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Modelling and report on the reactions of stakeholders and energy regulators

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1. Introduction

The preparation of one report with the risk profiles for the 7 pilot microgrids that have been designed in the framework of the PEGASUS project is foreseen in WP3. These 'risk profiles' were produced as a result of the "Discussion meetings with the Stakeholders" and the "Working meetings with the Energy Regulators" that were held in the areas of the seven pilot microgrids.

CRES prepared a common template of risks list that has been circulated and discussed in all pilot areas. At the end, the different risks lists from the seven pilots were collected and a final risks list and a matrix for microgrid risks were produced and they are presented in this report.

2. Organization of the procedures

2.1 Description of the modelling procedure

The steps that were followed when implementing the microgrid risk model are the following:

1. Preparation of an indicative list of risks: In a first stage CRES prepared a draft version of a Risks list (allocating and sizing the risks) to be discussed with the main Stakeholders and the Energy Regulator in each pilot area.

2. Review from the partners: The partners adapted the indicative list of risks according to their local conditions. During the meetings with the Stakeholders and the Energy Regulator in each country / region the results of the questionnaire (D 3.4.1) and the adapted risks list for each pilot microgrid were presented and discussed in order to be agreed and finalised (see D 3.4.3 and D 3.4.4).

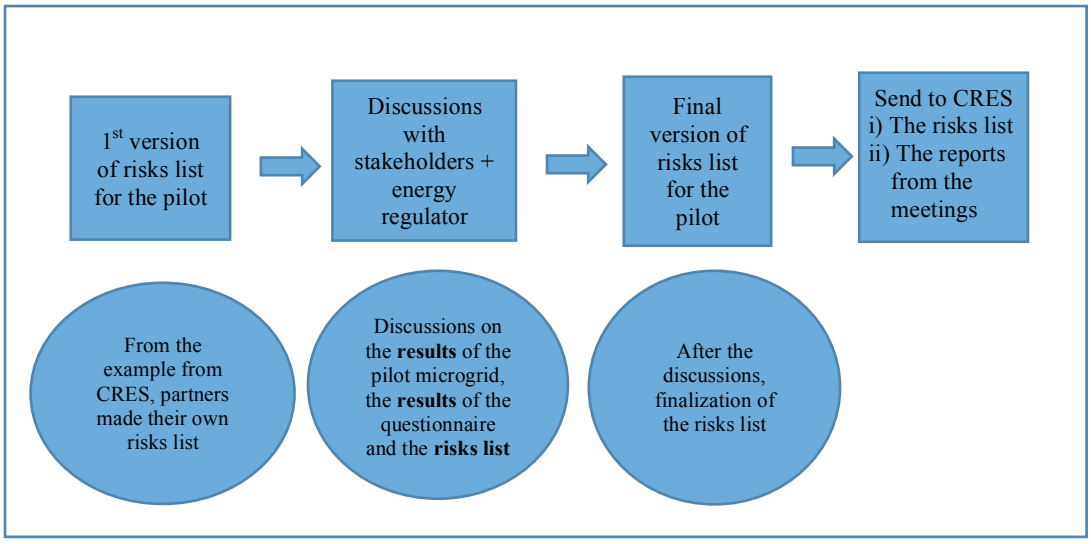


Figure 1: The instructions for the collection of the risks lists

3. Evaluation and modelling: After the meetings with the main Stakeholders and the Energy Regulator held in each country / territory the evaluation and the modelling of their reaction took place.

4. Collection of reports and risks lists: CRES collected the risks lists (one for every pilot) and the reports with the reaction of the main stakeholders and the Energy Regulator. Data were analysed by collating the responses.

5. Preparation of the risks profile: At the end of the procedure, a final Risks List and a Matrix for microgrid risks were produced by CRES covering all the pilot areas.

The whole procedure is graphically represented in Figure 1 above.

2.2. Discussion meetings with the stakeholders

One technical seminar/workshop per territory with the main local stakeholders was foreseen to be held in the framework of WP3 of the PEGASUS project. The following meetings, in which the lists of risks were discussed, took place.

2.2.1 Discussion meeting in Greece (CRES)

The event took place on May 3, 2019 at the Municipality of Farsala, 7 Patroklou st. During the event, CRES presented the project PEGASUS and the Greek pilot microgrid of Mega Evydrio. More specifically, the business/organizational model of the pilot (essentially under technical conditions), the results of the questionnaire and the list of risks that CRES had already prepared were presented to the participants.

For more details, see the deliverable D 3.4.3 “Discussion meeting with the stakeholders”.

2.2.2 Discussion meetings in France (AURA-EE)

There was not only one meeting held with the stakeholders but several meetings, which alternated with other events such as the local politicians meeting, the local campaign or the technical workshops.

