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SERENDI PV

D6.2 Summary of economic and legal constraints and opportunities for high profitability of PV

T6.2 Economic and legal constraints and opportunities for high profitability of PV

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Summary

The present deliverable is the final report for the Task 6.2, which provides a baseline for the other tasks in relation to grid integration of PV in the project. Therefore, analyses of the situation in several EU-countries (i.e., Austria, Belgium, France, Germany, Italy, Poland, the Netherlands, Slovakia, and Spain), based on the state of the art, were conducted in this deliverable. The analyses are mainly related to the **economic and legal limitations** as well as **suggestions** (such as procedure easing, new business models, etc) that may help accelerate the deployment of PV installations.

This document is initiated by BI as the Task Leader, who had insight on the Belgium case, then the inputs were collected from the other partners in the Task considering their countries. The deliverable is produced in the project timeframe from M06 to M18.

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1 EXECUTIVE SUMMARY

1.1 Description of the deliverable content and purpose

This report provides an analysis of **economical and legal constraints** for the optimal profitability of solar PV systems. These restrictions are for instance measures preventing PV systems from participating in electricity markets, leading to a lack of business models applicable to solar PV, with or without storage. These barriers have been inventoried and characterized for the Member States analysed (i.e. Austria, Belgium, France, Germany, Italy, Poland, the Netherlands, Slovakia and Spain).

Facilitating factors such as economic support schemes or supportive legal frameworks, which allow an ease of the deployment of PV systems, have also been evaluated. They are defined as **opportunities or recommendations**, depending on whether they are already implemented or whether they should be put in place to smooth the deployment of PV systems and/or their management.

Country factsheets provide a summary of constraints faced during the national deployment of PV systems, supported by an overview table showing the evaluation of each combination of steps and parameters. The full picture including the elements impacting (negatively or positively) the ease of deployment of PV systems is also included.

Finally, to further characterise these potentially faced constraints, comments are provided to describe the causes of these issues (such as delays, extra cost, etc). In addition, comments concerning potential opportunities and recommendations to overcome the identified obstacles are also made. The opportunities can be defined as elements already present in this specific country, that could accelerate the deployment of PV installations. Recommendations are quite like opportunities but are suggested elements that are not yet present in the country and may help accelerate the development of solar PV projects.

Eventually, through this identification of existing opportunities as well as the recommendations, this report suggests how to overcome or ease the identified barriers and what new business models could emerge, should these barriers be lifted. These business models, which can be country-specific, encompass PPA, energy market integration as well as self-consumption-based schemes or P2P solutions, among others.

1.2 Reference material

N/A

1.3 Relation with other activities in the project

This task T6.2 is a continuation of T6.1 which itself follows the work done in WP1.

The research for Task 6.2 was carried out in parallel with Task 1.3. Many of the findings were used in both, such as regulations in place in some countries, accessible business models, etc.

1.4 Abbreviation list

Table 1.1: Abbreviation list

Abbreviation	Meaning
agriPV	Agrivoltaic
BAPV	Building Applied Photovoltaic / Building Attached Photovoltaic
BIPV	Building Integrated Photovoltaic
BTM	Behind-The-Meter storage system
CAPEX	Capital Expenditure
CfD	Contract for Difference
CRE	French Energy Regulation Commission
DSO	Distribution System Operator
EEG	German Renewable Energy Sources Act
EIA	Environmental Impact Assessment
EMS	Energy Management System
GC	Green Certificates
GO	Guarantee of Origin
GSE	Energy service system operator in Italy
ISDE	Sustainable energy investment subsidy in the Netherlands
LSP	Local Spatial Plan
OKTE	Short-term electricity market operator in Slovakia (subsidiary of TSO)
P2P	Peer to Peer
PPA	Power Purchase Agreement
PV	Photovoltaic
REE	Red Eléctrica de España, TSO of Spain
RONI	Regulator of Network Industries
SCE	Cooperative Energy Generation Subsidy Scheme in the Netherlands
SDE++	"Subsidy sustainable energy production and climate transition" in the Netherlands
SPV	Special-purpose vehicle
TOR	Technical and Organisational Rules
TSO	Transmission System Operator
VAT	Value Added Tax
WEEE	Waste Electrical and Electronic Equipment Directive

2 INTRODUCTION

2.1 Objective

This report aims at analysing **economical and legal constraints** for an optimal profitability of solar PV systems. These constraints, or barriers, are for instance measures preventing PV systems from participating in electricity markets, which leads to a lack of business models applicable to solar PV, both with and without storage. These barriers will be inventoried and characterized, for each country analysed.

On the other hand, facilitating factors such as economic support schemes or supportive legal frameworks which allow an ease of the deployment of PV systems, will also be analysed. They will be defined as opportunities or recommendations, depending respectively if these frameworks are already in place or should be in place to ease the deployment of PV systems or their management.

