# 2014

## OBETAJOČE TEHNOLOGIJE ZA ELEKTROENERGETSKI SISTEM

## *PROMISING TECHNOLOGIES FOR ELECTRIC POWER SYSTEM*

## 1. TEHNOLOGIJE IZKORIŠČANJA BIBAVICE

Globalna energija oceanov (bibavica, morski tokovi, valovi, termika morske vode in osmoza) se ocenjuje na 100.000 TWh, kar je 5-krat več, kot je sedanja svetovna proizvodnja električne energije (ta je bila 20.726 TWh v letu 2011, ob instalirani moči 5.161 GW). Pri tem je tehnologija za proizvodnjo električne energije na bibavico najzrelejša od vseh. Njena prednost je odlična napovedljivost in stalnost. Teoretična zmogljivost proizvodnje energije na bibavico je 23.000 TWh oz. realna ekonomsko-tehnična zmogljivosti okrog 2000 TWh. Danes je zgrajenih le 522 MW in do leta 2020 jih bo 2000 MW.

### Tehnologije proizvodnje električne energije na bibavico

**1. Zajezitev morskih zalivov/ustij rek/jezer**

S to tehnologijo so zgrajene elektrarne La Rence 240 MW (Francija, 1966), Kistaja 1.7 MW (Rusija, 1968), Annapolis 20 MW (Kanada, 1984) in poleg ostalih še danes največja Shiwa 254 MW na sliki (J Koreja, 2011). Tehnologija s pregrado je primerna za velike plimne diference, večje od 7 metrov. Načrtujejo se velike bibavične elektrarne s to tehnologijo v Rusiji (Penziskaja …), V. Britaniji (Bristolski zaliv), Koreji in na Filipinih. Tehnologija je ekološko problematična in stroškovno zahtevna.

**2. Generator na plimni tok**

Je novejša tehnologija velikih možnosti. Ker je energetska gostota vode 850-krat večja od zraka, se s posebno zgrajenimi podmorskimi turbinami omogočajo učinkovite rešitve pri plimnem toku že od 1 m/s. Samo Anglija načrtuje 18 GW in letno proizvodnjo 62 TWh. Ta tehnologija omogoča nižji investicijski strošek (npr. 2000 evrov/kW v EU projektu SeaFlow).

**3. Dinamični odprti jez**

Je novejša metoda izkoriščanja bibavice z odprtim T jezom. Sicer še ni elektrarne s to metodo zajezitve, ampak obeti so odlični zlasti ob obalah V. Britanije, Nizozemske, Kanade in J Koreje. Ob kitajski obali so možnosti zgraditve do 150 GW elektrarn po tej metodi. Pilotski projekt je v fazi izvedbe.

## 1. TIDAL POWER TECNOLOGIES

*Global Ocean energy (tidal, sea currents, waves, thermal conditions of sea water and osmosis) is estimated to be 100.000 TWh, which is 5 times more than the actual world production of electricity (in 2011 it was 20.726 TWh with install capacity 5.161 GW). The most maturity of marine technologies for the production of electricity is tidal power. The benefit of that technology is excellent forecasting and continuity. The theoretical capacity of tidal energy production is about 23.000 TWh, but real economic performance is up to 2000 TWh. Today is in operation only 522 MW of tidal power plants and taking into account the power plant under construction by 2020 will be approximately 2000 MW.*

### *Technologies for electricity generation by tidal power*

***1. Tidal barrage***

*With this technology are built power plants La Rence, 240 MW (FR, 1966), Kistaja 1.1 MW (RU, 1968), Annapolis 20 MW (CN, 1984), and some other as well as the largest one of 254 MW, Shiwa (KR, 2011) presented in figure. Technology with the barrage is suitable for large tide difference, greater than 7 metres. In the plans there are a few large tidal power plants in Russia (Penziskaja, ...), the UK (Bristol Bay), Korea and the Philippines (Dulupiri). This technology could be ecological problem and cost-demanding.*

***2. Tidal stream generator***

*It is a novel technology with great feasibility. Because the fact that the energy density of the water is some 850 times greater than air it is possible with a special constructed submarine turbines to get very effective solutions. Tide stream from 1 m/s only could produce 4 times more energy than wind turbine at same technical performance.*

*In UK there are the plans for 18 GW and an annual production of 62 TWh. The expected investment cost is estimated to be EUR 2000/kW.*

***3. Dynamic tidal power is a novel method for Tidal Power exploitation using** open T barrage. At the present time there is no Tidal Power plant with this method, but are excellent prospects, in particular, on the seaside of the GB, NL, CN, KR, etc. In the Chinese coast feasibility study evaluated possibilities of construction up to 150 GW Tidal Power Plants by this method. Pilot project in China is at the stage of implementation.*

TEHNOLOGIJE IZKORIŠČANJA BIBAVICE
*TIDAL POWER TECHOLOGIES*

Shiwa (J.Koreja) – 254 MW največja elektrarna na bibavico
*Shiwa (S. Korea) – 254 MW The largest Tidal Power plant*

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December *December* 2013

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Februar *February*

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## 2. TEHNOLOGIJE ČISTEGA PREMOGA

Premog kot gorivo še vedno predstavlja največji delež v svetovni proizvodnji električne energije (v letu 2011 je bil delež v energiji 46 % in delež v instalirani moči 35 %). V naslednjih 20 letih naj bi se delež zmanjšal na 30 %. Njegova prednost so velike obratovalne ure (nad 80 %), stabilnost za sistem, velike zaloge premoga in razvoj novih učinkovitejših tehnologij z izkoristki okrog 50 %. Slabosti so v emisijah, zlasti $CO_2$, in eksternih stroških, ki se ocenjujejo na 4–8 cUSD/kWh. Zato je zelo pomemben razvoj tehnologije zajemanja, transporta in shrambe $CO_2$ (CCS – **Carbon Capturing and Storage**), ki bo omogočil zajemanje preko 80 % $CO_2$. Tem tehnologijam pravimo **tehnologije čistega premoga**. Razvite so tri tehnologije zajema $CO_2$ :

- pred zgorevanjem, (**Pre-combustion**),
- po zgorevanju (**Post-combustion**) in
- s kisikom (**Oxyfuel**).

Še vedno je velika težava shranjevanje $CO_2$, ki je lahko v zemlji: v opuščenih vrtinah nafte ali plina ter v rudnikih soli. Odprt ostaja tudi pravni status teh shramb.

Po uspešni fazi pilotskih projektov je v načrtih po svetu gradnja 23 projektov CCS, in sicer v velikosti 10 GW, večinoma premogovih elektrarn. V EU je v opciji 12 projektov (5,8 GW), med katerimi je nam najbližji TE Porto Tolle pri Benetkah, na agregatu 250 MW in v lasti ENEL-a. Uporabljena bo tehnologija zajema **post-combustion**, $CO_2$ pa bodo shranjevali v solinah pod globino Jadranskega morja. Stroški so ocenjeni na 2,5 milijard evrov, od tega bo EU prispevala 400 milijonov evrov. Zaradi okoljskih problemov projekt zamuja.

Tehnologije čistega premoga so blizu masovne komercializacije. V EU se računa, da bodo stroškovne cene proizvedene električne energije modernih PPC superkritičnih TE okrog 80 evrov/MWh, s tehnologijo zajema $CO_2$ pa okrog 140 evrov/MWh, kar je manj, kot so subvencije v Nemčiji za proizvedeno MWh iz off-shore vetrnih polj (150 evrov).