The following meetings took part:

- On 06/06/2017 launching pilot project (St Julien),
- 14/06 /2017 meeting with local grid operator (Valence)
- 11/ 07/2017 workshop with inhabitants (St Julien)
- 24/11 /2017 technical workshop (St Julien)
- 08/02 /2018 meeting with DSO (St Julien)
- 30/05/2018 meeting with municipality
- 10/07/2018 technical workshop (Valence)
- 10/10/2018 technical workshop (Valence)
- 01/03/2019 technical workshop (Valence)
- 29/04/2019 local campaign (St Julien)
- 28 /10/2019 synthesis of the project (webinar)

The stakeholders were closely associated to the PEGASUS activities through the organization of several meetings. Thanks to this, the inhabitants could get up-to-date information on the

project and confirmed in their answers to the questionnaire that they were mostly motivated and already had all the necessary information regarding the project. Besides a risk list was elaborated that enables to measure the different risk issues of the project. The lack of consumers and the lack of economic balance appear to be the stronger threats but mitigation strategies have been activated so that these risks should be enough controlled for the operational implementation of the project.

For more details, see the deliverable D 3.4.3 “Discussion meeting with the stakeholders”.

2.2.3 Discussion meeting in Slovenia (ENERGAP)

The event took place on 22/10/2019 at 11.00 at Režijski obrat Ruše, Mariborska cesta 3, Ruše. The main objective of the meeting was to gather main local stakeholders involved from the beginning of the project. There were presentations and discussions about the outcomes and results on the pilot microgrid in Sports park Ruše. It was also presented the outcomes of the Questionnaire that Energap had analysed and the report that was prepared on the reactions.

For more details, see the deliverable D 3.4.3 “Discussion meeting with the stakeholders”.

2.2.4 Discussion meeting in Cypruss (UCY-FOSS)

The event took place on 08/05/2019 in Nicosia. The PEGASUS team had the opportunity to inform stakeholders of the project on the results of the FOSS microgrid pilot. The risks associated with the Microgrid Pilot of the University of Cyprus were discussed and evaluated during this event. Recommendations were developed on how to promote the consumption energy in a responsible way, promote RES energy, contribute to energy efficiency and steer the grid to become more flexible.

For more details, see the deliverable D 3.4.3 “Discussion meeting with the stakeholders”.

2.2.5 Discussion meetings in Croatia (Preko)

In Croatia three meetings were organised:

- With employees from the Municipality Preko, on 05.06.2019 at Općina Preko
- With the local municipalities on 06.06.2019 in Preko,
- With the regional decision makers on22.05.2019 in Zadar

The theme of the workshops was to inform the local stakeholders with the possibilities of using renewable energy sources through microgrids and the advantages and disadvantages of local energy production. Also, the PEGASUS project and its results were presented to the participants.

For more details, see the deliverable D 3.4.3 “Discussion meeting with the stakeholders”.

2.2.6 Discussion meetings in Malta (MIEMA)

MIEMA organised several meetings with the local stakeholder groups, particular the building owners participating in the pilot in San Lawrenz, representatives of the Ministry for Gozo, the Gozo Regional Committee and meetings with other local councils that can replicate the results of the of pilot study. The bilateral meetings serves to keep all the involved

stakeholders, particular the pilot site owners, updated about the development of the project while at the same obtaining feedback in relation to their experience in the pilot and their perception about the potential of micro-grids within the local scenario.

MIEMA presented the project during a meeting organised by the Regional Committee on the 17th December 2018 which brough together mayors from different localities in Gozo. The main objective of the meeting was to discuss how micro-grids can help to improve the energy situation in the island Gozo while helping to achieve a more reliable energy supply as well as provide economic and environmental benefits.

For more details, see the deliverable D 3.4.3 "Discussion meeting with the stakeholders".

2.3. Working meetings with the Energy Regulators

In the framework of WP3 of the project one working committee meeting per territory with the Energy Regulator was foreseen. The following working committees meetings took place, in which the lists of risks were discussed.

2.3.1 Working committee meeting in Italy (Potenza)

The meeting held on 29th October 2019 with ARERA, the Italian Regulatory Authority for Energy, Networks and Environment (ARERA). Taking into account that the pilot of the Municipality of Potenza, to whose development DeMEPA contributed, complies with the regulation of the Scambio sul posto issued by ARERA and in force for over two years, the meeting instead on the analysis of potential related risks was focused on the future prospects and guidelines of ARERA about this regulation and more generally on the microgrids developed at demonstration level within PEGASUS project.

For more details, see the deliverable D 3.4.4 "Working meeting with Regulator".

2.3.2 Working committee meeting in Greece (CRES)

The meeting took place on Friday 19th of October 2018 at Pikermi at the CRES premises. The objective of the event was to get the latest info from the Greek Energy Regulator (RAE) about what is going on in the field of the microgrids in Greece and the ways to overcome the regulatory and legal constraints. During the event it was also discussed, the risks list of the Greek pilot that CRES had prepared.

For more details, see the deliverable D 3.4.4 "Working meeting with Regulator".

