STRIDE

REGIONAL ANALYSIS ON SMART GRIDS – METHODOLOGY

T.1 SMART GRID - GOOD PRACTICE EXAMPLES (VERSION 2.)

Project co-funded by the European Union funds (ERDF, IPA, ENI)

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1 Project identification

Name of the good practice case:

Czech self-sufficiency house

Country	Region name (NUTS code)
Czech Republic	**South Bohemian Region (CZ031)**

Level at which the good practice is implemented (select one dominant level)

National❏ Regional ❏ Local❏

Visibility (photo, image, diagram, logo, etc. that visually represents the good practice)

Figure 1 View of the off-grid house - outdoor

Figure 2 View of the off-grid house – outdoor 2

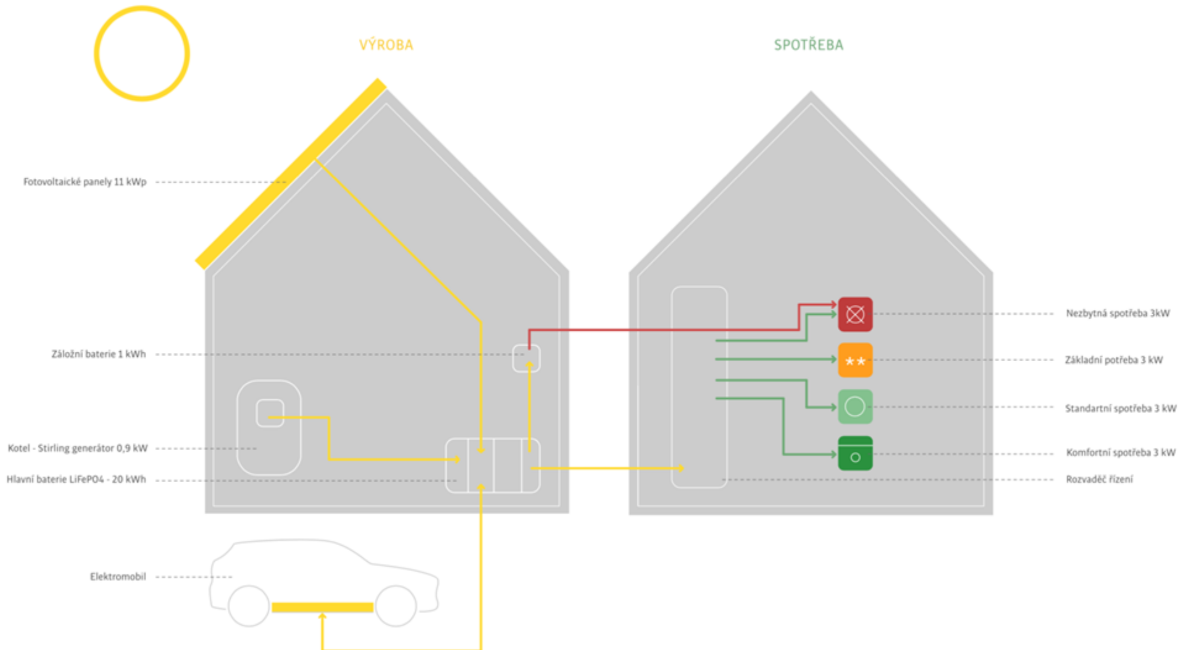

Figure 3 Energy concept of off-grid house

Figure 4 View of the off-grid house – indoor

Figure 5 View of the house – technology (distribution box, fuses)

Figure 6 View of the house – technology room (electricity)

Figure 7 View of the house – technology room (heating)

Reference (website, press release, media article, documents)

https://www.csdum.cz/

Organization in charge of the good practice case

Name: Český ostrovní dům s.r.o. (Czech off-grid house ltd.)	Public authority ❑ Economic and/or innovation agency❑ Energy agency ❑ Intermediary ❑ Other ❑, please specify: small ltd.

Contact person: name, organization, email.