## 2. CLEAN COAL TECHNOLOGIES

*Coal still represents the largest share of world electricity production (46% of the electrical energy, and 35% of installed capacity, in 2011). In the next 20 years coal's portion should be reduced on 30%.*

*Coal fuel preferences are: large load factor (over 80%), the stability of the system, large reserves of coal and the development of new and much more efficient technologies (over 50%), while there are weaknesses in the emissions of $CO_2$ and, in particular, the external costs, which are estimated at 4-8 cUSD/kWh. It is therefore very important to develop new technology of carbon capture, transport and storage (CCS – Carbon Capturing and Storage), which is already in a mature stage. This technology is called clean coal technology.*

*The three technologies of $CO_2$ capture have been already developed: Pre-combustion, Post-combustion and Oxyfuel. It's still a big problem the storage of $CO_2$ under the ground, in enhanced oil recovery, enhanced gas recovery or saline formation. The Problem is also the legal status of these stores.*

*After a successful pilot phase of the projects over the world there are a plans and also construction of 23 projects in the size 10 GW, mostly of coal power plants. In the EU there are the option of 12 projects (5, 8GW) one of which is the closest to us in Venice TPP Porto Tolle, on unit 250 MW owned by ENEL. Applied technology will cover $CO_2$ capture with post-combustion technology and transported in saline formation below the 1000 m depth of the Adriatic Sea. Estimated cost is €2.5 billion. ENEL will receive about €400 million from the EU. Project is delaying due to environmental issues.*

*Clean coal technologies are close to mass commercialisation. In the EU, the levelized cost of electricity (LCOE) what means the total lifecycle costs of producing MWh for modern supercritical PPC technology will be around 80 Eur/MWh and with CCS technology around 140 Euro/MWh, which is less than the subsidies in Germany for MWh produced from off-shore wind farms 150 Euros.*

TEHNOLOGIJE ČISTEGA PREMOGA
*CLEAN COAL TECHNOLOGIES*


Predstavitev TE z zajemanjem in shrambo $CO_2$
*Thermal power plant with Carbon capture and storage*

Spodaj: Pilotski projekt ENEL-a TE Brindisi z zajemom $CO_2$
*Below: ENEL pilot project in Brindisi with CO2 capture*

# Februar
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Januar *January*

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Marec *March*

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## 3. TEHNOLOGIJE ZA PAMETNA OMREŽJA

Električno omrežje bo odigralo ključno vlogo v strategiji zmanjševanja uporabe fosilnih goriv in prodora velikega števila razpršenih in obnovljivih virov za proizvodnjo električne energije. Leta 2005 je nastal nov koncept omrežja, ki so ga poimenovali pametna omrežja, kar naj bi pomenilo modernizacijo omrežja v smereh uvajanja:

- pametnega merjenja,
- aktivnih odjemalcev, pametnih hiš,
- masovne penetracije obnovljivih virov,
- decentraliziranega vodenja,
- velikega števila senzorjev,
- avtomatizacije in informatizacije omrežja.

Pametna omrežja naj bi dolgoročno omogočila cenejšo električno energijo, boljšo kakovost oskrbe, večjo konkurenčnost trga z električno energijo in boljšo zanesljivost oskrbe. To bo možno z uvajanjem novih tehnologij, ki bodo naredila pametna omrežja učinkovitejša in fleksibilnejša. Fleksibilnost pametnega omrežja bo omogočila množično uvedbo električnega prometa in na ta način velikih prihrankov končne energije. Časovni horizont nastajanja tega obljubljenega pametnega električnega omrežja je do leta 2050.

Evropska Unija načrtuje do leta 2020 vložiti 60 milijard evrov v številne projekte gradnje pametnega omrežja za prihodnost. Na svetovnem nivoju (po študiji IEA) se načrtuje do leta 2035 vložiti preko 6000 milijard USD v gradnjo moderniziranega električnega omrežja.
Pametna omrežja so zato tudi velika priložnost za razvoj novih industrij za nove tehnologije.

V Sloveniji imamo t. i. tehnološko platformo za pametna omrežja, v kateri so združena vsa podjetja, zainteresirana za izdelavo in vgradnjo te napredne tehnologije. V mnogih podjetjih tečejo različni pilotski projekti.

## 3. SMART GRIDS TECHNOLOGIES

*The electrical grid will play a key role in the strategy to reduce the use of fossil fuels and the penetration of large number of dispersed generation and renewable resources for the production of electricity. In 2005, ones created a new concept, called Smart grids, what actually means modernization of the electrical network in the direction of introducing*

- *Smart metering,*
- *Smart homes and active customers,*
- *Mass penetration of renewable sources,*
- *Decentralisation of system control,*
- *A large number of sensors,*
- *Automation and information of networks.*

*Smart grids should enable at long term period the cheaper electricity, better quality of electricity, increasing the competitiveness of the electricity market and improved security of supply. With the introduction of new technologies, Smart grids will be more efficient and flexible. The flexibility of the smart grid will enable the mass introduction of electric mobility and large savings of the end-energy. The time horizon of this coming advanced technology for our electrical network will be by 2050.*

*The European Union is planning to invest 60 billion Euros by 2020 to number of new projects in the Smart grid for the future.*

*At the world level (based on the IEA study) is planned by 2035 to spent over 6,000 billion dollars in the construction of Smart grids. This is also a great opportunity for the development of new industries for the new technology.*

*In Slovenia we have a technological platform for the smart grid in which combined all the companies interested in the manufacturing and implementation of this advanced technology. In many utilities running a variety of pilot projects.*

TEHNOLOGIJE ZA PAMETNA OMREŽJA
*SMART GRIDS TECHNOLOGIES*


Masovna vključitev OVE v sistem zahteva modernizacijo omrežja

*Mass penetration of renewables in system requires modernization of grid*

# Marec
## *March*

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Februar *February*

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April *April*

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## 4. KONCENTRIRANE SOLARNE ELEKTRARNE

Koncentrirane solarne elektrarne uporabljajo sisteme ogledal ali leč, ki koncentrirajo veliko površino sončne svetlobe ali sončne toplotne energije na majhen prostor.

V splošnem se delijo na dve skupini tehnologij.

**1. Koncentrirana fotovoltaika** (Concentrated PV – CPV), ki s pomočjo ogledal (oz. leč) zmanjša potrebne PV panele pri določeni proizvodnji električne energije. Trenutno je v obratovanju 130 MW, v načrtu pa novih 700 MW takšnih elektrarn. Cena je še vedno visoka, ampak se pričakuje bistveno nižanje stroškov za MWh na določenih lokacijah. Ta tehnologija je še v razvoju.

**2. Solarno termična proizvodnja elektrike** (STEG), imenovana tudi **Concentrated Solar Power** (CSP). S pomočjo koncentracije sončnih žarkov se segreva voda ali drug medij in v obliki pare poganja parne turbine, ki proizvajajo električno energijo. Gre za princip delovanja termoelektrarne z gorivom na sonce. Podobnost s tehnologijo TE je prednost te tehnologije. Obstaja več izvedb koncentracije žarkov, kot so stolpi, sklede, linearna ogledala in ogledala v obliki korit, ki so najzanimivejša.

Ta tehnologija je trenutno 2- do 3-krat dražja od klasične TE. Končna cena proizvedene MWh naj bi bila okrog 300 USD, kar je več kot pri PV tehnologiji. V naslednjih 10 letih smemo pričakovati bistveno nižje cene. S to tehnologijo je že zgrajenih okrog 5.000 MW elektrarn, v glavnem v Španiji in ZDA. Veliki načrti so v Indiji in na Kitajskem. Najbolj znan projekt je DESERTEC, s katerim se načrtuje zgraditev več deset GW elektrarn v tej tehnologiji v puščavah Afrike in v prvi fazi prenos 5 GW v Evropo.