2.3.3 Working committee meeting in France (AURA-EE)

AURA-EE contacted the technical director of the CRE, in October 2018. A phone call was also arranged on October 9th to discuss about the position of energy providers, the choice of TOU tariffs, and the grid fees in the projects.

On the 12th of November 2018, Didier Laffaille was invited to speak on the general issue of renewable energies, storage and smart-grids for the closure event of a local smart-grid project "SMAP" in which AURA-EE was lead partner.

For more details, see the deliverable D 3.4.4 "Working meeting with Regulator".

2.3.4 Working committee meeting in Slovenia (ENERGAP)

The discussions took place on March, April and May of 2019 in Maribor and Ljubljana. The objective of the events (bilateral talks, presentations at the final conference, free discussions) was to present the activities and results of pilot project in Slovenia and wider in PEGASUS and get the latest info what is going on in the field of micro-grids in Slovenia and how to foster the electricity market to be prepared for prosumers.

For more details, see the deliverable D 3.4.4 “Working meeting with Regulator”.

2.3.5 Working committee meeting in Cypruss (UCY-FOSS)

The event took place on 17/10/2019 in Nicosia. FOSS team had the opportunity to inform energy regulators of the Mediterranean area about the PEGASUS project and the results of the FOSS microgrid pilot. The risks associated with the Microgrid Pilot of the University of Cyprus were also discussed and with the Cypriot Energy Regulator during this workshop. And some recommendations were developed.

For more details, see the deliverable D 3.4.4 “Working meeting with Regulator”.

2.3.6 Working committee meeting in Malta (MIEMA)

A meeting with the regulator/national agency responsible for energy was held on the 6th June 2019 in the framework of National Roundtable on Financing Energy Efficiency in Malta. MIEMA presented the work being carried out through PEGASUS and presented the results achieve on both a local and partnership level. Challenges related to the deployment of micro-grids in Malta were also discussed, included lack of necessary infrastructure, the present electricity tariff system, size of the municipalities and lack of legal framework.

For more details, see the deliverable D 3.4.4 “Working meeting with Regulator”.

3. The microgrid risk model

Risk management is an important function in organizations today. As microgrids are increasingly complex and ambitious projects, and they must be installed and operate successfully, in an uncertain and often risky environment. It is necessary to be aware of these risks. But to try to address each and every risk that a project might face can be much too expensive, both in time and resources. Instead, there is a need to prioritize risks. If this can be done effectively, we can focus the majority of the time and effort on the most important risks.

A useful framework that helps to decide which risks need attention is provided by the Risk Impact / Probability Chart. This is based on the principle that a risk has two primary dimensions:

- ***Probability*** *– A risk is an event that "may" occur. The probability of it occurring can range anywhere from just above 0 percent to just below 100 percent. (It can't be exactly 100*

percent, because then it would be a certainty, not a risk. And it can't be exactly 0 percent, or it wouldn't be a risk.)

- ***Impact*** *– A risk, by its very nature, always has a negative impact. However, the size of the impact varies in terms of cost and impact on health, human life, or some other critical factor.*

The chart allows to rate potential risks on these two dimensions. The probability that a risk will occur is represented on one axis of the chart, and the impact of the risk, if it occurs, on the other.

In order to prepare the Risk Impact / Probability Chart the steps that were followed are:

CRES gathered all the lists from the partners of the likely risks that their microgrid projects seem to face. CRES experts then combined them and assessed the probability of each risk occurring, and assigned it a rating (see Table 1: List of risks for the microgrids).

A scale of 1 to 4 was used. Assigning a score of 1 when a risk is extremely unlikely to occur, and use a score of 4 when the risk is extremely likely to occur and assigned a 1 for low impact and a 4 for a critical / catastrophic impact. With all these data the ratings on the Risk Impact/Probability Chart were drew (see Table 2: Risk Impact/Probability Chart for a microgrid).

The corners of the chart have the following characteristics:

- *Low impact/low probability – Risks in the bottom left corner are low level, and they can often be ignored.*
- *Low impact/high probability – Risks in the top left corner are of moderate importance – if these things happen, they can be coped. However, it should be tried to reduce the likelihood that they'll occur.*
- *High impact/low probability – Risks in the bottom right corner are of high importance if they do occur, but they're very unlikely to happen. For these, however, you should do what you can to reduce the impact they'll have if they do occur, and you should have contingency plans in place just in case they do.*
- *High impact/high probability – Risks towards the top right corner are of critical importance. These are the top priorities, and are risks that are necessary to pay close attention to.*