Eventually, through this identification of existing opportunities as well as the recommendations, this report will suggest how to overcome or ease the identified barriers and what new business models could emerge, should these barriers be lifted. These business models, which can be country-specific, encompass PPA, energy market integration as well as self-consumption-based schemes or P2P solutions, among others

2.2 Boundary conditions

The scope of this report is limited by **geographical zones and time horizon**. The time horizon is around 2021-2022, including then recent measures adopted in 2022. Concerning the geographical zone considered, it is limited to the list of countries below:

- Austria
- Belgium
- France
- Germany
- Italy
- Poland
- Slovakia
- Spain
- The Netherlands

Note that the PV installations analysed are both **ground-mounted installations and rooftop systems** since both types of installations are facing specific issues. In addition, it is noteworthy that some countries distinguish between residential rooftop systems (typically up to 10 to 30 kWp), commercial rooftop systems (typically 30 to 500 kWp, sometimes even more) and industrial rooftop systems (typically larger than 1000 kWp). This country-specific distinction can be based on the business models even though it is still often closely tied to the installed capacity-based definition.

2.3 Methodology

First, an inventory of **economic and legal constraints and opportunities** for the market integration of PV has been performed, based on a literature review. Then, a qualitative assessment of these constraints and opportunities has been achieved thanks to validation/complementation among SERENDI PV partners. Based on results obtained in this analysis, templates for each studied country have been defined.

To proceed to the analysis, the PV system's deployment process has been split into its main steps, from its commissioning to its decommissioning. These are detailed here below.

a) Commissioning steps are listed and explained as follows:

- **Site selection**: Going from the search for an allowed location (lands, rooftops, etc) to the validation of this location
- **Electricity production license**: Permits allowing to generate and/or store electricity
- **Administrative authorization**: Permits required from local/national authorities (environmental assessments, building permits, etc)
- **Technical authorization**: Permits required from grid operators (grid connection permits, grid code compliance (tests, datasheets, etc.))
- **Legal & fiscal obligation**: Every legal & fiscal obligation such as taxes but also for instance some countries, for each PV plant (of a certain size) it is necessary to create an associated company, potentially leading to additional complexity and/or cost
- **Access to business models**: Depending on the size of the PV plant, access to a remuneration for the generated electricity can be simple or complex.

b) Operation step is explained as follows:

- **Monitoring/maintenance**: During the operational life of the PV plant, the monitoring/maintenance activities can be self-managed or managed with the help of intermediaries, potentially leading to additional complexity and/or cost.

c) Decommissioning step is explained as follows:

- **Disposal/recycling**: In some countries, disposal or recycling is managed by a third party which enables a reduced responsibility for the PV plant owner, possibly even leading to economic benefits.

To conduct a qualitative assessment of the overall economic/legal situation, each step listed here above has then been evaluated according to different parameters:

- ***Duration***: Process' timing (highlighting potential deadlines, frequent delay, etc)
- ***Intermediaries***: Number of potential intermediaries along the process
- ***Risk of extra costs***: Process' extra cost (e.g., extra costs can be due to delays or intermediaries)
- ***Digitalization***: Process' can be done online (e.g., completely, partially, not at all)
- ***Intelligibility***: (Un)clear guidelines/framework along the process
- ***Transparency***: Explicit information/data for every stakeholder along the process

For each of these parameters, an impact scale is defined, as shown on the table below.

Parameters	**Evaluation Impact Scale**		
	Low	**Medium**	**High**
Duration	Less than 3 months	3 months – 1 year	More than 1 year
Intermediaries	0-1 intermediary	2 intermediaries	3+ intermediaries
Digitalization	Fully online	Some steps online	Non-digitalized
Intelligibility	Clear guidelines	Some unclear guidelines	Unclear guidelines
Transparency	Explicit information	Partial transparency	Non-transparent
Risk of extra costs	None	Medium risks of extra costs*	High risks of extra costs
Overall appreciation	**No barrier identified****	**Small barriers identified**	**Crucial barriers identified**

*High probability of low extra costs or low probability of high extra costs

**Including also "not applicable" steps resulting trivially in no barrier

In the end, based on this assessment, an overall appreciation of the legal and economic situation of each step is conducted, allowing to identify the most constrained ones. The evaluation of the criticality of these constraints, for each combination of step and parameter, is summarised with a colour code:

- Low: Green
- Medium: Yellow
- High: Red
- Not enough information: Grey

Thanks to literature research and feedbacks/inputs from the partners, 9 country factsheets are elaborated. As some information comes from partners, it should be treated with caution. Some information reflects the views only of the authors/contributors. Each country factsheet will present a summary of faced constraints during the deployment of PV systems in the specific country. This will be supported by a complete table which evaluate each combination of steps and parameters. On the second page of each country factsheet, a complete overview of elements impacting (negatively or positively) the ease of deployment of PV systems.