## 4. CONCENTRATED SOLAR POWER PLANTS

*Concentrated solar thermal power plants use mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy in a small space.*

*It is generally divided into two groups of technologies :*

***1. Concentrated photovoltaic** (CPV), which with the help of mirrors (or lenses) reduces the required number of PV. Currently are in operation 130 MW and in the plan 700 MW of such power plants. The price is still high, but is expected to be the biggest reductions in costs. The technology is still in development.*

***2. Solar thermal electricity generation** (STEG), also known as **Concentrated Solar Power** (CSP). With the help of concentration of solar radiation heats the water or other media, and in the form of steam powered steam turbines that produce electricity. It's the principle of the operation of the thermal power plant with fuel as the concentrated Sun rays. The advantage of this technology is its similarity to TTP's . There are several implementations of a concentration rays such as towers, bowl, linear mirror and in the form of troughs, which are the most interesting .CPS technology is currently 2-3 times more expensive than traditional TTP . The final price of MWh expected to be around $ 300 which is more than the PV technology. Over the next 10 years is expected the cost to significantly lower.. With this technology is already built around 5,000 MW of power plants, mainly in Spain and the United States. Large plans are in India and China. The most famous is the DESERTEC project which sets out the construction of tens of GW power plants in the deserts of North Africa and its transmission of 5 GW in Europe in the first phase.*

KONCENTRIRANE SOLARNE ELEKTRARNE

*CONCENTRATED SOLAR POWER PLANTS*


Podoba koncentriranih solarnih termičnih elektrarn

*Concentrated solar thermal power plant image*

Spodaj: Potrebne električne povezave za idejni projekt DESERTEC

*Below: the necessary electrical connections to the DESERTEC concept design*

# April
## *April*

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## Marec *March*

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## 5. VODIKOVE TEHNOLOGIJE

Vodikove tehnologije se nanašajo na proizvodnjo in uporabo vodika. Kot je znano, ima vodik energetsko gostoto (114 MJ/kg), ki je mnogo višja od gostote bencina (46 MJ/kg), surove nafte (42 MJ/kg) ali zemeljskega plina (35 MJ/kg), zato je zelo zanimiv za energetiko, zlasti kot »zelena« tehnologija. V naravi se ne pojavlja kot gorivo, vendar na splošno velja kot medij, ki je idealen za shranjevanje energije. Med prednosti $H_2$ štejemo večplastno uporabnost in ogljično nevtralnost, med slabosti pa nizko energetsko učinkovitost, kompleksnost tehnologije in še vedno visoko ceno (ok. 9 evrov/kg). Pridobiva se z elektrolizo, termolizo in ektrakcijo fosilnih goriv ter z drugimi metodami. Utekočini se pri zelo nizki temperaturi 20 K.

Najpogostejši primer uporabe vodikovih tehnologij v energetiki je gorilna celica, ki lahko s pomočjo kemične reakcije proizvaja električno energijo. Prve gorilne celice sta izumila že leta 1838 W. Grove in C. F. Schönbein. Sestavljene so iz anode, katode in elektrolitov, ki omogočajo potrebno napetost med obema poloma gorilne celice. Glavna razlika med vrstami gorilnih celice je vrsta elektrolita. Prvo praktično uporabo gorilnih celic zasledimo pred petdesetimi leti v vesoljskih plovilih. Gorilne celice se uporabljajo za primarno in rezervno napajanje komercialnih, industrijskih in stanovanjskih stavb v odročnih ali nedostopnih območjih. Uporabljajo se za pogon vozil na gorilne celice: avtomobilov, avtobusov, čolnov, motornih koles itn.

V zadnjem desetletju je EU vložila v raziskave te tehnologije preko 500 milijonov evrov.

V Sloveniji smo letos dobili prvo polnilnico $H_2$, in sicer pri Bledu. Zmogljivost je 6 vozil na dan po 6 kg $H_2$ na vozilo. Čas polnjenja je 5 minut oz. do 15 minut za avtobus. Računa se, da lahko naredi avto okrog 130 km/kg $H_2$. Glede na še vedno nizek izkoristek v verigi od proizvodnje vodika do opravljenega dela avta (ok. 40 %) je še zgodaj napovedovati, ali bo zmagovalec v prihodnosti električni ali vodikov avto. Če upoštevamo napovedi velikih proizvajalcev avtomobilov (npr. v letu 2015 trije novi modeli na vodik), se lahko pričakuje širša uporaba te tehnologije v prometu. Obljubljena tehnologija postaja resničnost.

## 5. HYDROGEN TECHNOLOGIES

*Hydrogen technologies relating to the production and use of hydrogen. As it is known a hydrogen energy density is higher (114 MJ/kg) than the density of gasoline (44 MJ/kg), crude oil (42 MJ/kg) or natural gas (35 MJ/kg), so it is very interesting for energy sector, in particular as a "green" technology. Hydrogen does not occur in nature as a fuel, but it is generally considered as a medium that is ideal for storing energy. Among the advantages of $H_2$ counts multi-layer utilization and carbon neutrality; among the disadvantages are low energy efficiency, the complexity of the technology and the still high price (ca. 9 Euros/kg). It is produced from the water thermolysis, electrolysis, extraction from fossil fuels, and other methods. Liquefies at a very low temperature of 20 K.*

*The most common example of the use of hydrogen technologies is a fuel cell that may produces electricity with the help of a chemical reaction. The first fuel cell was invented in 1838, W. Grove and C. F. Schönbein. Drawn from the anode, cathode, and electrolyte, enabling the necessary voltages between these two poles of fuel cells. The main difference between the types of fuel cells is a type of electrolyte. The first practical application of the fuel cell can be traced back fifty years ago in space vehicles. Fuel cells are used for the primary and backup power for commercial, industrial and residential buildings in remote or inaccessible areas. They are used for propulsion of the vehicle to the fuel cells: cars, buses, boats, motorcycles, etc. In the last decade, the EU has invested in research on this technology over 500 million euros.*

*This year in Slovenia we have got the first hydrogen filling station in Bled. Capacity is 6 vehicles per 6 kg $H_2$/vehicle. The charging time is 5 minutes or up to 15 minutes for the bus. It is estimated that the car can do around 130 km/kg $H_2$. According to the still low efficiency chain from production of hydrogen over fuel cells operation up useful work of the car (40%), it is still early to say who will be the winner in the future traffic: electric or hydrogen car. Taking into account the forecasts of major automobile manufacturers (3 new cars in 2015), should be expected more users of this technology on the market. The promised technology is becoming a reality.*

VODIKOVE TEHNOLOGIJE
*HYDROGEN TECHNOLOGIES*


Prva vodikova črpalka v Sloveniji
*First Hydrogen pump station in Slovenia*

# Maj
*May*

| t/w | ponedeljek monday | torek tuesday | sreda wednesday | četrtek thursday | petek friday | sobota saturday | nedelja sunday |
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| 21 | 19 | 20 | 14:59 21 | 22 | 23 | 24 | 25 |
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## April *April*

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## Junij *June*

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## 6. KRIOGENSKE TEHNOLOGIJE – SUPERPREVODNOST

Kriogenske tehnologije izkoriščajo prednosti določenih lastnosti materialov pri zelo nizkih temperaturah. Začetnik ideje je bil Škot James Dewar, ki je leta 1892 odkril metodo shranjevanja snovi pri nizki temperaturi. Danes se uporabljajo različne kriogenske tehnologije v gospodinjstvih, medicini, industriji, znanosti in energetiki, kjer je najbolj obetavna tehnologija superprevodnosti. To je lastnost nekaterih kovin, ko pri zelo nizki temperaturi izgubijo električno upornost in postanejo superprevodne. Odkritje se pripisuje Nizozemcu H. K. Onnesu leta 1911, ki je tudi dal ime superprevodnost. Leta 1960 so raziskovalci Westinghousea iznašli zlitino niobij-titan, ki je bila prva komercialna uporaba in začetek uvajanja tehnologije superprevodnosti. Kot hladilno sredstvo je bil uporabljen tekoči helij. Tehnologija superprevodnosti, ki deluje na temperaturah okrog 20 K, so poimenovali LTS (nizkotemperaturna superprevodnost). Od leta 1986 je v uporabi t. i. HTS tehnologija (visokotemperaturna superprevodnost), ki deluje z materiali nad 70 K. To je bil pomemben napredek, ker je pri tej temperaturi možno uporabiti za hladilno sredstvo znatno cenejši tekoči dušik, kar je uporabnost te tehnologije približala realnosti. V elektroenergetiki so primeri uporabe superprevodnosti pri generatorjih, transformatorjih, motorjih, omejevalnikih toka, kablih, magnetnih shranjevalnikih energije (SMES) itn.