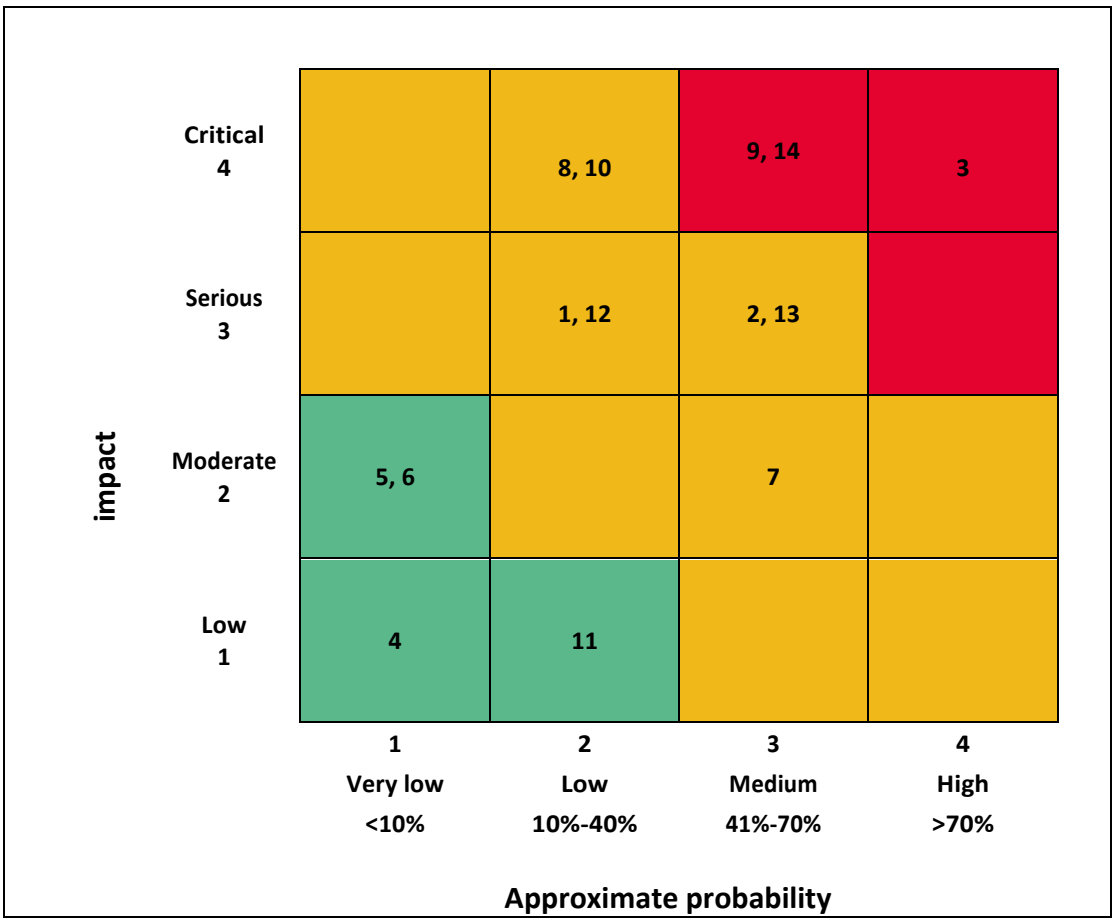
For a successfully implementation of a microgrid project, there must be a focus attention on the middle and high-priority risks – otherwise there is the risk of spreading efforts too thinly, that will lead to waste resources on unnecessary risk management.

Table 1: List of risks for the microgrids

No	Risk Description	Impact of Risk • Low • Moderate • Serious • Critical	Probability of Occurrence • Very low <10% • Low 10%-40% • Medium 41%-70% • High>70%
1	**Low adoption of micro-grid from household customer** This risk corresponds to the potential overestimation of the number of customers that will be connected compared to actual results, as it is difficult to estimate the potential adoption of a new service such as electricity. The associated revenues are therefore reduced.	**Serious**	**Low**
2	**Low demand from household customers** it is commonly seen that "customers tend to overestimate how much electricity they need" resulting in an actual consumption that is lower than expected. The fact that households will "climb the energy ladder" progressively should be expected, with limited consumption in the first months/years (light, mobile charging).	**Serious**	**Medium**
3	**Low adoption from productive users** for productive users, the adoption of electrical appliances can be uncertain due to limited equipment information (price, benefits) and limited investment capacity.	**Critical**	**High**
4	**Customer payment delay and default** revenue collection has been often highlighted as one of the main issues in microgrid operations as it can require a significant workforce and potentially lead to customer default	**Low**	**Low**
5	**Electricity theft** electricity theft can occur in a rural micro- grid through a direct link to distribution lines. In addition to unpaid electricity, risks include safety issues related to uncontrolled wiring, damages to the distribution lines, uncontrolled consumption leading to battery damage, etc.	**Moderate**	**Very low**
6	**Cyber security** Microgrids share a growing operational risk exposure to cyber-attacks. The integration of legacy and new technology systems that are commonly joined as microgrids makes this risk exposure a growing concern that needs to be addressed in the overall microgrid performance risk modelling.	**Moderate**	**Very low**
7	**Default payment of customers**	**Moderate**	**Medium**
8	**Increased capital expenditure (i.e., delays in construction, legal costs, etc.)** Cost overruns during the construction phase may seriously over-extend an investor financially, to the point where the project may not be finished to the expected standards, or may even have to be abandoned.	**Critical**	**Low**
9	**Lack of economic balance**	**Critical**	**Medium**
10	**Lack of funding**	**Critical**	**Low**
11	**Lack of PV production to feed the consumers**	**Low**	**Low**