Finally, to further characterise these potentially faced constraints, comments are provided to describe the causes of these issues (such as delays, extra cost, etc). In addition, comments concerning potential opportunities and recommendations to overcome the identified obstacles are also made. The opportunities can be defined as elements already present in this specific country, that could accelerate the deployment of PV installations. Recommendations are quite like opportunities but are suggested elements that are not yet present in the country and may help accelerate the development of solar PV projects.

3 COUNTRY FACTSHEETS

3.1 Austria – Ground-mounted PV

Currently, in Austria, the deployment of ground-mounted PV installations is facing multiple obstacles. Commissioning steps (such as site selection, electricity production license, administrative authorization) meet many minor constraints. Moreover, technical authorization's step is facing major constraints. These constraints could occasionally result in delay of few months depending on potential extended duration of the different steps.

Indeed, due to many land-use conflicts during the ***site selection***, this step could take longer than expected. In addition, non-simplified procedures and non-digitalized mapping for eligible land make this site selection step facing even more issues.

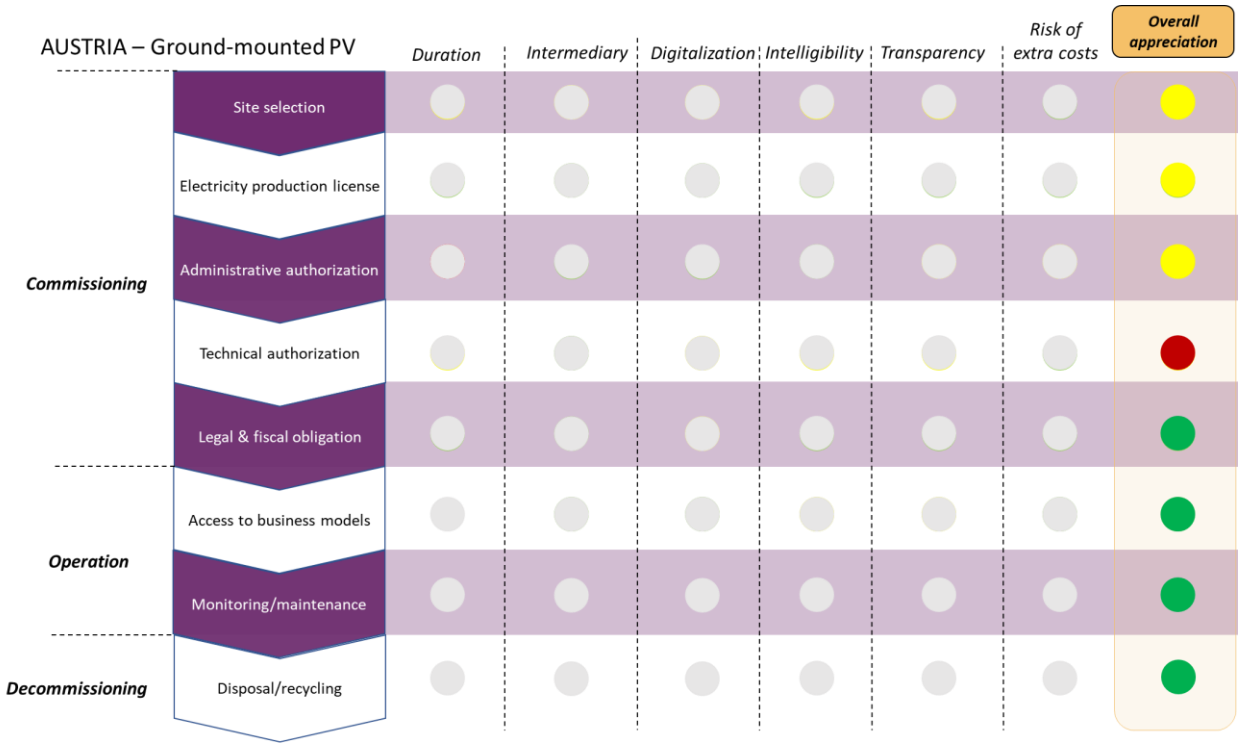
Concerning ***electricity production licensing***, the multiplicity of procedures can generate delays.

Similarly for ***administrative authorization***, multiple procedures make this step sometimes delayed. In addition, these procedures are depending on federal states, resulting in a completely inconsistent and unclear application system across the country.

Regarding the ***technical authorization*** step serious issues exist as well. First, significant delays are often faced during the acquisition of the grid connection permit. Moreover, other issues can be cited, such as a lack of transparency of information, the limitation of the capacity of the grid, the limitation of the power that can be fed-in as well as unclear guidelines. All in all, these constraints make this step a serious impediment to the deployment of ground-mounted PV systems in Austria.

Finally, about the ***access to business models***, no major obstacle exists, as investment aid or tenders are easily accessible. This results in a step without constraints. Nevertheless, it is noteworthy that few provinces have their own PV support schemes, impacting slightly the intelligibility of this step.