Pavel Podruh, Český ostrovní dům s.r.o., pavel@csdum.cz

Smart grid domain (max. 2 choices)

Smart network management ❑ ; Demand-side management ❑ ; Integration of storage technologies ❑ ; Integration of distributed generation ❑ ; Integration of large-scale RES ❑ ; Electric mobility ❑ ; Energy efficiency measures ❑ ; Other: Off-grid system ❑

Smart grid segment (max. 3 choices)

Software Smart Grid Distribution Management ❑ ; Smart Grid Network Management ❑ ; Grid Asset Management ❑ ; Substation Automation ❑ ; Smart Grid Security ❑ ; Billing and Customer Information System ❑ ; Advance Metering Infrastructure ❑. **Hardware** Smart meter ❑ ; Battery storage ❑ ; E-vehicle charging station ❑ ; RES (e.g., PV systems, wind turbines, etc.) ❑ ; Power quality system ❑ ; SCADA system ❑. **Services** Consulting ❑ ; Deployment and Integration ❑ ; Support and maintenance ❑. **Other** ………………………… (specification)❑

2 Description of the good practice

2.1 Short summary of the good practice

Briefly describe the identified project and argument how you consider it an innovative Best-Case practice.

The goal of descripted project is to create a house that produces all the electricity from the sun, stores it in batteries and then consumes it. It captures the maximum of rainwater, flushes with it and after cleaning it can be used even in the shower. It does not let out unnecessarily precious heat, but at the same time it is healthy to live and breathe inside it.

The main innovative element is in independent do-it-yourself (DIY) preparation and installation of RES technology, including battery storage. Students and practitioners participated in the development of the house and technology. The technologies underwent laboratory testing and the whole development took about 4 years. The result will be a freely available and replicable self-sufficient house concept for everyone else. As a result, it is a house in a low-energy standard - the important thing, however, is that the composition of the technology of the proposed building would work just as effectively in a wooden building, a straw house, a house printed from recycled plastic or an earth-house. The final project technical documentation will be shared with the public for free as an opensource concept.

2.2 Challenge addressed and targeted objective

Please provide shortly the main goals of the project and the addressed challenges.

The aim of the project is to create a widely usable and freely available technical documentation of a self-sufficient house. The documentation can be used for a complex solution or implementation of partial elements, mostly by DIY way. The final result will be freely shared with public, students and professionals.

2.3 Innovation

Multiple-choice and explanation

<u>Technological</u> ❑ ; Service❑; Commercial❑; Managerial❑; Social ❑; <u>Environmental</u>❑

Other❑: ....

Explanation: The result of the project will be a real installation and technical documentation of an energy self-sufficient house, including innovative DIY solutions. The environmental benefits will be saving of energy from non-renewable sources and related infrastructure (electricity or natural gas connections).

2.4 Technical characterization of the good practice

2.4.1 Included technical solution(s)

Multiple choices possible

New hardware component ☐ ;	New software component ☐;
Improved system integration ☐;	Optimized technologies/processes/procedures ☐;
New decision support system (DSS) ☐;	New data collection & analysis system ☐ ;
Other ☐, please specify:	

2.4.2 Applied technology/service providers

All the necessary products and services were supplied by a single solution provider or more than one provider were participated: Single provider ❑ ; Multiple provider ❑ ; not relevant ❑.
A system integrator (or general contractor) was applied for coordination or supervision of the participants' work: Yes ❑ ; No ❑; not relevant ❑.

2.4.3 Main competence field of the system integrator

System integrator company was applied with the following profile:
Software developer company ❑ ; Hardware supplier company ❑ ;
Research & development company ❑; Other (e.g., system operator) ❑; not relevant ❑.
In case of “other” please specify: The system integrator is own implementer, which buys, integrates and tests partial technological elements into a complex best available solution.

2.4.4 Alternatives regarding the technical solution

Decision was needed regarding the technical possibilities:
Multiple solution providers were available ❑; Multiple technical solution was on the market ❑;
Tailor made technical solution had to be developed ❑; not relevant ❑.

2.4.5 Brief description of the technical solution

e.g., main elements, new functions, interfaces towards other systems, R&D focus: e.g., Artificial Intelligence, AR/VR, Industry 4.0 etc.

The choice of individual technologies depends mainly on the consumption of electricity, which is crucial for a house independent of engineering networks.