Zadnja, tretja generacija HTS tehnologije omogoča neverjetno napredne parametre (npr. gostota toka preko 100 A/mm2 pri temperaturi 65–77 K ali 33-krat več kot klasična bakrena žica) in to ob desetkrat nižji ceni žic, kot je bila v prejšnji generaciji. V zadnjih letih se na področju superprevodnih kablov za prenos naglo povečuje število pilotskih projektov in nekaj komercialnih aplikacij.

Zelo znan je projekt (na sliki) iz l. 2010 v New Yorku (610 m/138 kV/2,4 kA), ki z zmogljivostjo kabla 560 MW napoveduje izjemne razvojne možnosti tehnologije za prenos. Na področju distribucije je aktualen projekt v Nemčiji (Essen), ki uporablja 10 kV superprevodne kable z omejevalnikom toka kratkega stika kot nadomestek 110 kV povezave v mestnem središču (AmpaCity project). Zanimivo je, da ta HTS projekt omogoča cenejšo rešitev od 110 kV rešitve.

## 6. CRYOGENIC TECHNOLOGY - SUPERCONDUCTIVITY

*Cryogenic technologies advantage of certain properties of materials at very low temperatures. The pioneer was the Scottish scientist James Dewar, who discovered in 1892, methods how to storage matters at low temperatures. Today, it is used in household, medicine, industry, science and energy, where is the most promising technology superconductivity. This is a property of certain metals or alloys that at very low temperatures lose their electrical resistance and become superconducting. The name was given by Dutch inventor H.K.Onnes, from Leiden University, in 1911. In the 1960, researches at Westinghouse invented niobium-titanium alloy, which opened the first commercial use of that technology. As a refrigerant has been used liquid helium. Superconductivity technology at around 20K is named LTS (low-temperature superconductivity).*

*Since 1986, in the use of so-called HTS (high temperature superconductivity), which could works with materials over 70K. This was an important advance because in new circumstances it was possible to use significantly cheaper refrigerant - liquid nitrogen (boiling point of nitrogen is 77 K). So, this moved superconductivity technology closer to reality. In electricity supply industry there are many examples of the use of superconducting for generators, transformers, motors, fault current limiters, cables, SMES.*

*The last third-generation technology provides incredible advanced parameters of the HTS (e.g. the density of the current over 100 A/mm2 at a temperature of 65-75 K or 33 times more than conventional copper wire) at ten times the lower price than the previous generation of the HTS wires. In recent years is evident rapidly increases the number of pilot projects and some commercial applications in the field of superconducting cables.*

*It is a very known (see figure) project in New York – Long Island in 2010 (with performances: 610m/138kV/2.4 kA), which with a capacity of 560 MW cable announces outstanding development opportunities for the transmission of electricity. In the area of distribution is on-going project in Essen (Germany), which uses 10-kV cables plus fault current limiter as a substitute of 110 kV connections to the city centre (AmpaCity project). It is interesting that the HTS project allows a cheaper solution than 110 kV. In the plans of a number of transmission and distribution companies.*

KRIOGENE TEHNOLOGIJE
*CRYOGENIC TECHNOLOGY*

Prva komercialna uporaba superprevodnega kabla v prenosu, 2008
*First commercial use of HTS cable in transmission, 2008*

# Junij *June*

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| 24 | 9 | 10 | 11 | 12 | 6:11 13 | 14 | 15 |
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| 26 | 23/30 | 24 | 25 | 26 | 10:08 27 | 28 | 29 |

## Maj *May*

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## Julij *July*

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## 7. TEHNOLOGIJA FUZIJE

Tehnologija fuzije je že dolgo na seznamu obljubljenih tehnologij za energetiko. Fuzija je fizikalni proces v jedrski fiziki in pomeni **zlivanje jeder**, v katerem se lahka jedra (npr. vodikova) zlivajo v težka jedra. Pri tem se sproščajo velike količine energije. Ker gre za podoben proces, kot je na Soncu in zvezdah, je nadzorovana fuzija eden največjih izzivov naše civilizacije. Za razliko od fisije (cepitev težkih jedr, npr. uranovih), ki je že razvita tehnologija delovanja obstoječih jedrskih elektrarn in pušča stoletja trajajoče radioaktivne odpadke, pri fuziji **ni takšnih radioaktivnih odpadkov**.

Za razvoj te tehnologije so potrebni predpogoji: razvoj visokih temperatur plazme (npr. temperatura v središču Sonca je okrog 15 milijonov K), ohranjanje in nadzor plazme ter izdelava fuzijskega reaktorja. Razvoj tako visokih temperatur je rešen. Danes je možno razviti temperaturo plazme tudi do 500 milijonov K. Za rešitev fuzijskega reaktorja se je svet združil (EU, ZDA, Rusija, Kitajska, Indija, Koreja, Japonska) v največji znanstveni projekt vseh časov imenovan ITER, kar pomeni po latinsko »POT«. Ocenjena vrednost projekta je 12 milijard evrov. Cilj je izdelati prvi fuzijski reaktor.

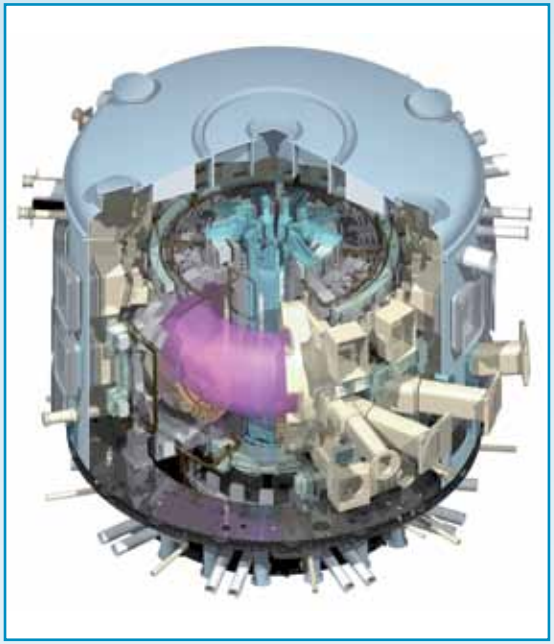
Multinacionalni iter projekt je zaživel v francoskem mestu Cadarache v bližini Aix-en-Provance. Testni reaktor je dimenzioniran na 500 MW. Cilj je, da bo vložek moči 50 MW (dosedanji rekord v fuzijski moči je bil 16 MW v Culhamu v V. Britaniji). V aprilu 2013 je bil odobren najbolj kritičen element reaktorja – »prevleka«, ki bo morala zdržati supertemperature reaktorja. Ta je v velikosti 81 plavalnih bazenov. Največja pozornost je posvečena varnosti (potresi, kakovost vsakega od milijonov elementov). V reaktorju bo toliko superprevodnih kablov, ki bi lahko 15-krat obkrožili Zemljo. Načrti so, da bo oktobra 2022. leta »prva plazma« in do leta 2027 »samogorilna plazma« s temperaturo 300 milijonov K, kar bo zadostno za zlitje v helij in odpadne produktne, ki se bodo reciklirali. Prva demonstracija delovanja fuzijskega reaktorja s proizvodnjo električne energije za omrežje naj bi bila do leta 2035. Komercialni fuzijski reaktorji za elektrarne so predvideni po letu 2050.