Table 3.1: Detailed evaluation of ground-mounted PV systems deployment in Austria



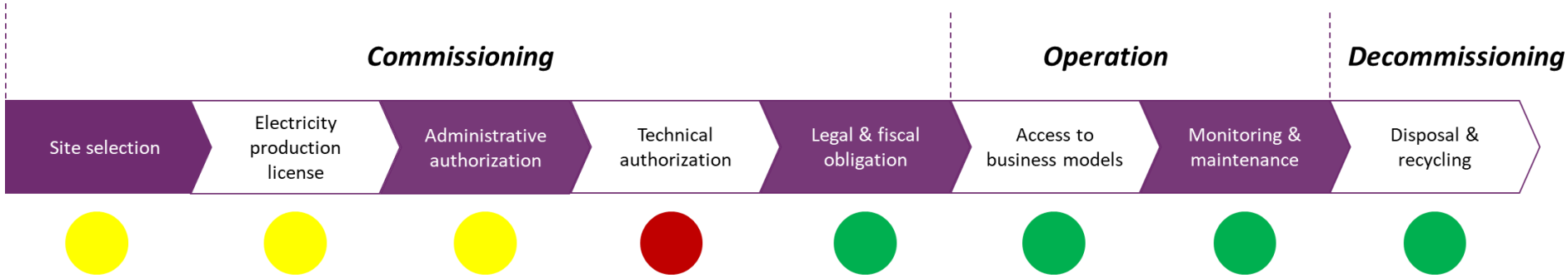


Table 3.2: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted system in Austria

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that can be highlighted as they help accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• Agriculture and ground-mounted PV installations are conflicting usages of available land surfaces. Also, the compatibility between eligible land and local development perspectives/zoning plans is difficult. • Larger installations (>3 000 m²) require a specific site selection in the local development concept and a designation in the zoning plan.	-	*Addressed to national/regional/local authorities:* • Rising the capacity limit for the obligation of a spatial planning procedure. • Simplified administrative procedure. • Digitalized map for eligible land. • Surface optimization: (1) favour ground-mounted PV installations on uncultivated, abandoned, or degraded land and (2) develop agriPV.
Electricity production license	Multiplication of different procedures, which brings delays.	Risen capacity limit for the obligation to apply for an electricity production license (raised to 500 kW).	*Addressed to national/regional/local authorities:* • Simplified, centralized, unique procedure. • Reduce maximum delays of issuance

Administrative authorization	Inconsistent and unclear application system. Multiplication of procedures with no standardized forms and structured differently depending on the federal states.	-	*Addressed to national/regional/local authorities:* • Reduce procedures' complexity and the number of steps through simplified procedures (jointly with an increase of the capacity limit allowing to access these simplified procedures). • Standardized forms. • Code of conduct[1] for administrative application to reduce rejected projects and complexity of procedures.
Technical authorization	• Delays in the grid connection process and high workload for grid operators' staff. • Maximum grid capacity has almost been reached. • Grid capacity is insufficient. • No/limited information on alternative connection points. (In some areas, the network operator does not disclose information about an optional low-power connection point that the network could provide. As a result, the applicant must attempt again with a lower system power and wait for approval.) • Feed-in power for larger installations is limited. (Grid operators are not particularly	-	*Addressed to grid operators:* • Grid operators' staff training and hiring. • Digitalized map of alternative connection point. • Rising limitation of the feed-in power for larger plants. • Public and commonly agreed interpretation of the TOR by local grid operators.

[1] Guidelines to follow, not compulsory but which substantially increase the chance of obtaining licenses or permits

	willing to expand the grid and therefore try to find ways to limit the feed-in power). • Different interpretation of the TOR ("Technical and organizational rules") by local grid operators.		
Legal & fiscal obligation	-	-	-
Access to business models	No incentive for ground-mounted systems below 200 kWp.	• Federal investment supporting schemes (Feed-in tariff, for systems between 200 and 500 kWp). • Supported with up to 250€ per kWp (for electricity storage with 200€ per kWh). • Trends organised by governments	-
Monitoring / Maintenance	-	-	-
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • Organizations exist such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. However, their activities in Austria are still limited.		*Addressed to organizations:* • Expand organization recycling activities (local collection and recycling).

3.2 Austria – Rooftop PV

Currently, in Austria, the deployment of rooftop PV installations is facing a few obstacles. Commissioning steps such as “administrative authorization” meet various minor constraints, while “technical authorization” is facing major constraints.

