



# GLOBAL SOLAR ENERGY TRENDS AND POTENTIAL OF BUILDING SECTOR IN HUNGARY

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## ABSTRACT

As the present trends show current policies lay more stress on using solar energy and renewable energy sources as some years before. There is a 175 000 TW power of solar energy, which came from the Sun. If it could be exploited, less than 10 % of this would be enough to cover the human economy. The solar energy has an important role in the reduction of the Ecological Footprint of humanity. This research would be offered a survey the global solar energy trends and the potential of building sector in Hungary. Furthermore, also the alternative energy sources appeared in the transport: many governments give financial assistance to the proliferation of electric cars.

Government and policy support for renewable energy has increased considerably over the past decade. Two drivers underpin this trend: first, the effort to constrain growth in greenhouse-gas emissions and, second, concerns to diversify the supply mix (promoted particularly by high oil prices, especially in 2005-2008). To address these concerns, more and more governments are adopting targets and taking measures to enhance the share of renewables in the energy mix.

## KEYWORDS

energy trends, solar energy, energy potential, building sector assessment, decision support

## CLASSIFICATION

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## GENERAL GLOBAL ENERGY TRENDS

One of the major challenges faced by European countries today is the reduction of CO<sub>2</sub> emissions that contribute to climate change, and one of the key areas where improvements could be made easily and at low cost is the energy efficiency of buildings. There is an urgent need nowadays to reduce current levels of greenhouse gases emissions. Greenhouse Gases (GHGs) are water vapour (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), ozone (O<sub>3</sub>), chlorofluorocarbons (CFCs) and hydrofluorocarbons (HCFCs, HFCs). On the other hand, the European Union (EU) countries are largely dependent on energy imports and vulnerable to disruption in energy supply, which may in turn threaten functioning of their current economic structure. The EU imported 54 % of its energy sources in 2006 and was projected to increase even further by 2030. Reducing its import dependency EU is one of the main goals of the 20-20 by 2020 target – this legislative package is believed to reduce the expected imports of energy by 26% compared to the development before the 20-20 initiative. There were three main directions of the 20-20 programme, which are the 20 % cutting of GHGs, the 20 % rising in the using of renewables and the development of energy efficiency by 20 %. The pledge of Hungary in this programme was the increasing of the renewable energy using with 14,65 % and the decrease of GHGs emission with 10 %. One of the most important environmental problems is the energy consumption of the buildings. It is shown in this paper that buildings can deliver large energy and CO<sub>2</sub> emission reductions at low costs. The directives and the methods of the energy certification of the buildings spread across Europe. Only 1-2 % part of the building stock is exchanged every year, so it is very important to increase the energy efficiency of the existing buildings, too.

As the statistics shows, in Middle Europe the gap to reach the 2020 renewable energy share target is on an average value. In Hungary the purposed value to 2020 is 14,7 % and the reached value in 2016 is 14,2 % [1]. In other Middle European countries, for example in Poland and in Slovakia the stance in 2016 was worse than in Hungary. The intent in Poland is 15,9 % and the reached value in 2016 was 11,3 %. The corresponding values in Slovakia in 2016 were 14,0 % to 12,0 %.

The following table shows the forecast in Poland. Accordingly, the three major energy user sectors in 2020 still the Industry, Households and Transport. This table is similar to other countries in this region, and based on this, it is clearly visible that the intervention may be the most efficient in these sectors.

**Table 1.** Demand for final energy by sectors of the economy in Poland, based on [2].

	2006	2010	2015	2020	
<b>Industry</b>	20,90	18,20	19,00	20,90	29 %
<b>Transport</b>	14,20	15,50	16,50	18,70	26 %
<b>Agriculture</b>	4,40	5,10	4,90	5,00	7 %
<b>Services</b>	6,70	6,60	7,70	8,80	12 %
<b>Households</b>	19,30	19,00	19,10	19,40	27 %
<b>Total</b>	65,50	64,00	67,20	72,80	100 %

Short-term changes in energy demand and the composition of the fuel mix are largely a function of economic conditions, energy prices and the weather. But long-term trends, as is shown by the strong contrasts across the main WEO-2015 (World Economic Outlook) scenarios, can be significantly changed by the manner in which governments intervene in markets to tackle energy-related challenges.