## 7. FUSION TECHNOLOGY

*Fusion Technology has been for long time on the list of promising energy technologies. Fusion is the nuclear reaction in which light nuclei (i.e. hydrogen) combine to form of heavy nuclei with the simultaneous release of energy. Because it is a similar process, such as at the Sun and the stars, controlled fusion is one of the biggest challenges of our civilization. Unlike fission (fission of heavy nuclei, i.e. uranium), which has already developed technology in use in the existing nuclear power plants and leaves lasting radioactive waste for centuries, in the fusion doesn't have such radioactive waste.*

*For the development of this technology are the necessary preconditions: the development of high temperature plasma (e.g. temperature in the center of the Sun is about 15 million K), continuity and control of plasma and fusion reactor design. The development of such high temperatures is solved. Today it is possible to develop the plasma temperature by up to 500 million K. For the salvation of the fusion reactor, the entire world united (EU, USA, Russia, China, India, Korea, and Japan) in the largest scientific project ever called ITER, which means "the WAY" in Latin. The estimated value of the project is 12 billion euros. The goal is to produce the first fusion reactor.In the south of France, in the Cadarache forest of Provance a multi-national project of the ITER begin to live. Test reactor is sized at 500 MW, with the aim that it will input the power 50 MW (the current record for released fusion power is 16 MW, held by the European JET facility located in Culham, UK). In April 2013 project gained final approval for the design of the most technically challenging component – fusion's "blanket" that will handle the super-heated nuclear fuel. It will cover the size of 81 of the swimming pool. Maximum attention is paid to safety (earthquakes, the quality of each of the millions of items). In the reactor will be so much the superconducting cables that could circle the Earth 15 times. The plans are to be "first plasma" in October 2022. and by the year 2027, "self-burning plasma" with injection of tritium, so with temperature about 300 million K, which will be sufficient for the fusion to helium, and the waste product, which will be recycled. The first demo of the fusion reactor to produce electricity for the network was supposed to be by the year 2035. Commercial fusion reactors for power plants are planned by the year 2050.*

TEHNOLOGIJA FUZIJE
*FUSION TECHNOLOGY*



Koncept fuzijskega reaktorja ITER
*The concepts of the ITER fusion reactor*

# Julij *July*

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| 29 | 14 | 15 | 16 | 17 | 18 | 4:08 ☾ 19 | 20 |
| 30 | 21 | 22 | 23 | 24 | 25 | 26 | 0:42 ● 27 |
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## Junij *June*

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## Avgust *August*

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## 8. TEHNOLOGIJA BIOMIMIKRIJE - UMETNA NANODREVESA

Biomimikrija je umetno posnemanje procesov v naravi, ki so se razvijali v preteklih treh milijardah let, za reševanje naših sedanjih problemov. Narava je iznašla več kot 30 milijonov različnih trajnostnih rešitev, ki ne povzročajo problematičnih odpadkov.

Zelo obetavna tehnologija s tega področja za energetiko je umetno nanodrevo.

Umetni nanolisti izkoriščajo obnovljive vire energije za proizvodnjo električne energije. Nanolisti so izdelani iz prožnega substrata, ki je uporaben na obeh straneh, po postopku tankoplastnega nanosa iz termo- in fotonapetostnih materialov za pretvorbo v električno energijo. Listi imajo vgrajene tri vrste miniaturnih modulov za pretvorbo v električno energijo: fotovoltaične, termostatične in piezoelektrične.

Vse tri tehnologije (sončna, toplotna in vetrna) so združene v enem nanolistu, ti pa tvorijo množico listov na umetnih nanodrevesih in drugih rastlinah poljubnih oblik. To je podobno, kot da bi imeli solarni panel, solarni kolektor in vetrno elektrarno v enem.

Iz rezultatov pilotskih projektov (podjetje Solar Botanic) so poročali, da je proizvodnja električne energije iz enega takšnega drevesa 40–50 % večja od solarnega panela ekvivalentne površine.

V literaturi je možno najti tudi podatek, da lahko eno umetno drevo premera 6 m z umetnimi nanolisti oblike klasičnega hrasta pridela od 2.000 do 7.000 kWh/leto, odvisno od mesta namestitve. Življenjska doba takega drevesa naj bi bila okrog 20 let.

Upoštevajoč poprečno letno proizvodnjo 5000 kWh/ drevo bi bila proizvodnja takega drevesa v življenjski dobi okrog 100.000 kWh. Cena enega drevesa se ocenjuje na 10.000 do 15.000 evrov. Za odkupno ceno po 0.15 evrov/kWh bi bil tako celoten prihodek v življenjski dobi podoben investicijskem strošku.

Ker so cene električne energije za gospodinjstva (energija, sistemske storitve in dajatve) podobne znesku 0,15-0,20 evrov/kWh, bi bilo možno oceniti, da lahko 2–3 umetna drevesa dolgoročno zadovoljijo potrebe enega aktivnega gospodinjstva.

Zato se lahko tehnologija umetnega nanodrevesa uvršča med zelo obetavne tehnologije prihodnosti na področju obnovljivih virov energij in pametnih omrežij.

## 8. BIOMIMICRY TECHNOLOGY- ARTIFICIAL NANO TREES

*Biomimicry is an artificial imitation of processes in nature that have been developed over the past three billion years to solve our current problems. Nature has invented more than 30 million of different sustainable solutions that do not cause problematic waste.*

*Very promising technology in the field of electricity is artificial nano tree.*

*Artificial nano leaves exploit renewable energy sources for electricity production. Nano leaves are made of a flexible substrate, which is usable on both sides , according to the process of a thin-film layer of thermal and photovoltaic materials used for the conversion into electrical energy (EE).*

*Nano leaves have a built-in miniature three types of modules for conversion to electricity: Photovoltaic to conversion of sunlight into electricity, thermostatic to convert ambient heat into electricity, piezoelectric for conversion of wind energy into electricity.*

*All three technologies are combined in a single nanoleave to form a plurality of leaves on artificial nano trees and other plants of any shape.*

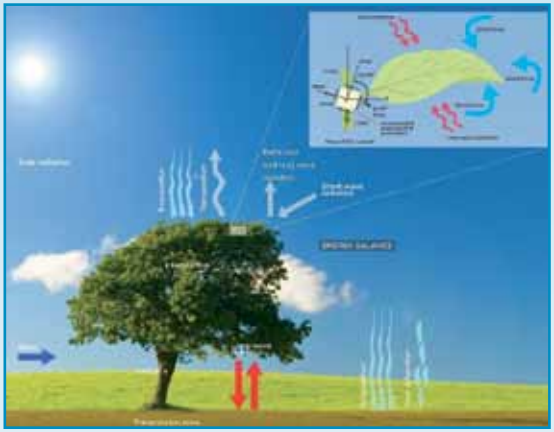
*From the results of the pilot projects (i.e. company Solar Botanic) reported that the production of electricity from one of those trees would increase energy production 40-50% greater than the equivalent of the solar panel.*

*In the literature it is possible to find the information that one of the artificial nano tree with a diameter of 6 m with artificial forms of the classic oak leaves can produced from 2000 to 7000 kWh/year, depending on the location of the installation. The lifecycle time of the artificial nano tree is evaluated to be about 20 years.*

*Taking into account the average annual production of 5,000 kWh per tree/year, the production of such trees in the lifetime should be around 100,000 kWh. The investment cost of one tree is estimated to be about 10,000 to 15,000 euros. For a purchase price of € 0.15/kWh would be so complete turnover in lifetime similar to the investment cost.*

*As electricity prices for households (energy, ancillary services and charges) are similar to the amount of 0,15-0,20 €/kWh, it would be possible to estimate that 2-3 artificial nano trees can meet the needs of the long term one of the active household consumer. Therefore, the technology of artificial trees can rank among promising technologies of the future in the field of renewable energy and Smart grid.*

TEHNOLOGIJA BIOMIMIKRIJE –
UMETNO DREVO
*BIOMIMICRY TECHNOLOGY*



Umetno nanodrevo – tri tehnologije v eni
*Artificial nano tree – three technologies together*

# Avgust
## *August*

Julij *July*

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September *September*

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## 9. UMETNA FOTOSINTEZA – TEHNOLOGIJA ALG

Umetna fotosinteza je kemični proces, ki posnema naravni proces fotosinteze, to je s pomočjo sončne svetlobe in vode pretvarja ogljikov dioksid v ogljikove hidrate in kisik. Rastline pretvorijo vsako leto več kot tisoč milijard ton $CO_2$ v organske snovi, ki je tudi energija za živali. Pri tem uporabijo samo 3 % sončne svetlobe, ki doseže Zemljo.