12	**Low adoption of a small-scale or large-scale micro-grid from potential customers (i.e. public buildings, company offices)** This risk corresponds to the potential overestimation of the number of customers that will be connected compared to actual results, as it is difficult to estimate the potential adoption of a new service such as electricity. The associated revenues are therefore reduced.	**Serious**	**Low**
13	**Non-efficient operation of electricity market**	**Serious**	**Medium**
14	**Regulatory roadblocks for the implementation of a microgrid** In some countries legislature and energy regulatory agency should recognize the benefits of the microgrids and prioritize microgrid expansion by adopting relevant legislation. Moreover, the state could award grants to local public authorities, municipalities or industries for developing and implementing microgrids	**Critical**	**Medium**

Table 2: Risk Impact/Probability Chart for a microgrid



4. Conclusions

Even though microgrids are composed of equipment whose operational and risk exposure characteristics are well understood, the same cannot be assumed for a microgrid system overall. They can cover large areas and require reliable power generation and distribution capabilities under adverse conditions. This geographic diversity can provide unique weather-

and system-related risk exposures – and not just for microgrid activation due to utility power failures, but for sustained island mode operation.

For a specific microgrid in a specific location, performance risk can be quantified with reasonable accuracy. However, in a general analysis we are interested in identifying and estimated the overall importance of different risk drivers.

From the above Risk Impact/Probability Chart we can have a number of key conclusions.

The following 3 risks

- Low adoption from productive users
- Lack of economic balance
- Regulatory roadblocks for the implementation of a microgrid

are the most important risk for a microgrid. These risks towards the top right corner are of critical importance. These are the top priorities, and are risks that are necessary to pay close attention to.

The following 4 risks

- The Customer payment delay and default,
- Electricity theft,
- Cyber security,
- Lack of PV production to feed the consumers

are the 4 less important risk Risks and they can often be ignored.

Annex 1: Indicative list of risks proposed by CRES

No	Risk Description	Impact of Risk • Low • Moderate • Serious • Critical	Probability of Occurrence • Very low <10% • Low 10%-40% • Medium 41%-70%	Mitigation Strategy
1	**Low adoption of micro-grid from household customer** This risk corresponds to the potential overestimation of the number of customers that will be connected compared to actual results, as it is difficult to estimate the potential adoption of a new service such as electricity. The associated revenues are therefore reduced.	**Serious**, as revenues can be significantly reduced but lower than the impact of connecting a "bad" customer consuming very low energy for which expenses are engaged (wiring, meter).	**Low**, as potential customers are very interested in being connected, but they do wait for early adopters' feedback to be confident in the benefits provided by the microgrid.	Realistic evaluation of potential customers as well as pre-construction promotion effort enable to ensure good matching between planned and actual customer number.
2	**Low demand from household customers** it is commonly seen that "customers tend to overestimate how much electricity they need" resulting in an actual consumption that is lower than expected. The fact that households will "climb the energy ladder" progressively should be expected, with limited consumption in the first months/years (light, mobile charging).	**Critical**, as the connection cost engaged is unbalanced with the limited revenues generated.	**High**, as seen in numerous cases of microgrid development, especially during the first months/years of operations	Connecting customers with sufficient demand from the start through realistic evaluation of willingness to pay; focusing commercial efforts on these customers and accelerating the transition toward higher demand for other customers. Partnerships with local shops and MFI can support the acquisition of medium consumption appliances (TV, fridge, fan). Indeed, the ability to get appliances is the main barrier to increased electricity consumption before ability to pay
3	**Low adoption from productive users** for productive users, the adoption of electrical appliances can be uncertain due to limited equipment information (price, benefits) and limited investment capacity.	**Critical**, as productive users are expected to represent a significant share of the consumption, enable to reach higher utilization rate and display high consumption for a single connection (limited cost for high revenues)	**High**, as seen in numerous cases of microgrid development, especially for the mechanization of manual tasks and the development of new activities	address the two bottlenecks for adoption by productive users: lack of capital and lack of information. It is crucial that the project developer (or her partners) provide productive users with the relevant information regarding electrical equipment (potential costs, economic balance, advantages of electrical equipment) to ensure that this aspect is not a limitation. The project owner should also facilitate access to capital for productive users so that they can invest in new equipment.