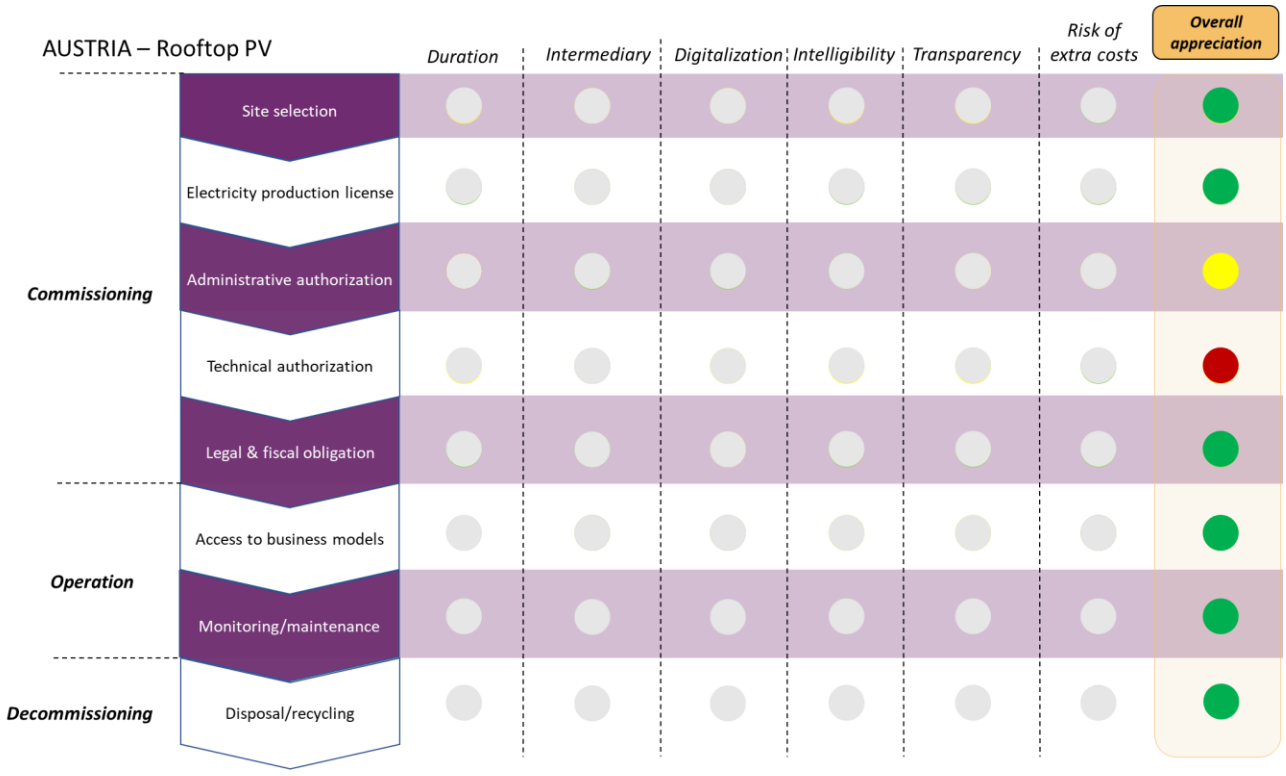
Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV systems.

For ***administrative authorization***, multiple procedures make this step sometimes delayed. In addition, these procedures are depending on federal states, resulting in a completely inconsistent and unclear application system across the country.

Regarding the ***technical authorization*** step serious issues exist as well. First, significant delays are often faced during the acquisition of the grid connection permission. Moreover, other issues can be cited such as a lack of transparency of information, the limitation of grid capacity, the limitation of the power that can be fed-in as well as unclear guidelines. All in all, these constraints make this step a serious impediment to the deployment of rooftop PV systems in Austria.

Finally, about ***access to business models***, no major obstacle exists, as basic feed-in tariff or investment aid are easily accessible as well as self-consumption scheme. However, these support schemes cannot be combined. In addition, it is noteworthy that few provinces have their own PV support schemes, impacting slightly the intelligibility of this step.

