Avtomatizirano načrtovanje in upravljanje lokalnih energetskih skupnosti

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Oznaka in naziv projekta

L2-70116 Avtomatizirano načrtovanje in upravljanje lokalnih energetskih skupnosti
L2-70116 Automated planning and management of local energy communities

Logotipi ARIS in drugih sofinancerjev

Projektna skupina

Vodja projekta: Gregor Dolanc

Sodelujoče raziskovalne organizacije: *Povezava na SICRIS*

Institut "Jožef Stefan"
INEA d.o.o.
EXOR-ETI d.o.o.

Sestava projektne skupine: *Povezava na SICRIS*

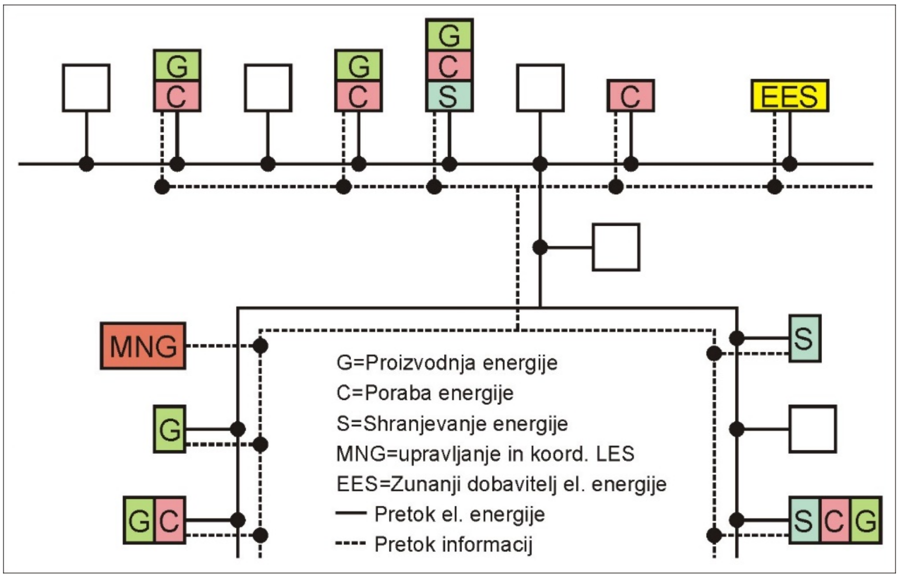
Vsebinski opis projekta

Predlagani projekt je usmerjen na področje lokalnih energetskih skupnosti, točneje v metode za avtomatizirano in digitalizirano podporo načrtovanja in obratovanja lokalnih energetskih skupnosti.

Evropski zeleni dogovor, zakonodajni okvir Čista energija za vse Evropejce in Celovit nacionalni energetski in podnebni načrt Republike Slovenije (NEPN) nas usmerjajo v racionalizacijo porabe energije, zmanjšanje porabe fosilnih ogljiko-vodikovih goriv in prehod na uporabo obnovljivih virov energije. Obnovljivi viri energije (fotovoltaika, veter, vodna energija) so učinkovit način za spopadanje z naraščajočo globalno porabo energije, podnebnimi spremembami in onesnaževanjem zraka. Vendar pa so obnovljivi viri odvisni od letnega časa ter vremena in posledično povzročajo operaterjem elektroenergetskih sistemov dodatne izzive pri usklajevanju proizvodnje in porabe električne energije (uravnoteženje elektroenergetskega sistema). Eden od načinov za spopadanje s tem izzivom je uvajanje t.i. lokalnih energetskih skupnosti (LES), katerih glavni cilj je vzajemno sprotno usklajevanje proizvodnje in porabe električne energije znotraj skupnosti ter sodelovanje energetske skupnosti pri uravnoteženju elektro-energetskega sistema in trga.

Predlagani projekt se umešča na presek področij zelenega prehoda in digitalizacije. To izhaja iz dejstva, da lokalne energetske skupnosti podpirajo uporabo zelenih obnovljivih virov energije, za njihovo učinkovito delovanje pa so potrebne metode s področja digitalizacije.

