energy in the oil industry—Current status and future prospects

M. Absi Halabi^b, A. Al-Qattan^{a,*}, A. Al-Otaibi^a^a Energy and Building Research Center, Innovative Renewable Energy Program, Kuwait Institute for Scientific Research, PO Box 24885, Safat 13109, Kuwait^b Petroleum Research Center, Kuwait Institute for Scientific Research, PO Box 24885, Safat 13109, Kuwait

ARTICLE INFO

Article history:

Received 6 April 2014

Received in revised form

29 September 2014

Accepted 1 November 2014

Available online 26 November 2014

Keywords:

Oil industry

Petroleum

Renewable

Solar

Fossil fuels

ABSTRACT

The scope of this review is to highlight the potential contributions of solar energy in meeting the energy requirements of the oil and gas industry. It includes an assessment of the key factors that impact the world energy scene and the anticipated role of solar energy up to 2035. It appears that oil and gas will continue to play a dominant role in meeting world energy demand over the next two decades, accounting for nearly 60% of total primary energy, and reaching around 9960 Mtoe in 2035. The energy consumption of the oil and gas industries is nearly 10% of its total energy production and is expected to grow to a higher value with the growth of the share of unconventional oil and gas resources. The amounts of energy projected to be consumed by the oil and gas industry is estimated to be at least 39.4 EJ by 2035. The energy supply to meet the demand of the oil and gas industry is based mostly on hydrocarbon energy sources, which leads to high levels of ecological footprints. Solar energy utilization within the industry will reduce its fossil fuels consumption, and therefore reduce its ecological footprints. Specifically, solar energy will help the industry in meeting part of its energy requirements in locations where conventional fuels, such as natural gas, are limited. This paper reviews various efforts made in developing solar technologies to suit the oil and gas industry. It also shows that some upstream oil and gas industries have already utilized solar energy in demonstration field applications. The review concludes that the application of solar energy in the oil and gas industry presents a very good opportunity for future business of the renewable energy industry. These opportunities includes the use of photovoltaic and solar thermal technologies.

© 2014 Elsevier Ltd. All rights reserved.

Contents

1. Introduction	297
1.1. World energy supply and demand	297
1.1.1. Current and projected energy supply and demand	297
1.1.2. Availability of energy resources and security of the supply	298
1.1.3. Environmental impact of the oil and gas industry	298
2. Energy consumption in the oil and gas industry	299
2.1. Energy consumption by the upstream oil and gas industry	300
2.2. Energy consumption by the downstream oil and gas industry	300
2.3. Factors impacting future energy consumption of oil and gas industry	301
3. Potentials of renewable energy in meeting the energy requirements of the oil industry	301
3.1. Providing electrical power to oil and gas production operations	301
3.2. Meeting oil production industry thermal energy needs	302
3.2.1. Low-medium temperature solar thermal applications: Process heat	302
3.2.2. High temperature solar heating applications in oil production: Enhanced oil recovery	303
3.3. Solar applications in oil-field water desalination and treatment	305
3.4. Applications of other renewable energy resources in oil production industry	305
4. Potential applications of renewable energy in downstream industry applications	306

* Corresponding author.

E-mail addresses: mhalabi@kisir.edu.kw (M. Absi Halabi), aqattan@kisir.edu.kw (A. Al-Qattan), ahotaibi@kisir.edu.kw (A. Al-Otaibi).

4.1. Hydrogen and synthesis gas production. 307
 4.2. Developments in photocatalytic reactors 307
 5. Role of oil and gas companies in developing renewable energy technologies 307
 6. The economics of utilization of renewable energy in the oil and gas industry 309
 7. Future prospects of renewable energy in the oil and gas industry. 309
 8. Conclusions 311
 Acknowledgments. 312
 References 312

1. Introduction

The global demand for energy over the next two decades is expected to increase by nearly 50%, reaching around 778 EJ by 2035 [1,2]. This increase in energy demand is expected to pose a major challenge for energy companies, particularly oil and gas companies, due to diminishing conventional oil reserves around the world, and increasing dependence on heavy crude oil, which requires significantly higher energy to produce and process. Hence, both the total energy consumption and the energy intensity, i.e., quantity of energy required per unit of oil or gas produced, are expected to increase. The oil and gas industry meets most of its energy demand from available hydrocarbon resources, therefore, environmental impact due to CO₂ emissions during oil and gas production is expected to increase dramatically.