The only source of electricity will be own photovoltaic power plant with an installed capacity of 15 kWp, supplemented by extremely durable and high-quality lithium-phosphate battery storage with a capacity of 20 kWh. Standard photovoltaic panels will be built into the entire area of the southern part of the gable roof in a classic double-skin structure with a ventilated gap and thus replace the

roofing. While the entire south roof will be covered with solar panels, black ceramic tiles are designed on the north roof. The house will primarily function analogously with only small elements of the so-called smart home as a functional, independent superstructure. Battery storage and the entire energy system of the house will not be a black box, but an open, hardware solution that should be able to be serviced by a local electrician. It is use only freely and commonly available components that can be easily replaced and ordered immediately from available e-shops.

2.5 Funding sources / Financing mechanism

Provide a brief description of the used financial mechanism and the funding sources

The project is implemented by self-help in cooperation with students and commercial partner Hypoteční banka (hypothec bank). Part of the development is the organization of student competitions in the design of technological and architectural solutions. The cooperation with hypothec bank results also to new financial product “Green hypothec” focused on financing of domestic RES.

2.6 History: origin, definition phase, start and end

Please give a general overview about the roll-out and the timeframe of the project development.

The preparation of the project before the actual implementation took 4 years (2015-2019). The first house construction began in 2019 and is just before completion now. The preparation included regular annual student competitions, cooperation with a battery manufacturer (GWL) and the processing of landscape and building permits (2016-2019). The cooperation with hypothec bank runs since 2017. In cooperation with GWL a laboratory was set up in 2018 where technologies were actually tested. Completion of the first house is planned for a year. The project includes 2 houses on neighboring lands. However, the project will result in a replicable concept.

2.7 Stakeholders involved in implementation

Please select the type of involved organizations, multiple choices allowed

Distribution System Operators (DSOs) ❑; Generation company ❑; ICT company & Telecom ❑; <u>Technology manufacturer</u> ❑; Industry association ❑; Engineering services ❑; Utility ❑; Research center ❑; Retail company ❑; Consultancy ❑; University ❑; Public Institution ❑;

Policy makers ❑; Other: domestic and foreign students of various universities (mainly Czech technical university in Prague) and Hypoteční banka (hypothec bank)

2.8 Stakeholder involvement and target groups

Please describe briefly the key actors involved in the development of the project and their role.

GWL: The largest Li-Ion batteries distributor in Europe - assistance with system design and the establishment of an experimental technology laboratory. Hypoteční banka (hypothec bank): Bank focused on financing construction - assistance with building financing University students: Design and planning of construction and technological solutions within the announced student competitions.

2.9 Beneficiaries

Give a brief overview of the covered area by the project implementation and the beneficiaries.

The main beneficiaries are builders and future occupants of the house (the founders of Český ostrovní dům s.r.o.). GWL gains new experience and also customers. Hypoteční banka developed new financial product "Green hypothec" as a result of project. Students participating in the competition gain new practice experience. All interested potential beneficiaries will be able to use free technical documentation that will be result of project.

3 Implementation

3.1 Implementation process

Please present the implementation process *of the project focusing on issues specific for new innovation, necessary steps and subsequent activities, resources and management effort for a successful development.*

The preparation of the project took 4 years and included mainly technical solutions and processing of official permits. The technical solution was developed in cooperation with the technology company (GWL) and university students. This solution includes establishment of a technological laboratory for testing of partial elements and their connection to a complex system. The financing of the project was solved in cooperation with a bank focused on hypothecs. The implementers state that the processing of permits was very demanding and exhaustive.

3.2 Achieved results

Please give a brief description regarding the achieved results (indicate technological, environmental and social) after the project implementation.

The achieved results are on 2 levels:

The specific level – construction of 2 off-grid houses on the holdings of the implementer.

The replication level – freely accessible technical and building documentation of off-grid house.

4 Financial achievement

4.1 Key figures

Please summarize the main relevant financial key figures of the project (investment volume, financial objectives, financial status before project implementation, etc.), if they are publicly available

The complete cost spent per one house was 230.000 EUR.

The hypothec bank joined the project during the solution and developed new public financial product "Green hypothec" as a result.