Nonetheless, several fundamental energy trends persist across the scenarios: rising incomes and population push energy needs higher; energy-market dynamics are increasingly determined by the emerging economies; fossil fuels meet most of the world’s energy needs, from an ample resource base; and providing universal energy access to the world’s poor remains an elusive goal [3] (Fig. 1.).

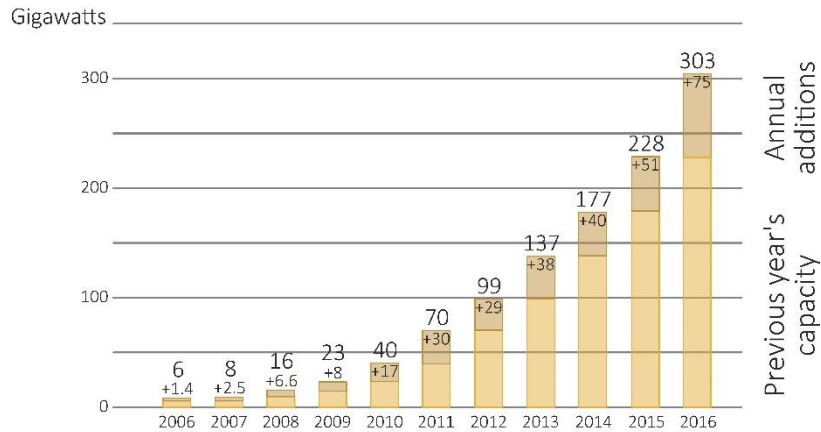


Figure 1. Solar PV Global Capacity and Annual Additions, 2006-2016, on the basis of [4].

## RISING RENEWABLE ENERGY PARTICIPATION

In 2040, the share of renewables (including traditional biomass) in world primary energy demand could/would/planned to/etc. reach 15,7 %, from 12,6 % in 2010. This rapid increase is underpinned by incentives to overcome market barriers, falling technology costs, stronger application of policies, rising fossil fuel prices and in some cases carbon pricing (see Section 1). Most of the growth occurs in the power sector, where their share in total generation grows from 20 % to 31 %, a near tripling in actual generation.

Global demand for renewable energy continued to rise during 2011 and 2012, despite the international economic crisis, which makes us feel its influence in the future, on-going trade disputes, and policy uncertainty and declining support in some key markets. Renewable energy supplied an estimated 19,2 % of global final energy consumption by the end of 2014, the latest year for which data are available.