4	**Customer payment delay and default** revenue collection has been often highlighted as one of the main issues in microgrid operations as it can require a significant workforce and potentially lead to customer default	**moderate** for delayed payment as microgrids are long-term assets but high for default customer	**Medium** for delayed payment and low for customer default when the price was set in accordance with the ability to pay of customers.	Implementation of pay-as-you-go with mobile money solutions solves revenue collection issue as the consumption credits are prepaid
5	**Electricity theft** electricity theft can occur in a rural micro- grid through a direct link to distribution lines. In addition to unpaid electricity, risks include safety issues related to uncontrolled wiring, damages to the distribution lines, uncontrolled consumption leading to battery damage, etc.	**Serious** as the theft causes revenue loss and puts the inhabitants and the asset at risk.	**Very low** as the limited scale of the microgrid makes it easy to control (compared to national grid).	Mitigation strategy: electricity theft can be avoided by community engagement through clear explanations of the price structure (to limit disagreement with the price) and of electricity theft impact on the community. If electricity theft still occurs, it can be detected, either visually or through data monitoring, and acted on.

Annex 2: Final list of risks for the pilot microgrid in Mega Evydrio

No	Risk Description	Impact of Risk • **Low** • **Moderate** • **Serious** • **Critical**	Probability of Occurrence • **Very low <10%** • **Low 10%-40%** • **Medium 41%-70%** • **High>70%**	Mitigation Strategy
1	**Low adoption of micro-grid from household customer** This risk corresponds to the potential overestimation of the number of customers that will be connected compared to actual results, as it is difficult to estimate the potential adoption of a new service such as electricity. The associated revenues are therefore reduced.	**Serious**, as revenues can be significantly reduced but lower than the impact of connecting a "bad" customer consuming very low energy for which expenses are engaged (wiring, meter).	**Low**, as potential customers are very interested in being connected, but they do wait for early adopters' feedback to be confident in the benefits provided by the microgrid.	Realistic evaluation of potential customers as well as pre-construction promotion effort enable to ensure good matching between planned and actual customer number.
2	**Low demand from household customers** it is commonly seen that "customers tend to overestimate how much electricity they need" resulting in an actual consumption that is lower than expected. The fact that households will "climb the energy ladder" progressively should be expected, with limited consumption in the first months/years (light, mobile charging).	**Critical**, as the connection cost engaged is unbalanced with the limited revenues generated.	**High**, as seen in numerous cases of microgrid development, especially during the first months/years of operations	Connecting customers with sufficient demand from the start through realistic evaluation of willingness to pay; focusing commercial efforts on these customers and accelerating the transition toward higher demand for other customers. Partnerships with local shops and MFI can support the acquisition of medium consumption appliances (TV, fridge, fan). Indeed, the ability to get appliances is the main barrier to increased electricity consumption before ability to pay
3	**Low adoption from productive users** for productive users, the adoption of electrical appliances can be uncertain due to limited equipment information (price, benefits) and limited investment capacity.	**Critical**, as productive users are expected to represent a significant share of the consumption, enable to reach higher utilization rate and display high consumption for a single connection (limited cost for high revenues)	**high**, as seen in numerous cases of microgrid development, especially for the mechanization of manual tasks and the development of new activities	address the two bottlenecks for adoption by productive users: lack of capital and lack of information. It is crucial that the project developer (or her partners) provide productive users with the relevant information regarding electrical equipment (potential costs, economic balance, advantages of electrical equipment) to ensure that this aspect is not a limitation. The project owner should also facilitate access to capital for productive users so that they can invest in new equipment.

4	**Customer payment delay and default** revenue collection has been often highlighted as one of the main issues in microgrid operations as it can require a significant workforce and potentially lead to customer default	**moderate** for delayed payment as microgrids are long-term assets but high for default customer	**medium** for delayed payment and low for customer default when the price was set in accordance with the ability to pay of customers.	Implementation of pay-as-you-go with mobile money solutions solves revenue collection issue as the consumption credits are prepaid
5	**Electricity theft** electricity theft can occur in a rural micro- grid through a direct link to distribution lines. In addition to unpaid electricity, risks include safety issues related to uncontrolled wiring, damages to the distribution lines, uncontrolled consumption leading to battery damage, etc.	**Serious** as the theft causes revenue loss and puts the inhabitants and the asset at risk.	**very low** as the limited scale of the microgrid makes it easy to control (compared to national grid).	Mitigation strategy: electricity theft can be avoided by community engagement through clear explanations of the price structure (to limit disagreement with the price) and of electricity theft impact on the community. If electricity theft still occurs, it can be detected, either visually or through data monitoring, and acted on.
6	**Cyber security** Microgrids share a growing operational risk exposure to cyber-attacks. The integration of legacy and new technology systems that are commonly joined as microgrids makes this risk exposure a growing concern that needs to be addressed in the overall microgrid performance risk modeling.	**moderate** as the cyber-attacks revenue loss and puts the inhabitants and the asset at risk.	**very low** as the limited scale of the microgrid makes it easy to control (compared to national grid).	Financial plans and budgets should include funds for sustaining the overall quality of the security services expected to meet the business requirements of the microgrid. Instruct personnel how to recognize and respond to security attacks. Typically, the staff to be hired and trained should have experience with control systems engineering and security, smart grid engineering and security, integration projects and proprietary energy system protocols and systems