Lokalne energetske skupnosti so sestavljene iz množice članov, ki so lahko porabniki električne energije (npr. stanovanjski, poslovni, industrijski objekti), proizvajalci električne energije (lokalni obnovljivi viri energije), kombinacije porabnikov in proizvajalcev (npr. stanovanjski ali poslovni objekti z lokalnimi obnovljivimi viri električne energije) ter člani s hranilnimi kapacitetami, ki lahko električno energijo shranjujejo v hranilnikih na osnovi baterij ali vodikovih tehnologij, lahko pa tudi v obliki toplote (npr. objekti s toplotnimi črpalkami in zalogovniki toplote) ali v obliki hladu (npr. hladilnice ali trgovski centri s hladilnimi omarami).



Interes članov za sodelovanje v skupnosti izhaja iz potrebe po ekonomsko sprejemljivi in stabilni preskrbi z električno energijo ali iz želje po prodaji proizvede električne energije ali prodaje storitev, kot je hramba energije, nudenje fleksibilnosti porabe ali dobave električne energije.

Lokalne energetske skupnosti delujejo po principu trgovanja z električno energijo med člani po vnaprej določenih pravilih. Osnovni princip je, da se trenutni viški električne energije članov, ki energijo proizvajajo, uporabijo za pokritje potreb članov, ki se trenutno soočajo s primanjkljajem električne energije.

Lokalne energetske skupnosti imajo dve ključni funkciji: 1. ustvariti pogoje za cenovno ugodno in stroškovno učinkovito ter zanesljivo vzajemno preskrbo članov z električno energijo in 2. prispevati k uravnoteženju celotnega elektro-energetskega sistema in trga. Funkcija pod točko 2 energetska skupnost izpolnjuje tako, da odjema energijo iz omrežja v času viškov in nižjih cen, energijo pa v omrežje dovaja v času primanjkljajev energije in posledično višjih odkupnih cen. Implementacija tega načina delovanja lahko poteka v okviru obstoječih mehanizmov (trg znotraj dneva in trg za en dan vnaprej), v okviru sistemskih storitev in v bodočnosti preko novih mehanizmov, ki jih bo šele treba razviti posebej za integracijo energetskih skupnosti z elektro-energetskim sistemom in trgom.

Za optimalno delovanje lokalnih energetskih skupnosti morata biti izpolnjena dva ključna pogoja:

1. Lokalna energetska skupnost mora imeti ustrezno sestavo, ki vsebuje nabor medsebojno komplementarnih članov, med katerimi je možno sprotno uravnavanje proizvodnje in porabo električne energije. Sestava mora biti izbrana že v fazi načrtovanje energetske skupnosti. Če je sestava energetske skupnosti neustrezna, potem učinkovito delovanje in uravnavanje proizvodnje in porabe energije ni možno oziroma ni optimalno.

2. Lokalna energetska skupnost mora imeti sistem vodenja oziroma koordinacije. Tipično gre za centralne sisteme za vodenje, cilj vodenja je vzpostavitev energetskih tokov med člani na način, da ima vsak član zagotovljeno stabilno in ekonomsko ugodno preskrbo z električno energijo ter da je proizvodnja in porabe električne energije znotraj skupnosti vedno izravnana. Sistem za vodenje mora torej zagotavljati učinkovito koordinacijo med člani.
3. Tema predlaganega raziskovalnega projekta sledi gornjima dvema izzivoma in je usmerjena na metodologijo za avtomatizirana za načrtovanje in obratovanje lokalnih energetskih skupnosti.

Načrtovanje sestave lokalne energetske skupnosti lahko v primeru večjega števila raznolikih članov postane kompleksna naloga, ki je ni mogoče rešiti s preprostimi kalkulacijami energijskih bilanc. Izziv izhaja iz raznolikih časovnih odvisnosti proizvodnje in porabe električne energije posameznih članov ter iz dinamičnega načina obračuna omrežnine, kar vodi v dinamični optimizacijski problem. Za rešitev takega problema je potrebno ustrezna metodologija in programsko orodje.