4.2 KPIs

Input the collected data from your researches, using the template "KPIs Best Case" in the provided Excel-toolkit and please give a brief interpretation of the values regarding the analyzed project goals.

Table 1 KPIs

Aspect focused	Name of KPI	Unit	Value	Description /What is measured	Comments
Project area	Producers involved	number	**40**	target focused in project	experts worked free of charge
	Consumers involved	number	**4000000**		cumulative media reach of the project
	Prosumers involved	number	**10.000s**		hard to evaluate, but tens of thousands
	Smart meters	number	**0**		off-grid
	Electric vehicles	number	**1/day**		charging only solar energy from spring to autumn
	Charging stations	number	**4**		1 for cars, 3 for bicycles
	Consumption area	MWh/year	**4.3**		subtle house, subtle consumptions
	Share of consumption originate from non-dispatchable resources	%	**100**		off-grid PV

Economic	Investment/CAPEX	%	50	Ratio of CAPEX (Capital Expenditure) to Investment amount	230.000 Eur
	ROI	%	60	Return on Investment	
	IRR	%	N/A	Internal Rate on Return	
	Payback Period	Years	15	The period of time needed for the cumulative gains from an investment to equal cumulative cost	
	LCOE	EUR/MWh$_{el}$	0.18	Levelized Cost of Energy	24.000 Eur cost of energy system / 131400 kWh
Benefits	Energy savings	**%**	**100**	Energy saved per annum with the project proposed solutions	per annum
		EUR	**5600**	Amount of energy savings	per annum
	Reduced outages	%	N/A	Reduction of outages duration	
	Reduced O&M costs	%	N/A	Measure the reduction of operation and maintenance costs	No maintenance needed so far
	Reduced energy losses (technical/non technical)	%	-	Percent of energy losses reduction	
		MWh	-	Amount of energy losses	
	Reduced system management costs	%	-	Measure the reduction of system management costs (ancillary services, congestion management)	
	Increase of RES capacity	%	-	Percent of RES capacity added	
		MWh	-	RES capacity added	
	Increase storage capacity	%	-	Percent of storage capacity added	
		MWh	-	Storage capacity added	
	Reduced Fossil Fuel Consumption	MWh	4.3	Reduced Fossil Fuel Consumption by implementing proposed solutions	per annum
	CO2 tonnes saved	tonnes CO_2/a	5.2	Tonnes saved per annum with proposed solutions	

The case involves triple helix – industry (materials and components suppliers, builders) – academy (students – volunteers) – government (legislators – demanding conditions).

The case includes charge station for EV and its share of consumption originate from non-dispatchable resources is 100 % (100 % of own RES energy for housing and mobility). It does not include smart meters because it is off-grid concept.

5 Innovative approach

Describe the innovative characteristics realized through the implementation of the project

The innovativeness of the project is in several aspects:

- involvement of market available technologies in a complex functional unit - the off-grid house
- technology concept for DIY installation and maintenance (without specialized companies and professionals)
- free access to technical documentation to all potential interested parties
- involvement of students, financial and technology subject to preparation of project, beneficial for all involved

6 Evidence of success

6.1 Most successful elements

Advantageous cooperation of builder with students, financial and technology subject.

Testing of partial technologies and the its complex before installation to the house.

Free technical documentation – published after the end of project (2021).

6.2 Lessons learned

Own solution of optimal use of RES technologies for off-grid house is possible.

The benefit is the mutually beneficial involvement of suitable experts (students, technology and financing subject) in the preparation of the project.

7 Difficulties encountered

Most important encountered difficulties

Obtaining of landscape, construction and other necessary permits is a demanding and lengthy process in the Czech Republic.

8 Potential for knowledge transfer

Ideas for transfer of good practice knowledge

The main knowledge transfer potential is in free technical documentation of off-grid house with technologies, published after the end of project.

9 Future perspectives

Please present what future perspectives you can expect, regarding development, functionality, synergies for development of new innovations in the field of smart grids.

The concept of off-grid house will be open for further optimization and possible use of new innovations in the field of smart grids. It is valid for specific off-grid houses built by investor and also for free technical documentation users in the future.