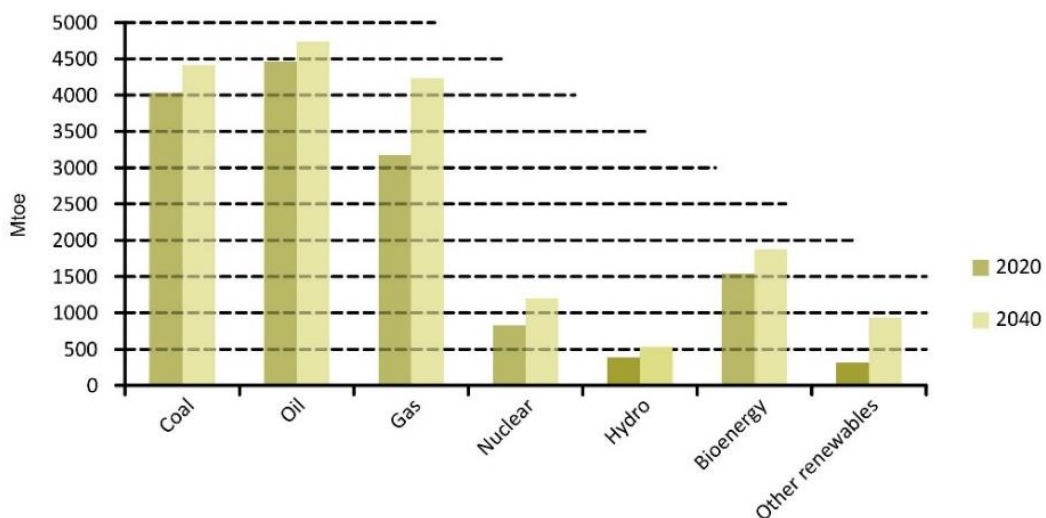
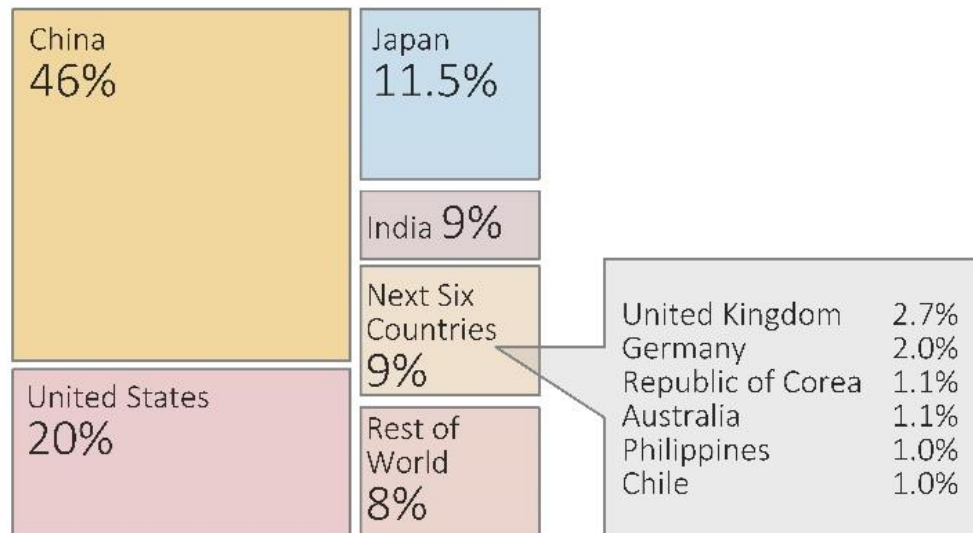


Figure 2. World primary energy demand by fuel in the New Policies Scenario, based on [3].

Of this total, approximately 8,9 % came from traditional biomass, which is used primarily for cooking and heating in rural areas of developing countries. Useful heat energy from modern renewable sources accounted for an estimated 4,2 % of total final energy use; hydropower made up about 3,9 %; and an estimated 1,4 % was provided by power from wind, solar, geothermal, and biomass and by biofuels. Among others this rate shows that the value of wind energy using is lower in 2014 than in 2012 (Fig. 2.).

Renewables are a vital part of the global energy mix. Modern renewable energy can substitute for fossil and nuclear fuels in four distinct markets: power generation, heating and cooling, transport fuels, and rural/off-grid energy services. This section provides an overview of recent market and industry developments in the first three sectors, while the Rural Renewable Energy section covers rural/off-grid energy in developing countries. The section that follows provides technology-specific coverage of market and industry developments and trends [5].

During the two-year period 2012-2014, installed capacity of many renewable energy technologies grew very rapidly, with the fastest growth in the power sector. Total capacity of solar Photo Voltaic (PV) grew at rates averaging 60 % annually. Concentrating Solar thermal Power (CSP) capacity increased more than 40 % per year on average, growing from a small base, and wind power increased 25 % annually over this period [5].



**Figure 3.** Renewable power capacities in the world, EU27, BRICS, and Top Seven Countries End-2015, based on [4].

PV additions shows us the fastest PV growing trends in the world. It shows that the leading country is China and the United States follows it with the half of its growing (Fig. 3.).