23.1.3 Cilji raziskave

Cilj raziskave je razviti metodologijo in pripadajočo prototipno programsko orodje za podporo pri načrtovanju in obratovanju lokalnih energetskih skupnosti. Metodologija bo temeljila na digitalnem dvojčku oziroma matematičnem modelu lokalne energetske skupnosti. Potreben bo tehno-ekonomski model, ki bo opisoval fizikalne spremenljivke (energijski pretoki, stanja v hranilnikih, izgube pretvorbe energije, obraba sistemov) in ekonomske spremenljivke (finančni tokovi med člani). Za uspešno delovanje energetskih skupnosti je poleg tehničnih parametrov potrebno načrtovati in upravljati finančne tokove, saj je to pogoj za motivacijo članov za sodelovanje v takih skupnostih. Vsak član mora namreč imeti jasno sliko o finančnih učinkih, k jih energetska skupnost prinaša. Celoten matematični model bo modularen in bo sestavljen iz modelov članov energetske skupnosti. Kot omenjeno, so člani energetskih skupnosti v osnovi zelo različni, lahko so proizvajalci električne energije, porabniki energije, kombinacije proizvajalcev in porabnikov, ponudniki storitev hranjenja energije ali pa ponudniki storitev fleksibilnosti pri proizvodnji in porabi električne energije. Uvedli bomo univerzalni model člana, ki bo vseboval niz parametrov, s katerimi bo mogoče opisati vse tipe članov energetske skupnosti. Ti parametri bodo za posameznega člana predvidoma naslednji:

- nominalni letni in dnevni časovni profil, negotovost ter fleksibilnost proizvodnje električne energije,
- nominalni letni in dnevni časovni profil, negotovost ter fleksibilnost porabe električne energije,
- kapaciteta shranjevanja energije vključno z največjimi močmi in izkoristki pri polnjenju in praznjenju hranilnika,
- parametri modela obrabe in preostale življenjske dobe opreme člana (lokalna elektrarna in hranilnik),
- cena proizvedene električne energije,
- cena shranjevanja električne energije.

Ker energijski tokovi med člani potekajo preko različnih segmentov javnega distribucijskega omrežja in prenosnega omrežja (v primeru, da so člani LES v različnih distribucijskih območjih), bo potrebno razviti in implementirati tudi stroškovni model omrežja, ki bo opisoval ceno prenosa energije v odvisnosti od količine energije, časa v dnevu in letnega časa, kar je skladno s konceptom t.i. dinamične omrežnine, ki je trenutno fazi uvajanja.

Celoten matematično model, sestavljen iz tehno-ekonomskih modelov članov ter stroškovnega modela distribucijskega omrežja, bo omogočal simulacijo celoletnega obratovanja energetske skupnosti. Tipično obdobje simulacije je eno leto, kar pokrije vse letne čase in večino vremenskih razmer, ki znatno vplivajo na delovanje energetskih skupnosti. Simulacija bo izračunala časovne poteke sledečih spremenljivk:

- proizvedena in porabljena energija posameznega člana,

- prihodki posameznega člana z naslova dobave energije drugim članom ali omrežju,

- stroški posameznega člana z naslova kupljene energije in stroškov lastnega sistema (kapitalski in obratovalni stroški lokalne elektrarne in hranilnika, če obstajata),

- obraba sistema člana (obraba in preostala življenjska doba lokalne elektrarne in hranilnika, če obstajata),

- stroški prenosa električne energije med člani na račun uporabe javnega omrežja (omrežnina),

- stanje v hranilnikih energije in izgube pri shranjevanju.

Tehno-ekonomski model člana vsebuje modele proizvodnje in porabe električne energije, modele hranilnikov (hranilniki na osnovi baterij in vodikovih tehnologij) ter modele, ki opisujejo fleksibilnost porabe, npr. v obliki odstopanja porabljene moči ter časovnega intervala, v okviru katerega se moč lahko porabi. Poleg tehničnega modela je podan tudi ekonomski model, ki ocenjuje stroške in prihodke člana energetske skupnosti. Prihodki v splošnem nastajajo iz naslova prodane električne energije ter storitev fleksibilnosti pri porabi električne energije. Stroški pa nastajajo z naslova plačila za dobavljeno električno energijo ter z naslova nabavnih in obratovalnih stroškov lastne tehnološke opreme člana (lokalna elektrarna ter hranilniki).