Med mnogimi možnimi tehnologijami, ki lahko uporabljajo umetno fotosintezo, se zdi zelo obetavna za energetiko tehnologija umetne fotosinteze alg.

Alge s pomočjo fotosinteze, to je s pomočjo sončne svetlobe, pretvarjajo ogljični dioksid v biomaso (avtotrofna rast) in iz tega v električno energijo oz. za proizvodnjo obnovljivih virov goriv: biodizla, etanola, zelenega bencina ali drugih goriv.

Zelo pomembno je, da alge pri proizvodnji biogoriv uporabljajo nasičen $CO_2$, ki je stranskih produkt pri izgorevanju fosilnih goriv v termoelektrarnah. Alge gojijo v velikih ribnikih ali v zaprtih fotoreaktorjih z dovajanjem $CO_2$. S pomočjo alg lahko na učinkovit način rešimo probleme skladiščenja $CO_2$ in tako rešujemo okoljske težave.

V raziskave in razvoj, ki temeljijo na tehnologiji alg, je bilo vloženih že več milijard dolarjev, saj alge predstavljajo najbolj obetavno tehnologijo za dolgoročni trajnostni vir biomase in olj za goriva, hrano, krmo in druge stranske proizvode.

Obstoječe fotovoltaične tehnologije na osnovi polprevodnikov so drage in zelo neučinkovite. Sistemi za umetno fotosintezo, ki posnemajo dogajanje v rastlinah, lahko ustvarijo neskončna, relativno cenena goriva in električno energijo, ki jo bomo lahko tudi uskladiščili.

Prvo stavbo na svetu, ki uporablja le energijo iz alg, so letos odprli v Hamburgu. Poimenoval so jo BIQ House. Stavba ima bioadaptivno fasado iz alg in bo služila kot testni poligon za trajnostno proizvodnjo energije v mestnih območjih in samozadostnih bivalnih stavbah.

## 9. ARTIFICIAL PHOTOSYNTESIS - ALGAE TECHNOLOGY

*Artificial photosynthesis is a chemical process that mimics the natural process of photosynthesis, with the sunlight and water it converts carbon dioxide into carbohydrates and oxygen. Plants converted every year more than one thousand billion tons of $CO_2$ into organic substances, which is the energy for the animals. In doing so, use only 3 % of the sunlight that reaches the earth.*

*Among the many potential technologies that may be used for artificial photosynthesis seems to be very promising for energy – the technology of artificial photosynthesis of algae.*

*Algae through photosynthesis, which is, using sunlight, $CO_2$ converted into biomass (autotrophic growth) and for production of renewable fuels as biodiesel, ethanol, green gasoline or other fuels.*

*It is very important that algae biofuels production using saturated $CO_2$ by-product of the combustion of fossil fuels in thermal power plants. Algae grown in ponds or in closed photo reactors by introducing $CO_2$. The algae could be used also for carbon storage and to solve the environmental problems on effective way.*

*In research and development for algae based technologies has already been invested billions of dollars due to algae represent the most promising technology for long-term sustainable source of biomass and oil for fuel, food, feed and other by-products.*

*Existing photovoltaic technology based on semiconductors are expensive and very inefficient. Systems for artificial photosynthesis, which mimic the action of plants , you can create an endless , relatively cheap fuel and electricity , which will be stored as well .*

*The first building in the world that runs exclusively on energy from algae has opened this year in Hamburg. It was named BIQ House. The building has a bio-adaptive façade of algae and will serve as a testing ground for sustainable energy production in urban areas and self-sufficient residential buildings.*

UMETNA FOTOSINTEZA –
TEHNOLOGIJA ALG
*ARTIFICIAL PHOTO SYNTESIS –*
*ALGAE TECHNOLOGY*


Prva hiša, oskrbovana s tehnologijo alg (Hamburg, Nemčija)
*The first House supplied with algae (Hamburg, Germany)*

# September
## *September*

| t/w | ponedeljek monday | torek tuesday | sreda wednesday | četrtek thursday | petek friday | sobota saturday | nedelja sunday |
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| 37 | 8 | 3:38 ○ 9 | 10 | 11 | 12 | 13 | 14 |
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### Avgust *August*

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### Oktober *October*

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## 10. TEHNOLOGIJA BATERIJE LITIJ/ZRAK

Tehnologija baterije litij/zrak je zelo obetajoča tehnologija baterij, ki s kemično reakcijo oksidacije litija na anodi in odvzemanjem kisika na katodi proizvaja električni tok. Že leta 1970 so jo omenjali kot možen vir energije za električna vozila. Litij/zrak baterije so ponovno vzbudile zanimanje znanstvenikov šele v letu 2000, in sicer zaradi napredka v tehnologiji materialov in povečanega povpraševanja po okolju varnem in od nafte neodvisnem viru energije.

Glavna prednost baterije litij/zrak je izjemna gostota energije, ki jo ta baterija omogoča. Ima energijsko gostoto, primerljivo z energijsko gostoto bencina. Razlog za to je uporaba kisika iz zraka namesto internega shranjevanja kisika. Litij/zrak baterije imajo potencial 5- do 15-kratne energijske gostote sedanjih litij-ionskih baterij. Teoretična gostota energije teh baterij je 12 kWh/kg brez mase kisika. Za primerjavo je gostota energije bencina približno 13 kWh/kg.

Tehnologija litij/zrak baterij zahteva še veliko raziskav na različnih področjih, preden bo uporabna v komercialne namene. Ocenjuje se, da je potrebnih še 10 let. Poznamo štiri izvedbe: aprotično, vodno, v trdnem stanju in mešano vodno/aprotično.

Leta 2009 je začel IBM s projektom razvoja baterije litij/zrak (Battery 500), ki je sčasoma k sodelovanju pritegnil različne partnerje.

Hkrati je treba omeniti, da to ni edini igralec v razvoju te vrste baterije, saj sta pred kratkim sklenila zavezništvo pri podobnem razvoju Toyota in BMW, poleg njiju pa je še cela vrsta manjših ali večjih imen, ki sodelujejo na podobnih projektih.