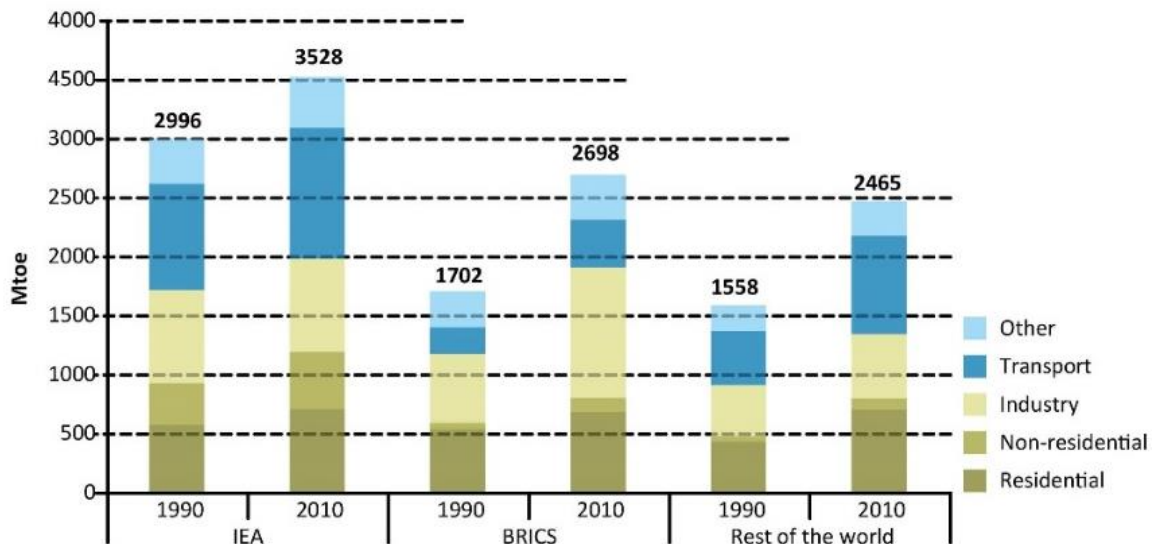
Hydropower and geothermal power are more mature technologies and their growth rates have been more modest, in the range of 3- 4% per year. Bio-power is also mature but with steady growth in solid and gaseous biomass capacity, increasing at an average 8 % annually. Demand has also increased rapidly in the heating/cooling sector, particularly for solar thermal systems, geothermal ground-source heat pumps, and some bioenergy fuels and systems [5].

## RELEVANCE OF BUILDING SECTOR – ENERGY CONSUMPTION

Buildings are the largest consumers of energy. The sector’s global final energy consumption doubled between 1971 and 2010 to reach 2 794 Mtoe, driven by population increase and economic growth. During current policies, global energy demand from buildings is projected to grow by an additional 838 Mtoe by 2035 compared to 2010 [6].

Most of this growth will result from the increase of building's energy use in non-IEA countries. The growing energy consumption of buildings is expected to effect heavy pressure on the global primary energy supply unless effective policy action is taken at a global level ((International Energy Agency) IEA, 1994).

In most EU member countries, buildings currently account for more than 40 % of primary energy consumption. [7] The residential sub-sector remains the largest consumer of energy at a global level, and the non-residential sub-sector has increased its share since 1990, especially in Brazil, Russia, India, China and South Africa (BRICS) [8] (Fig. 4.).



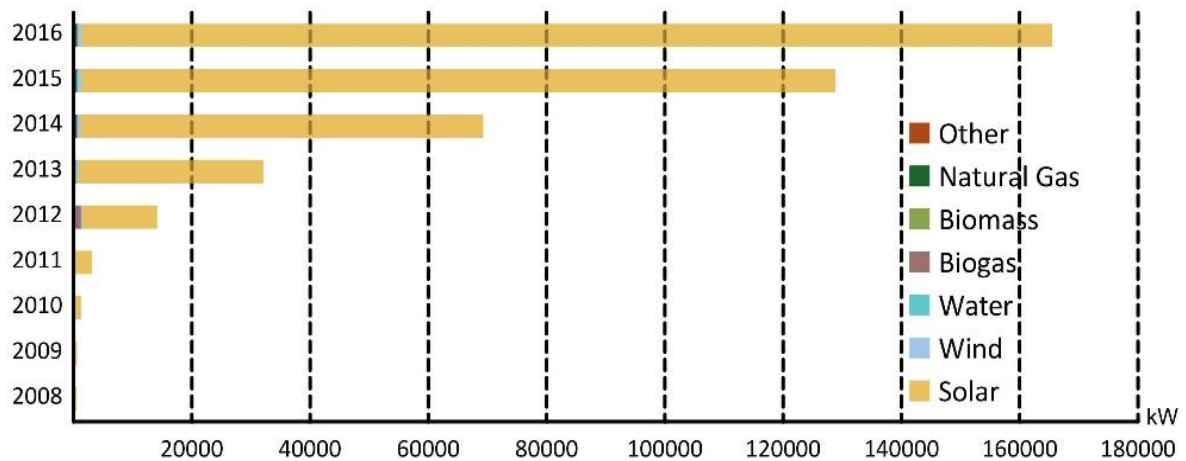
**Figure 4.** Average annual growth rates of renewable energy capacity and biofuels production, end-2007–2012, based on [8].