The topic of the proposed project are Local Energy Communities (LEC), in particular, methods for their automated and digitized design and operation. European Green Deal, legislative framework Clean energy for all Europeans, and National energy and climate plan of the Republic Slovenia (NEPN) guide us towards the reduction of energy consumption, the reduction of the consumption of fossil fuels and the transition to renewable energy sources. Renewable energy sources (photovoltaic, wind, hydropower) are an effective way to deal with increasing global energy consumption, climate change and air pollution. However, renewable sources depend upon the time of year and the weather and, as a result, cause additional challenges for electric power system operators in coordinating the electric energy production and consumption (balancing the electric power system). One of the ways to undertake this challenge is to introduce the local energy communities (LEC), the main goal of which is the permanent mutual coordination of production and consumption of electric energy within the LEC and the participation of the LEC in balancing the public electric power system and the market. LECs support the use of green renewable energy sources, while digitization methods are needed for effective planning and automated operation of LECs. This positions the proposed project at the intersection of the green transition and digital transition. Typical LEC consists of a number of members which can be consumers of electric energy (e.g., residential, commercial, industrial buildings), producers of electric energy (local renewable energy sources), combinations of consumers and producers (e.g. residential or commercial buildings with local renewable sources of electricity) and members with storage capacities that can store electric energy in batteries or storages based on hydrogen technologies, but can also be in the form of heat (e.g. buildings with heat pumps and heat storage tanks) or in the form of cold (e.g. shopping centres with large-scale refrigerators).

LECs have two key functions: 1. To provide affordable, cost-effective and reliable mutual supply of electric energy to members, and 2. to contribute to the balancing of the entire public electrical power system and market. This is done by consuming electric energy from the public electric power system during periods of electric energy surpluses and lower prices, and supplying the electric energy to the public power system during periods of energy shortages and consequently higher prices. This can be implemented via existing market mechanisms (intra-day market and one-day-ahead market), or via ancillary services of the public electric grid and by the new mechanisms that may be developed specifically for the integration of LECs with the electric power system and the market in the future. The interest in participating in the LEC stems from the need for an economically advantageous and stable supply of electric energy, or from the desire to sell the renewable electric energy or to sell services such as energy storage and flexibility in the consumption or supply. For instance, heating systems, cooling systems and charging of electric vehicles can in general be flexible in consumption to some extent (their consumption can be temporarily reduced or shifted in time, depending on particular case). LECs operate on the principle of mutual exchange of electric energy between members according to the predetermined rules. The basic principle is that current surpluses of energy-producing members are used to cover the needs of members who are currently facing the lack of electric energy. For the optimal effect of LECs, two key conditions must be met: 1. The LEC must have an appropriate composition and it must contain a set of mutually complementary members, among which real-time balancing of electric energy production and consumption is possible. The LEC composition must be selected already in the design phase. If the composition of LEC is inadequate, then effective operation and balancing of energy production and consumption is not optimal or even impossible. 2. During its operation, LEC must be constantly managed by an automated control and coordination system. Typically, these are central control systems, the goal of control is to establish energy flows between members in such a way that each member is guaranteed a stable and economically advantageous supply of electric energy and that the production and consumption of electric energy within the LEC is always balanced. The control system must therefore ensure effective coordination of energy and financial flows between LEC members considering the adopted revenue sharing and collective investments rules. This brings us to the main goal of the project, which is the development of methods for automated LEC design and automated LEC operation. In case of a number of diverse LEC members, design and operation become complex tasks, which cannot be solved by simple calculations of energy balances and financial flows. The challenge arises from diverse and partly unpredictable time profiles of electric energy production and consumption of particular LEC members. In addition, LEC members usually exchange energy over the public electric grid and this is charged by the grid operator considering the dynamic transmission prices. All these conditions lead to a dynamic optimization problem.