## 10. BATTERY TECHNOLOGY LITHIUM/AIR

*Lithium/air battery technology is very promising innovative battery technology, which by chemical reaction of oxidation of lithium anode and removal of oxygen at the cathode, producing an electric current. As early as 1970, it mentioned as a possible energy source for electric vehicles. Li / air batteries are re-arouse the interest of scientists again in 2000, due to advances in materials technology and the increasing demand for environmentally safe and oil independent source of energy.*

*The main advantage of Li / air battery is high energy density, which is a measure of the amount of energy that the battery can be saved to a specific volume. Li / air battery has an energy density comparable to gasoline.*

*The reason for that is use of oxygen from the air instead of the internal storage of oxygen. Li / air batteries have the potential 5 -15 times the energy density of current lithium-ion batteries. Theoretical energy density of Li/air batteries is 12 kWh / kg excluding the mass of oxygen. Energy density of gasoline is about 13 kWh/kg.*

*Li / air batteries technology require much more research in different areas before it will be useful for commercial purposes, it is estimated that it takes at least 10 years.*

*There are four performances: aprotic, water, solid and mixed aqueous / aprotic.*

*In 2009, IBM launched the project of development of Li / air (Battery 500), which over the years has invited a variety of partners.*

*At the same time it should be noted that this is not the only player in the development of this type of battery as it was recently concluded partnership in similar development of Toyota and BMW, in addition to them is a whole range of minor or major names involved in a similar projects.*

TEHNOLOGIJA BATERIJE - LITIJ/ZRAK

*BATTERY TECHNOLOGY - LITHIUM/AIR*


Litij-zračna baterija z energetsko gostoto, podobno bencinu. KDAJ?

*Lithium-air battery with an energy density similar to gasoline. WHEN?*

# Oktober
## *October*

| t/w | ponedeljek monday | torek tuesday | sreda wednesday | četrtek thursday | petek friday | sobota saturday | nedelja sunday |
|---|---|---|---|---|---|---|---|
| 40 | | | 21:32 1 | 2 | 3 | 4 | 5 |
| 41 | 6 | 7 | 12:51 8 | 9 | 10 | 11 | 12 |
| 42 | 13 | 14 | 21:12 15 | 16 | 17 | 18 | 19 |
| 43 | 20 | 21 | 22 | 23:57 23 | 24 | 25 | 26 |
| 44 | 27 | 28 | 29 | 30 | 3:48 31 | | |

### September *September*

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| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | | | | | |

### November *November*

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| 24 | 25 | 26 | 27 | 28 | 29 | 30 |

## 11. BREZŽIČNI PRENOS ENERGIJE

Tehnologije brezžičnega prenosa omogočajo prenos električne energije na razdaljo brez galvanske povezave. Prvi, ki se je s to tehnologijo ukvarjal, je bil znanstvenik Nikola Tesla ob koncu 19. stoletja.

Pri brezžičnem prenosu je zelo pomemben parameter izkoristek prenesene moči. Brezžični prenos se izvaja na tri načine: z neposredno indukcijo, resonančno indukcijo in prenos z usmerjenim žarkom mikrovalov in laserjev.

Princip neposredne indukcije je podoben kot pri transformatorju, kjer se iz enega navitja električna energija brezžično prenaša na drugo navitje. Vir ustvarja magnetno polje, ki inducira tok v napravi. Ta se pretvori v potrebno moč naprave. Ta princip se največ uporablja za polnjenje mobilnih naprav: telefonov, tablic in drugih.

Za brezžični prenos energije na večje razdalje, kot je nekaj metrov, daje boljše rezultate resonančna indukcija. Na ameriškem MIT so leta 2006 izvedli prototip, ki je omogočal brezžični prenos energije na daljavo 1,8 m na 60 W žarnico s 40 % učinkovitostjo. INTLU je uspelo leta 2008 demonstrirati brezžični prenos energije na razdalji enega metra s 75 % učinkovitostjo. INTEL je svojo tehnologijo imenoval WREL (Wireless Resonant Energy Link).

Pristopa MIT in INTEL temeljita na pojavu elektromagnetne indukcije in resonance. MIT je v stavbo namestil poseben oddajnik, ki je prostor pokrival z elektromagnetnim valovanjem, s katerim se napaja različne naprave z nameščenim sprejemnikom frekvenc, ki resonirajo z elektromagnetnim poljem. Neizkoriščen tok samodejno absorbira oddajnik. Prenos energije naj bi bil za človeka neškodljiv.

Podjetje WiTricity razvija tehnologijo brezžičnega prenosa energije, ki naj bi delovala od nekaj cm do nekaj metrov in moči od nekaj mW do kW. Omogočala naj bi aplikacije napajanja mobilnih naprav in LCD TV na steni brez napajalnih kablov in brez nevarnih vplivov na zdravje ljudi in živali.

Brezžični prenos večjih količin električne energije na večje razdalje je še vedno samo obetajoča tehnologija.

## 11 WIRELESS POWER TRANSMISSION

*Wireless technology enables wireless transmission of electricity. The first, which has dealt with this technology, was Nikola Tesla at the end of the 19th century.*

*At wireless transmission is very important parameter power efficiency of transmitted energy. Wireless transmission is carried out in three ways: by direct induction, resonant induction and transfer of directional beam of microwaves and lasers.*

*The principle of the direct induction is similar to that of the transformer, where one of the windings of electrical energy wirelessly transmitted to the second winding. The source generates a magnetic field which induces a current in the device. This is converted to the necessary strength to the device. This principle is mostly used for charging of mobile devices: phones, tablets and others.*

*For the wireless transmission of energy over long distances to a few meters gives better results resonant induction. In the U.S. MIT in 2006 carried out a prototype that allows wireless transmission of energy at a distance of 1.8 m to 60 W bulbs with 40 % efficiency. INTEL succeeded in 2008 to demonstrate wireless transmission of energy at a distance of one meter with 75 % efficiency. Intel has its own technology called WREL (Wireless Resonant Energy Link).*

*Approach of MIT and Intel are based on the phenomenon of electromagnetic induction and resonance.*

*MIT installed in a building special transmitter that covered the space with electromagnetic waves, variety of devices were powered by the receiver running on frequencies that resonate with electromagnetic fields. Untapped flow was automatically absorbed by the transmitter. The transfer of energy to be harmless to humans.*

*Company WiTricity is developing technology of wireless energy transfer, which should operate from a few centimeters to a few meters and with power from a few mW to kW. The applications will allow to power mobile devices and LCD TV on the wall without any power cords and without dangerous effects on human and animal health.*

*Wireless Transmission of large amounts of electricity at greater distances is still just a promising technology.*

## BREZŽIČNI PRENOS ENERGIJE
*WIRELESS POWER TRANSMISSION*

Brezžični prenos električne energije le na kratke razdalje

*Wireless power transmission, only a short distance*

# November
*November*

| t/w | ponedeljek monday | torek tuesday | sreda wednesday | četrtek thursday | petek friday | sobota saturday | nedelja sunday |
|---|---|---|---|---|---|---|---|
| 44 | | | | | | 1 | 2 |
| 45 | 3 | 4 | 5 | 23:23 ○ 6 | 7 | 8 | 9 |
| 46 | 10 | 11 | 12 | 13 | 16:15 ☾ 14 | 15 | 16 |
| 47 | 17 | 18 | 19 | 20 | 21 | 13:32 ● 22 | 23 |
| 48 | 24 | 25 | 26 | 27 | 28 | 11:06 ☽ 29 | 30 |

### Oktober *October*

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### December *December*

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## 12. CASIMIROVA ENERGIJA VAKUUMA

Gre za tehnologijo prihodnosti. Že ob koncu 19. stoletja so nekateri znanstveniki (npr. Nikola Tesla) razpravljali o tezi, da nas obdajajo velike količine energije v etru okoli Zemlje, ki jo še ne znamo izkoristiti. Kasneje je Albert Einstein postavil koncept »energije ničelne točke« (izraz **zero point energy** prihaja v angleščino iz nemške besede **nullpunktenergie**) in predstavlja v kvantni mehaniki izhodiščno energijo – energijo vakuuma. Lastnosti te energije v vakuumu je leta 1948 prvi opisal nizozemski fizik Hedrik Casimir, ki je ugotovil, da se dve nenabiti kovinski plošči v vakuumu privlačita. Razlog je premikanje mej vakuumskega področja. Mnogo kasneje so drugi fiziki izmerili te sile z nanotehniškimi napravami. Ta neznana kvantna energija v vakuumu je bila poimenovana Casimirova energija vakuuma ali energija ničelne točke, ki obdaja celotno vesolje. Nekateri so to energijo poimenovali tudi brezplačna energija. Pojasnjuje se tudi z delci tahioni, ki nenehno potujejo s hitrostjo višjo od svetlobne.