Renewable energy plays a key role in reducing greenhouse gas (for example CO<sub>2</sub>) emissions and other forms of pollution, diversifying and improving the security of energy supply of humanity and maintaining our world-leading, clean-energy technology industry. That is why the European Union has agreed on legally binding national targets for increasing the share of renewable energy, so as to achieve a 20% share for the entire Union by 2020.

From the viewpoint of the security of supply Hungary is highly dependent on energy source imports, and fulfils 80 % of its domestic crude oil demand, and over 83 % of its natural gas consumption from imports, primarily from former Commonwealth of Independent States (CIS) countries (due to the limited hydrocarbon reserves of the country, the share of imports may increase further). Through the use of renewable energy sources, the dependency on imports can be reduced, as the use of renewable energy is planned to be realised from domestic sources [9].

In the last few years there has been a spectacular growth in using private renewable energy, which has been envisaged by the Hungarian Ministry of National Development. Nowadays, in Hungary, these power stations, which are nominal built in power is less than 50 kW, does not need regulatory or Distribution System Operator (DSO) permission – this is one of the main reasons of growth in renewable energy usage [10] (Fig. 5.).

Energy saving: The most efficient and successful implementation methods to increase the security of supply in the near future are reducing of the primary energy consumption and increasing the energy efficiency [11]. The common aim is increasing the inland primer energy use in Hungary (1085 PJ in 2010) by only 6 % till 2030. But it will not be more than



**Figure 5.** Built in performance of small-scale household power stations according to energy sources, based on [10].

1150 PJ that was the average value in years before the economic crisis. It can be created with the reducing of CO<sub>2</sub> emissions and fossil-energy use [9].

## CONCLUSIONS

Environmental sustainability and climate protection: the use of renewable energy sources contributes to the reduction of CO<sub>2</sub> emissions. While selecting specific applications, environmental and nature conservation considerations have special priority. An important mean of ensuring is that environmental and nature conservation aspects are taken into account to include them as criteria for having regarded in particular to the establishment of aid schemes [12].

The most important strategic objective of Hungarian renewable energy policy is to optimise the joint implementation of the security of supply, competitiveness and sustainability as primary national economic goals, while also taking into account long-term considerations.

There can be various forms of interaction between the aforementioned three goals – in many cases their implementation may conflict with one another, but they may also strengthen each other [13].

If the energy consumption reaches the amount of 1150 PJ, the energy intensity will drop rapidly because of increasing of gross national product is associated with an almost stagnant energy consumption. As a result, import dependency of inland fossil-fuels and fluctuation of the energy prices can decrease.

A significant part of energy efficiency increasing is the building energy efficiency program. Nowadays the 40 % of total energy consumption in Hungary is the energy need of the building stock, and two-thirds of it is for heating and cooling. 70 % of the building stock (about 4,3 million) does not fulfil the technical Energy Performance of Buildings Directive (EPBD) requirements. In case of the public buildings this rate is almost the same.

This is the reason of the buildings renovation – most of all in case of public buildings – has priority (because they consume a significant amount of energy). The aim of energy strategy is to decrease about 30 % – 40 % at heating energy demand till 2030 in accordance with guidelines of the EU building energy program. On the other hand, the development of the solar power generation and distribution plays key role in improving energy efficiency, and in reducing energy demand of the industrial and transport sector, too.

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