Oil production and refining consume nearly 10% of the produced oil, which is equal to nearly 28 EJ in 2013. The largest share of this consumption is in the form of thermal energy required for processing oil and converting it into petroleum products. Abood et al. [3] pointed out that the industry must be more energy efficient and must also utilize renewable energy sources, whenever feasible. The industry should use its business and technology knowledge base to develop and promote sustainable energy products. The use of renewable energy resources by the industry will save significant amounts of oil and gas resources, freeing them to meet the energy demand for other applications locally or internationally, as well as reducing the environmental impact of the industry. This is in line with UNIDO's [4] projections, which estimated that by 2050 the potential of renewable energy for industrial applications will reach around 21% of the final energy use in the manufacturing industry.

The objective of this paper is to review the efforts made by the oil and gas industry over the past 40 years in adapting renewable

energy technologies and applying it to meet the energy demand of the industry. The paper also provides highlights of the role of the industry in developing renewable energy technologies and its attempt to integrate these technologies within the industry's role as energy provider. The potential role of some advanced renewable energy applications, specifically solar energy technologies, which are currently in the R&D phase, in directly meeting the energy needs of selected high-temperature energy-intensive processes required for the petroleum refining industry is also being presented and its potential impact is discussed

1.1. World energy supply and demand

It is important to acknowledge the dominant factors that currently impact the world energy scene. These factors are the following:

- Projected energy demand.
- Availability of energy resources and security of their supply.
- Impact of energy resources on the environment.

1.1.1. Current and projected energy supply and demand

Energy supply and demand for 2010 was pictorially summarized by the International Energy Agency (IEA) in its World Energy Outlook 2012 [2] (Fig. 1). The figure shows that total energy supply was around 532.5 EJ (12.72 Gtoe), out of which oil and gas supplies were around 53.8%, with most of the oil going into fossil fuels. The figure also shows that 34.25 EJ (818 Mtoe) or around 12.5% of input oil, gas, and coal were losses and consumed energy for producing fuels. For energy demand projection and according to the IEA's reference scenario, which is based on a business-as-usual assumption,

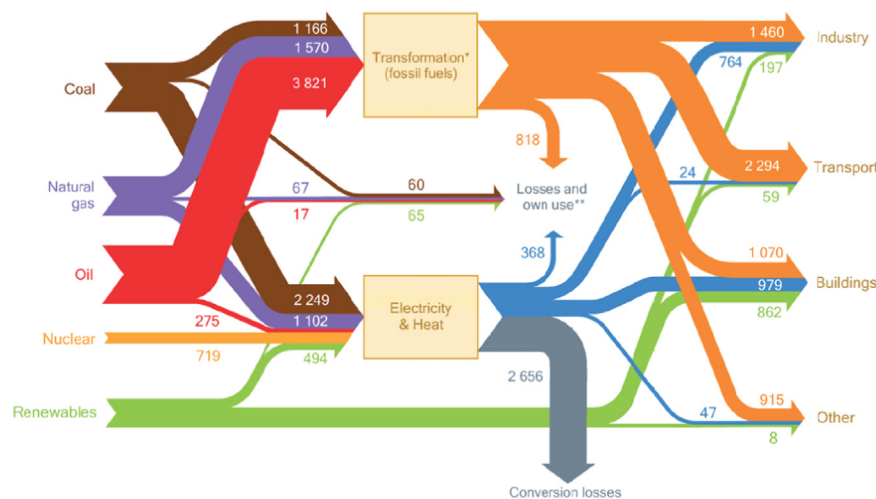


Fig. 1. The global energy system (in million tons oil equivalent (Mtoe)) ([2], p. 62). (Notes: * Transformation of fossil fuels from primary energy into a form that can be used in the final consuming sectors. ** Includes losses and fuel consumed in oil and gas production, transformation losses and own use, generation lost or consumed in the process of electricity production, and transmission and distribution losses. 1 Mtoe=41.868 PJ).

Download English Version:

<https://daneshyari.com/en/article/8117575>

Download Persian Version:

<https://daneshyari.com/article/8117575>

[Daneshyari.com](https://daneshyari.com)