Število referatov na temo možnosti izkoriščanja te energije iz leta v leto narašča eksponencialno. Scientific American je objavil članek o raziskovalnih projektih ameriškega obrambnega ministrstva (DARPA) za tehnološki preboj na področju energije vakuuma. NASA je objavila raziskovalne projekte o poskusih gradnje vesoljskega plovila, hitrejšega od svetlobe, na podlagi Casimirove energije vakuuma.

Razvoj tehnologije, ki bo omogočala izkoriščanje Casimirove energije vakuuma, vsekakor lahko uvrstimo med obetajoče tehnologije tudi za področje elektrogospodarstva.

## 12. CASIMIR ENERGY OF VACUUM

*It should be the technology of the future. At the end of the 19th century, some scientists (e.g.. Nikola Tesla) discussed the proposition that surround us there are large amounts of energy in aether or the air around the Earth, which it does not yet know how to use it. Later in 1913, Albert Einstein made the concept of "zero-point energy" (the term zero point energy comes into English from the German nullpunktenergie) and represents a baseline of energy in quantum mechanics, the energy of the vacuum. Properties of this energy in vacuum are first described in 1948 Dutch physicist Hedrik Casimir, who noted that the two close parallel uncharged conducting plates in the vacuum attracted each other. It is due to quantum vacuum fluctuation of the electromagnetic field. Much later, other physicists have measured these forces with the nano-technical devices. This unknown quantum vacuum energy has been named Casimir energy of the vacuum or zero-point energy, which surrounds the entire universe. Some have called this energy free energy. It explains also the particles named tachyons, which constantly travelling at a speed higher than the light. A number of the scientific papers on the subject of the exploitation of the potential of this energy are growing exponentially from year to year. Scientific American has published an article about the research projects of the US Department of Defence (DARPA) for a technological breakthrough in the field of energy of the vacuum. NASA has published research program calls Breakthrough propulsion Physics to build spacecraft capable of travelling at speeds faster than light based on the Casmir energy of the vacuum. The development of technologies that will allow the exploitation of the Casimir energy of the vacuum, however, can be classified as promising technologies.*

CASIMIROVA ENERGIJA VAKUUMA
*CASIMIR ENERGY OF VACUUM*

Ničelna energija vakuuma na eksperimentalnem nivoju
*Zero point energy of vacuum still at the experimental level*

# December
## *December*

| t/w | ponedeljek monday | torek tuesday | sreda wednesday | četrtek thursday | petek friday | sobota saturday | nedelja sunday |
|---|---|---|---|---|---|---|---|
| 49 | 1 | 2 | 3 | 4 | 5 | 13:27 ○ 6 | 7 |
| 50 | 8 | 9 | 10 | 11 | 12 | 13 | 13:51 ☾ 14 |
| 51 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 52 | 2:36 ● 22 | 23 | 24 | 25 | 26 | 27 | 19:31 ☽ 28 |
| 1 | 29 | 30 | 31 | | | | |

November *November*

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Januar *January* 2015

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| 26 | 27 | 28 | 29 | 30 | 31 | |

# 15. tematski koledar / *15th The thematic calendar* 2014

## OBETAJOČE TEHNOLOGIJE ZA ELEKTROENERGETSKI SISTEM

## *PROMISING TECHNOLOGIES FOR ELECTRIC POWER SYSTEM*

| Mesec<br>*Month* | Tehnologija<br>*Technology* | Vir za sliko<br>*Source for figure* | Avtor teksta<br>*Author of text* |
|---|---|---|---|
| 1 | Tehnologije izkoriščanja bibavice<br>*Tidal power techologies* | Leaflet of Shiwa Tidal Power Plant | Krešimir Bakič |
| 2 | Tehnologije čistega premoga<br>*Clean coal technologies* | http://www.caer.uky.edu/cct/ccthome.html | Krešimir Bakič |
| 3 | Tehnologije za pametna omrežja<br>*Smart grids technologies* | http://ec.europa.eu/research/energy/pdf/smartgrids_en.pdf | Krešimir Bakič |
| 4 | Koncentrirane solarne elektrarne<br>*Concentrated solar power plants* | DESERT Power 2050, Executive report, Dii Gmbh, Germany | Aleš Peršin |
| 5 | Vodikove tehnologije<br>*Hydrogen technologies* | arhiv Medium | Aleš Peršin |
| 6 | Kriogene tehnologije<br>*Cryogenic technology* | http://www.superconductorweek.com/free-content-photo-gallery | Krešimir Bakič |
| 7 | Tehnologija fuzije<br>*Fusion technology* | www.iter.org | Krešimir Bakič |
| 8 | Biomimikrija- umetno nanodrevo<br>*Biomimicry technology: artificial nano tree* | www.Solarbotanic.com | Krešimir Bakič |
| 9 | Umetna fotosinteza – tehnologija alg<br>*Artificial photo syntesis* | http://www.biotechnologie.de/BIO/Redaktion/Bilder/de/Newsfotos/2013-algenhaus-iba-hamburg,property=bild,bereich=bio,sprache=de.jpg | Aleš Peršin |
| 10 | Tehnologija baterije - litij/zrak<br>*Battery technology - lithium/air* | http://www.toyota-global.com/innovation/vision/images/next_generation_secondary_03.jpg | Aleš Peršin |
| 11 | Brezžični prenos energije<br>*Wireless power transmission* | http://insideevs.com/volvo-car-group-completes-study-of-wireless-charging-of-electric-vehicles/ | Aleš Peršin |
| 12 | Casimirova energija vakuuma<br>*Casimir energy of vacuum* | http://scienceblogs.com/ | Krešimir Bakič |

**Reference** / *references*: 1. World Energy Perspectives cost of technology, WEC, London, 2013. 2. K. Bakic: Possible scenarios of interconnection development, 1. conference SLOKO-CIGRE, Ljubljana, 1993. 3. Global CCS Institute 2013, the Global Status of CCS: 2013, Melbourne, 2013. 4. C. Morris, Energy Switch, New Society Publishers, 2006. 5. Clean Coal technologies, http://www.caer.uky.edu/cct/ccthome.html (pdf) 6. European Smart Grids technology Platform, EU DG for Research, 2006. 7. DESERT Power 2050, Executive report, Dii Gmbh, Germany, 2012. 8. www.iter.org 9. www.solarbotanic.com 10. D. Hatcher, The Tesla papers - on Free Energy and Wireless Transmission of Power, Editid by David hatcher, oct. 2000. 11. Thomas Valone, The fuel of the future, Zero point energy, Integrity Research Institute, 2007.

**Avtor ideje in urednik izdaje:** Krešimir Bakič **Teksti:** Krešimir Bakič, Aleš Peršin **Lektoriral:** Aleš Vrbovšek
**Založnik:** Slovensko združenje elektroenergetikov CIGRE-CIRED, Tehnološki park 20, Ljubljana. **Tisk:** Medium, Žirovnica **Naklada:** 400 izvodov.

# 2015

## Januar *January*

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## Februar *February*

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## Marec *March*

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## April *April*

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## Maj *May*

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## Junij *June*

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## Julij *July*

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## Avgust *August*

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## September *September*

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## Oktober *October*

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## November *November*

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| 23/30 | 24 | 25 | 26 | 27 | 28 | 29 |

## December *December*

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| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
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| 28 | 29 | 30 | 31 | | | |