The main goal of the proposed research is to develop a methodology and associated prototype software tool to support the automated LEC design and automated LEC operation demonstrated in simulation environment. The solutions of both problems will be based on a simulation and automated multi-criteria optimization. To perform LEC simulation and optimization, mathematical models are needed. Two models are needed: 1. model of the LEC and its members, and 2. model of the public electric power system and market. Techno-economic models are needed, which describe physical variables (energy flows, energy balances in storages, energy conversion losses, degradation of systems) and also economic variables (financial flows, i.e. incomes, costs). For the successful operation of LEC, it is necessary to plan and manage financial flows, as this is a condition for motivating members to participate in LECs.
Each member must have a clear picture of the financial effects of participating in LEC. Therefore the rules for revenue sharing and collective investments must be defined. LEC model will be modular and will consist of models of LEC members. As mentioned, the LEC members differ from each other, so a generalised model of LEC member will be developed, which will include all possible functions: energy generation, energy consumption (flexible and nonflexible), and energy storage (batteries, hydrogen or heat). By proper configuration and parametrization of the generalised model it will be possible to describe all types of LEC members. The general LEC member model will contain dynamic models of local electric energy production and consumption, energy storage models and models that describe the flexibility of consumption, e.g. in the form of the tolerance as a function of time. A dynamic model of electric energy production from e.g. local photovoltaic power plants will consider size, location, orientation and efficiency of the power plant and historical data on solar radiation throughout the year. The electric energy consumption model will consider historical consumption data of the specific member, including the type of day (weekday, weekend, holiday) and the flexibility of its consumption. The battery storage model will consider energy storage capacity, maximum power and efficiency during charging and discharging. The dynamic model of the hydrogen-based energy storage will contain models of the electrolyser, hydrogen compressor, hydrogen pressure storage tank, and fuel cell. It will consider the minimum and maximum power and efficiencies of the electrolyser and fuel cell and their dynamic limitations. The thermal capacity models will be estimated based on area of heated buildings or volume of cooled goods in case of large stores, respectively, given the eligible temperature bounds. The economic part of LEC model will predict revenues and costs of LEC members based on operation and LEC financial rules. Revenues are generally generated from the sale of electric energy and sale of load flexibility. The costs arise from the payment for the purchased electric energy and from the investment and operating costs of the member's own technological equipment (local power plant and energy storage). The economic model will also consider costs that arise from equipment degradation (reducing remaining service life), which is a consequence of ageing and intensity of operation (total operation time, load factor, number of on/ff cycles, power ramping up and down, etc.). Electric power

system and market model will simulate the operation of a public electric power system by generating time profiles of electric energy surpluses and deficits and corresponding dynamics energy prices. It will simulate mechanisms such as balancing market, intra-day market, one-day-ahead market and ancillary services (in particular secondary control). The model will be implemented on the basis of historical data modified with random components, considering the principles introduced in the ongoing project ARIS-L2-4456. Since energy is being exchanged between LEC members through different segments of the public distribution grid and possibly also through the transmission grid (in case if LEC members are in different distribution areas), it will be necessary to develop and implement energy transmission cost model that will describe the transmission cost as a function of the amount of energy transferred, power, time of day and season. This is in line with the concept of the dynamic electric grid fees, which are currently being introduced in Slovenia. The overall model will enable the simulation of LEC within an arbitrary time period. A typical simulation period is one year, which covers all seasons and most of weather conditions that significantly affect the operation of LECs. The simulation will estimate the time profiles of the following variables: • produced and consumed electric power of each member, • income of particular member from the supply of electric energy to other members or the public electric power system and market, • cost of particular member from purchased energy and own system costs (capital and operating expenditures of the local power plant and storage tank, if they exist), • wear and degradation of the member's system (degradation and remaining life of the local power plant and storage facilities, if they exist), • costs of electric energy transmission between members due to using the public grid (grid fee), • the state of charge of possible energy storage and storage losses. Modelling will be followed by the development of automated LEC design and LEC operation methods. LEC design (i.e. selection of members and optimal sizing their technological equipment) is a complex problem that has many degrees of freedom (sizes of local renewable resources, capacities and types of storage tanks, utilization of available consumption flexibility, etc.) and many possible criteria functions (price of electric energy supply, energy transmission costs between members, equipment investment costs, CO2 reduction and many others). Therefore, it is generally not possible to effectively solve the design problem analytically. To solve the problem, different methods from the field of multicriteria stochastic optimization (genetic algorithms, particle swarm methods, etc. [1]) will be used and compared. For LEC design it is necessary to consider the year-round operation of the LEC, since the production, consumption and prices of electric energy strongly depend on the time of year and also time in day. LEC control (i.e. real-time management of energy and financial flows) is also a complex problem. Energy exchange between members within the LEC and between the LEC and the public electric power system and market must be continuously managed, by exploiting the available flexibility of consumption of individual members, available storage capacities for storing surpluses and covering deficits of electric energy. To do this efficiently, it is necessary to consider the forecasts of electric energy production by local renewable sources, energy consumption, the state-of-charge of energy storages, the dynamic prices of electric energy supply and transmission. The control algorithm will be a combination of predetermined rules or decision paths and dynamic optimization techniques. In a resulting hybrid system, the predetermined decision structure will ensure adherence to critical rules, while optimization will dynamically adjust the control actions to improve performance. Different criteria functions and their combinations are possible: resulting price of electric energy supply, share of green electric energy, and similar. In this case, too, an analytical solution is not possible, so different methods of multi-criteria stochastic optimization or predictive control will have to be used, but the time range of the optimization is shorter than in case of planning. It can typically be one or more days ahead, implemented as a sliding horizon. There can also be long-term planning (a period of one year), which comes into play if the LEC has seasonal energy storage capacities to store surplus energy from the summer period for the winter period.