Table 3.3: Detailed evaluation of rooftop PV systems deployment in Austria



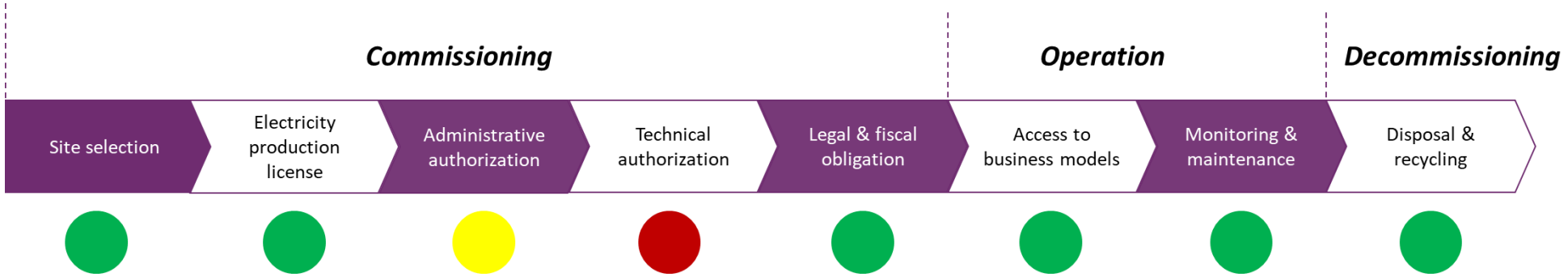


Table 3.4: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Austria

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	• No standardized forms. This affects all authorities and administrative process steps. • Inconsistent and unclear application system. Multiplication of procedure with no standardized forms and structured differently depending on the federal states. • Strict standards and guidelines in building law procedure (High level of detail required).	Notification-free small-scale rooftop PV systems currently running in the province of Carinthia.	*Addressed to national/regional/local authorities:* • Increase the capacity limit to access simplified procedure. • Standardized forms. • Code of conduct for administrative application to reduce rejected projects and complexity of procedures. • All rooftop PV systems should be completely notification-free.

	• Extensive requirements for large plants lead to delay. • Simplified procedure for self-consumption commercial PV installation (typically between 30 and 500 kWp) is perceived as complex, labour-intensive, not efficient.		
Technical authorization	• Delays in the grid connection process and high workload for grid operators' staff. • Grid capacity is insufficient. • Feed-in power for larger installations is limited. (Grid operators are not particularly willing to expand the grid and therefore try to find ways to limit the feed-in power). • No/limited information on alternative connection points. • No existing simplified procedure for connecting small-scale solar PV systems to the electricity grid.	-	*Addressed to national/regional/local authorities:* • Grid operators' staff training and hiring. • Digitalized map of alternative connection point. • Grid expansion suggestion. • Rising limitation of the feed-in power for larger plants. • Put in place simplified procedures.
Legal & fiscal obligation	-	-	-
Access to business models	There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding	• Federal investment supporting schemes (Feed-in tariff). • For systems between 5 and 200 kWp, feed-in-tariff of 7,06 c€/kWh (2020 tariff). • For systems between 200 and 500 kWp, supported with up to 250€ per kWp (for electricity storage with 200€ per kWh).	-

	tariffication) could lead to additional complexities and/or barriers.	• Self-consumption is allowed (Collective self-consumption was introduced in 2017 and mainly dedicated to PV systems on multifamily buildings). • Support level depends on the type of system (BAPV or BIPV). In case of BAPV, depend also in the size of the system.	
Monitoring / Maintenance	-	-	-
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • Organizations exist such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. However, their activities in Austria are still limited.	-	*Addressed to organizations:* • Expand organization recycling activities (local collection and recycling).

3.3 Belgium

3.3.1 Belgium – Brussels – Ground-mounted PV

The Brussels region in Belgium has the particularity of being exclusively an urban region. Therefore, no ground mounted PV installations are foreseen.

3.3.2 Belgium – Brussels – Rooftop PV

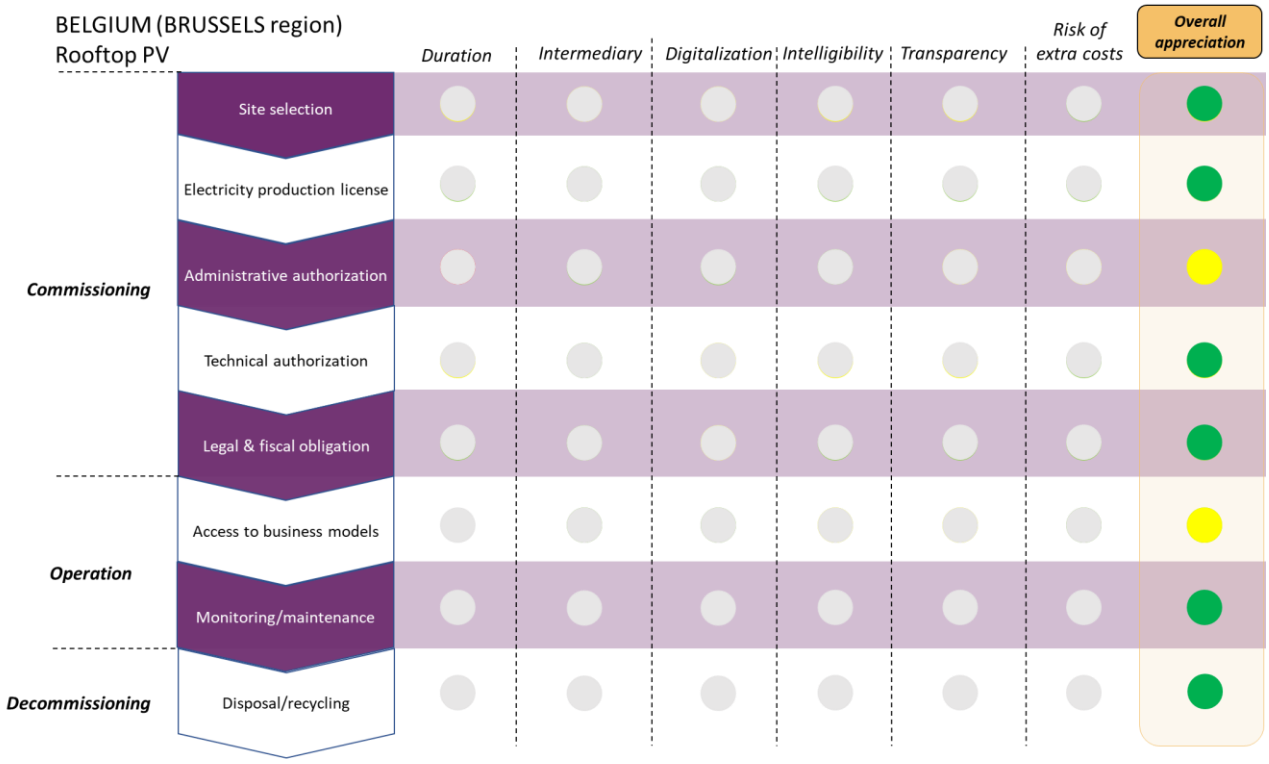
Currently, in Brussels, the deployment of rooftop PV installations is facing minor obstacles. “Administrative authorization” as well as “access to business models” meet some minor constraints.

Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV systems.

For the ***administrative authorization***, exchanges with multiple intermediaries make this step sometimes longer than expected. In addition, authorities are often overwhelmed making this step even more delayed.

Finally, about the ***access to business models***, no major obstacle exists, as adapted green certificates (GC) are easily accessible as well as self-consumption scheme. However, due to booming of PV installations, there is an excess of supply of GC resulting in a lack of demand of these GC. This non-purchase of GC makes this step facing minor constraints.

Table 3.5: Detailed evaluation of rooftop PV systems deployment in Brussels



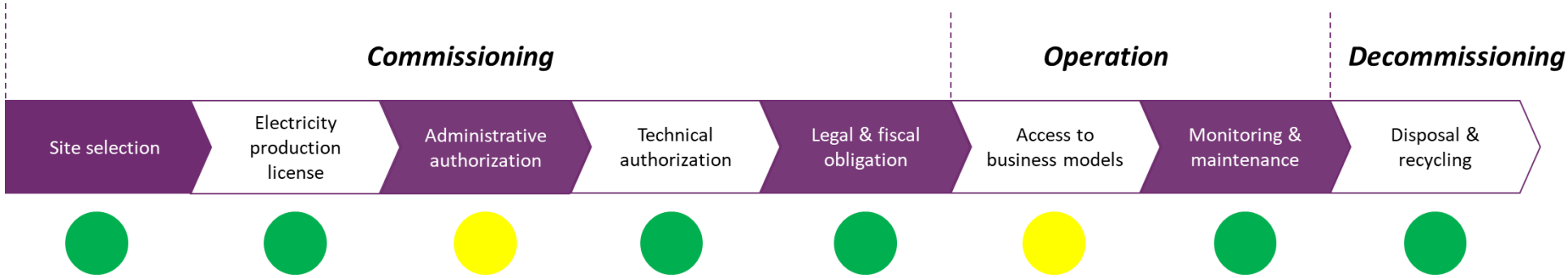


Table 3.6: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Belgium (Brussels region)

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	• If the modules can be seen from a public place and are not installed in the same plane as the roof (especially the case for BIPV installations), they require urbanism permission. This often leads to extra delays/extra costs. • Number of intermediaries slow down the process to obtain required certification. In addition, overwhelmed authorities make this process even slower.	-	*Addressed to national/regional/local authorities:* • The level of green certificates (GC) should be locked at the level it was during the entry period of the required urban permission. *Addressed to grid operators:*

			• Training, hiring staff.
Technical authorization	Cost of main decoupling device need to be taken into account (6000-8000 €).	-	-
Legal & fiscal obligation	-	Tax at 6% (instead of 21%) on buildings (older than 10 years).	-
Access to business models	• Excess electricity produced is no longer applicable to net-metering or feed-in tariff. PV owners/developers must therefore negotiate with a utility the purchase of the excess electricity produced. • Risk of not buying GC. Indeed, due to booming of PV installations, there is an excess of supply of GC resulting in a lack of demand of these GC. • There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.	• Green certificate scheme is applicable (Regulator regularly adapt level of this certificate following the market trends. For instance, on the 1st of January 2022, a decrease of the support level was planned but due to recent increase of components' price, the initially planned decrease has been suspended). • Support level depends on the type of system (BAPV or BIPV) and the size of the system. • Self-consumption is allowed. • For business and professionals, the federal government provides a 13,5% (2022) tax reduction on annual taxable income for energy savings-related investment. • Energy communities can be set up, in single buildings or within a neighbourhood.	*Addressed to national/regional/local authorities:* • Expand possibility of energy sharing schemes.
Monitoring / Maintenance	Not fully automatized transmission of production information.	-	*Addressed to grid operators:* • Fully automatized transmission of production information.
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life.	-

	PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	This free of charge comes from a small prior payment, paid by the end customer.	