Annex 3: Final list of risks for the pilot microgrid in Saint-Julien-en-Quint

No	Risk Description	Impact of Risk • Low • Moderate • Serious • Critical	Probability of Occurrence • Very low <10% • Low 10%-40% • Medium 41%-70% • High>70%	Mitigation Strategy
1	**Low number of consumers involved in the microgrid**	**SERIOUS**	**MEDIUM**	The village is small and the regulation requires that the microgrid can only concern one transformer HV/LV, which limits the number of consumers to involve. To avoid missing too many consumers, a reinforced communication has been developed locally so that people could get closely aware of the project and better stick to its objectives. The questionnaire gave very positive feedbacks regarding the motivation of the consumers. Moreover, during the summer 2019 a new law was published in France and introduced the possibility to extend the perimeter to a range of 1km. This is not very significant for St Julien since it is a rural area, but the local policy makers decided to meet the government with the support of a local deputy to make this regulation evolve. The idea is to enable in rural areas, the perimeter of collective self-consumption to be larger than 1 km. This meeting with the Ministry took place on September 2019, 11th. If it accepted, the proposal will provide more flexibility to find consumers for the microgrid
2	**Low demand from household customers**	**SERIOUS**	**LOW**	A variation of the load demand could lead to unbalance the sizing of the microgrid. Nevertheless, the technical study which was done within PEGASUS showed that we could also include some load control of the hot water tanks to improve the global self-consumption rate, so it could still be a solution if consumptions decrease. What's more, for the same reason as in risk n°1, some efforts have been made to facilitate the inclusion of new consumers in the project, so that a drop of the demand could be compensated more easily.

3	**Lack of PV production to feed the consumers**	**LOW**	**LOW**	If many consumers get involved on the project, it will be necessary to have a well-sized PV plant. The CBA led in PEGASUS showed that 36 kWp were 5% self-consumption rate with 33 consumers. Since the project is based in a small rural village, there are not so many large roofs that can be equipped. Actually the roof which had been selected for the microgrid project finally was abandoned since the frame of the building was not strong enough to bear the PV modules. Hence, the local company searched for another roof, and found one on a farmer's house. The PV potential is a bit lower (31 kWp) but should be enough.
4	**Lack of funding**	**CRITICAL**	**LOW**	The producer is a local cooperative, whose shareholders are mainly citizens. Thus, making the equity grow is not so easy, it takes time and the legislation also gives a very strict framework to fundraising based on citizens' contributions. A solution which was implemented was to apply for subsidy calls so that some funding could increase the company's equity. Besides, since this is a very recent model, some risk was identified as regards the bank loan: actually, the revenues highly depend from people's behaviour (and not on a feed-in tariff, as in the previous models), so the bank might ask for additional guarantees on the loan. The solution which was found is to propose to the bank a global project, including 5 PV plants, where 4 plants are selling electricity to the grid through a feed-in tariff and only the fifth one is devoted to the microgrid. This has been accepted.
5	**Lack of economic balance**	**CRITICAL**	**MEDIUM**	As regards the business model, the CBA showed that it was very weak and dependant from public support. Thus, some subsidy was asked and obtained from the Regional council and to a local LEADER program.
6	**Default payment of customers**	**MODERATE**	**MEDIUM**	This risk will have to be treated within the agreement which will be signed between the consumers and the producers, as well as in the statutes of the moral body which links consumers and producers together (in this case, the moral body is the cooperative local company). Rules will have to be defined to state in what cases the electricity contract can be interrupted.

Annex 4: Final list of risks for the pilot microgrid in Sport Park RUŠE

No	Risk Description	Impact of Risk • Low • Moderate • Serious • Critical	Probability of Occurrence • Very low <10% • Low 10%-40% • Medium 41%-70% • High>70%	Mitigation Strategy
1	**Low adoption of micro-grid from household customer** This risk corresponds to the potential overestimation of the number of customers that will be connected compared to actual results, as it is difficult to estimate the potential adoption of a new service such as electricity. The associated revenues are therefore reduced.	**SERIOUS** People do not understand well the system and do not trust; the price of electricity is still very low and payback periods are long; people do save the electricity and with lower use the financial calculation are not good	**MEDIUM**	Realistic evaluation of potential customers as well as pre-construction promotion effort enable to ensure good matching between planned and actual customer number.
2	**Low demand from household customers** it is commonly seen that "customers tend to overestimate how much electricity they need" resulting in an actual consumption that is lower than expected. The fact that households will "climb the energy ladder" progressively should be expected, with limited consumption in the first months/years (light, mobile charging).	**CRITICAL** as the connection cost engaged is unbalanced with the limited revenues generated.	**HIGH** as seen in numerous cases of microgrid development, especially during the first months/years of operations	Connecting customers with sufficient demand from the start through realistic evaluation of willingness to pay; focusing commercial efforts on these customers and accelerating the transition toward higher demand for other customers. Partnerships with some specific users (as swimming pool, sport halls, schools,…) where the electricity use is quite constant it can have a good influence to other users
3	**Low adoption from productive users** for productive users, the adoption of electrical appliances can be uncertain due to limited equipment information (price, benefits) and limited investment capacity.	**CRITICAL** as productive users are expected to represent a significant share of the consumption, enable to reach higher utilization rate and display high consumption for a single connection (limited cost for high revenues)	**HIGH** as seen in numerous cases of microgrid development, especially for the mechanization of manual tasks and the development of new activities	address the two bottlenecks for adoption by productive users: lack of capital and lack of information. It is crucial that the project developer (or its partners) provide productive users with the relevant information regarding electrical equipment (potential costs, economic balance, advantages of electrical equipment) to ensure that this aspect is not a limitation. The project owner should also facilitate access to capital for productive users so that they can invest in new equipment.