Osnovni podatki sofinanciranja so dostopni na spletni strani https://cris.cobiss.net/ecris/si/sl/project/24428.

Faze projekta in opis njihove realizacije

WP1: Vodenje projekta: 10%
WP2: Analiza zahtev in specifikacije: 50%
WP3: Razvoj digitalnih dvojčkov: 0%

WP4: Razvoj algoritmov za načrtovanje in obratovanje LES: 0%
WP5: Promocija in razširjanje rezultatov: 0%

WP1: Project coordination: 10%
WP2: Analysis of the requirements and specification: 50%
WP3: Development of digital twins: 0%
WP4: LEC design and control algorithms: 0%
WP5: Promotion and dissemination of the results: 0%

Bibliografske reference

- *Reference - SICRIS*
- *Referenca 1*
- *Referenca 2*
- *Referenca - Revija*

Komunikacijski načrt

Projekt: L2-70116 Avtomatizirano načrtovanje in upravljanje lokalnih energetskih skupnosti

Nosilec: Gregor Dolanc

Trajanje: 1.3.2026 - 28.2.2029

Vrsta projekta: Aplikativni raziskovalni projekt

Partnerji: Institut Jožef Stefan, Odsek za sisteme in vodenje (IJS)

INEA d.o.o. (INEA)

EXOR ETI d.o.o. (EXOR ETI)

Datum: 25.8.2026

Verzija: 1.0

1. Namen in cilji komuniciranja

Ta komunikacijski načrt določa strukturiran pristop za notranjo in zunanjo komunikacijo projekta, podpira znanstvene in družbene cilje projekta ter povečuje prepoznavnost in uporabnost rezultatov projekta v strokovni in industrijski skupnosti.

Komunikacija projekta bo dvojezična. Znanstvena komunikacija bo za dosego širšega kroga primarno potekala v angleškem jeziku, medtem ko bodo aktivnosti namenjene splošni javnosti izvedene v slovenskem in angleškem jeziku.

Cilji komunikacije

- Zagotavljanje skladnosti z ARIS zahtevami in pravočasno pripravo poročil.
- Učinkovita koordinacija partnerjev (IJS, INEA, EXOR-ETI) za nemoten potek dela.
- Diseminacija znanstvenih in praktičnih rezultatov v strokovne kroge in industrijo.
- Povečanje prepoznavnosti projekta v strokovnih krogih in med potencialnimi uporabniki LES rešitev.
- Spodbujanje prenosa tehnologije in komercialnih priložnosti za partnerje.

2. Ciljne skupine

- Notranje: projektna skupina IJS, INEA, EXOR-ETI.
- Uradni naročnik: ARIS.
- Strokovne javnosti: raziskovalci, univerze, strokovni forumi.
- Industrija: DSOs, ponudniki energije, trgovci, podjetja za digitalizacijo in avtomatizacijo.
- Splošna javnost in mediji: lokalne skupnosti, zainteresirane javnosti (potencialni člani LES).

3. Ključna sporočila

- Vrednost projekta: avtomatizirana metodologija za načrtovanje in obratovanje LES povečuje energetsko učinkovitost in omogoča vključevanje obnovljivih virov.

- Inovativnost: integracija digitalnega dvojčka, dinamičnih omrežnin in tržnih mehanizmov.
- Uporabnost: orodje bo omogočalo simulacije, optimizacijo in podporo odločitvam za različne tipe članov LES.
- Sodelovanje: projekt temelji na sodelovanju raziskave in industrije ter prinaša konkretne rešitve za trg.

4. Kanali in orodja

- Uradna poročila ARIS.
- Notranja komunikacija: redni projektni sestanki (okvirno vsaka 2 meseca), e-pošta, skupni repozitorij.
- Strokovna diseminacija: znanstveni članki, konferenčne predstavitve, delavnice.
- Industrijska diseminacija: predstavitve na sejmih, strokovnih srečanjih.
- Spletna stran projekta.

5. Časovni načrt komuniciranja

- D1.1 Zapisniki sestankov: redno, ca vsaka 2 meseca
- D1.2 Poročila za ARIS: vmesno poročilo M18 31.08.2027, končno poročilo M36 28.02.2029
- D2.1 Analiza zahtev: M06 31.08.2026
- D2.2 Specifikacije: M06 31.08.2026
- D3.1 Poročilo o digitalnem dvojčku članov energetske skupnosti: M18 31.08.2027
- D3.2 Poročilo o digitalnem dvojčku elektroenergetskega sistema in trga: M18 31.08.2027
- D4.1 Poročilo o izvedenem simulacijskem okolju: M23 31.01.2028
- D4.2 Poročilo o razvitem algoritmu za načrtovanje: M23 31.01.2028
- D4.3 Poročilo o razvitem algoritmu za obratovanje: M26 30.04.2028
- D4.4 Poročilo o ovrednotenju algoritmov: M34 31.12.2028
- D5.1 Izvedene predstavitve na strokovnih srečanjih, nacionalnih in mednarodnih konferencah: M26 30.04.2028, M36 28.02.2029
- D5.2 Objavljeni prispevki v znanstvenih revijah: M26, M36 28.02.2029

6. Vloge in odgovornosti

- IJS (koordinator) – nosilec projekta Gregor Dolanc in Samo Gerkšič
  - Vodja komunikacije z ARIS; priprava poročil; organizacija sestankov; priprava znanstvenih publikacij.
- INEA – Matjaž Kobal
  - Priskrba podatkov; podpora pri modeliranju; sodelovanje pri strokovnih predstavitvah; priprava promocijskih vsebin; prispevek k industrijskim stikov.
- EXOR-ETI – Matjaž Berce
  - So-financiranje; širjenje rezultatov v industrijskih mrežah.
- Vsi partnerji
  - Aktivno sodelovanje pri pripravi vsebin, udeležba na dogodkih, pregled in potrditev komunikacijskih materialov.

7. Kazalniki uspešnosti

- Število znanstvenih objav
- Število predstavitev na konferencah.
- Število izvedenih promocijskih aktivnosti na sejmih in pri potencialnih partnerjih LES.

- Pravočasno dostavljena poročila.

8. Skladnost z zahtevami ARIS

Pri objavah in dogodkih je obvezno skladno navajanje sofinanciranja ARIS (L2-70116) in uporaba logotipov.
https://www.aris-rs.si/objave/novice/dolznost-navajanja-afiliacije-in-omemba-arrs-pri-so-financiranih-programih-in-projektih-dopolnitev-2017-01-31
https://www.aris-rs.si/uploads/sl/agencija/logo/inc/ARIS-logo-specifikacija1.pdf

Objave bodo objavljene v odprtem dostopu, prav tako bodo odprto dostopni vsi podatki uporabljeni za njihovo pripravo. Delovna poročila bodo internega značaja, ker lahko vsebujejo zaupne interne podatke, vendar se partnerji zavezujejo, da bodo zagotovljeni odpto dostopni podatki potrebni za pripravo publikacij.

Prijavitelj in vsi sodelujoči raziskovalci izjavljamo, da pri izvajanju projekta ravnamo v skladu z etičnimi načeli raziskovalne integritete in javnega delovanja, kot jih določajo smernice ARIS, Kodeks ravnanja za raziskovalno integriteto (ALLEA) ter veljavna zakonodaja Republike Slovenije in Evropske unije.

Zavezujemo se k spoštovanju načel poštenosti, zanesljivosti, objektivnosti, preglednosti, strokovnosti in integritete ter k preprečevanju vseh oblik neetičnega ravnanja, vključno s plagiarizmom, ponarejanjem podatkov, manipulacijo rezultatov, neustreznim avtorstvom in kršitvami varstva osebnih podatkov.

Izjavljamo, da bomo zagotovili etično ravnanje pri obdelavi podatkov, objavi, komuniciranju in diseminaciji rezultatov ter vidno označili sofinanciranje ARIS. Morebitne kršitve bomo nemudoma prijavili ARIS in sprejeli ustrezne ukrepe.