4	**Customer payment delay and default** revenue collection has been often highlighted as one of the main issues in microgrid operations as it can require a significant workforce and potentially lead to customer default	**LOW** Because the customer could be switch off	**VERY LOW** when the price was transparently calculatetd and showed to the customers.	Implementation of pay-as-you-go with mobile money solutions solves revenue collection issue, as the consumption credits are prepaid. The price has to be calculated transparent with different scenarios in advance and discussed with customers
5	**Electricity theft** electricity theft can occur in a rural micro- grid through a direct link to distribution lines. In addition to unpaid electricity, risks include safety issues related to uncontrolled wiring, damages to the distribution lines, uncontrolled consumption leading to battery damage, etc.	**LOW** as the theft causes revenue loss and puts the inhabitants and the asset at risk.	**VERY LOW** as the limited scale of the microgrid makes it easy to control (compared to national grid).	electricity theft can be avoided by community engagement through clear explanations of the price structure (to limit disagreement with the price) and of electricity theft impact on the community. If electricity theft still occurs, it can be detected, either visually or through data monitoring, and acted on.

Annex 5: Final list of risks for the pilot microgrid in the University of Cyprus

No	Risk Description	Impact of Risk • Low • Moderate • Serious • Critical	Probability of Occurrence • Very low <10% • Low 10%-40% • Medium 41%-70% • High>70%	Mitigation Strategy
1	**Low adoption of a small-scale or large-scale micro-grid from potential customers (i.e. public buildings, company offices)** This risk corresponds to the potential overestimation of the number of customers that will be connected compared to actual results, as it is difficult to estimate the potential adoption of a new service such as electricity. The associated revenues are therefore reduced.	**Serious**, as revenues can be significantly reduced if the pool of customers is misinterpreted	**Low**, as potential customers are very interested in being connected, but they do wait for early adopters' feedback to be confident in the benefits provided by microgrids.	Realistic evaluation of potential customers as well as pre-construction promotion effort enable to ensure good matching between planned and actual customer number.
2	**Increased capital expenditure (i.e., delays in construction, legal costs, etc.);** Cost overruns during the construction phase may seriously over-extend an investor financially, to the point where the project may not be finished to the expected standards, or may even have to be abandoned.	**Critical**, as the investment can be abandoned if there is no benefit for the microgrid operation. Cost overruns reduce the effectiveness of investments and require additional finance to be raised, while poor cost performance reduces or eliminates profit margins	**Low**, as seen in numerous cases of microgrid development, due to the proper estimation of costs, as well as risks, involved with a microgrid project	Realistic and effective plan for the microgrid construction phase, which recognises potential problems and risks and ensures the ability to effectively manage them. The plan should address the two bottlenecks for adoption of microgrids: lack of capital and lack of information. It is crucial that the project developer (or her partners) provides all relevant information regarding electrical equipment (potential costs, economic balance, advantages of electrical equipment) to ensure that this aspect is not a limitation.
3	**Regulatory roadblocks for the implementation of a microgrid** The Cyprus legislature and energy regulatory agency should recognize the benefits of the microgrids and prioritize microgrid expansion by adopting relevant legislation. Moreover, the state could award grants to local public authorities, municipalities or industries for developing and implementing microgrids	**Critical**, as, the Cyprus Electricity Laws and the current state electric rules, despite support for microgrids, are preventing their widespread deployment and need to be changed	**Medium**, as the EU has agreed a comprehensive update of its energy policy framework to facilitate the transition towards cleaner energy (Winter Package), which envisions the implementation of energy communities and could be updated to include a wider microgrid adoption	State officials, regulators and utilities could resolve some barriers to wider microgrid adoption. Lawmakers and public service commissions will need to realign their energy laws and regulations to enable the adoption of clean-tech microgrids. For example, to make a private microgrid financeable, the developers will need to know approximately how many microgrid or energy community projects can be connected to the grid
4	**Non-efficient operation of electricity market**	**Serious,** as there is no liberated electricity market operating in Cyprus right now	**Medium,** as the operation of the liberated electricity market in Cyprus, which was scheduled for July 2019, has already been postponed for July 2021	Realistic evaluation of the date of operation of the liberated electricity market, by processing all involved complexities