3.3.3 Belgium – Flanders – Ground-mounted PV

Currently, in Flanders in Belgium, the deployment of ground-mounted PV installations is facing multiple obstacles. Commissioning steps such as “legal & fiscal obligation” meet various minor constraints, while the “administrative authorization” process is facing major constraints.

Concerning the ***site selection***, even if no standardized procedure exists about environmental permits, no major obstacles are encountered during this step. However, it is difficult to receive a permit for PV installations on agricultural land.

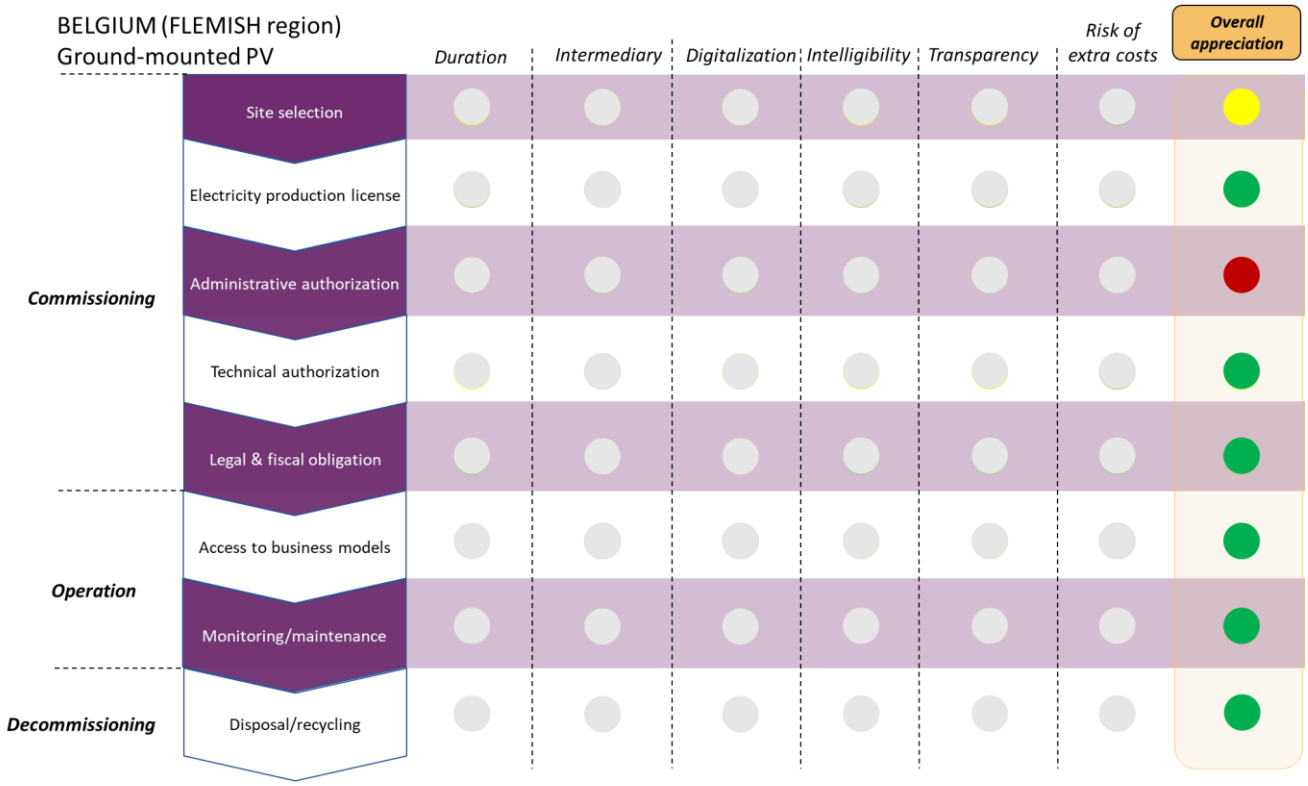
Similarly, for the ***electricity production licensing***, ground-mounted PV systems deployment encountered no obstacles during this step.

While for the ***administrative authorization*** step serious issues exist. In addition to significant delays, other issues can be cited, such as the considerable quantity of appeals as well as an inconsistent actual legal framework. All in all, these constraints make this step a serious impediment to the deployment of ground-mounted PV systems in the Flemish region of Belgium.

Regarding the ***technical authorization***, formalities take place between the DSOs/TSOs and the project developers relatively smoothly, which limits the obstacles that must be delt with. Nevertheless, it is noteworthy that some costs impact slightly the ease of this step.

Finally, about the ***access to business models***, no major obstacle exists, as tenders are easily accessible.

Table 3.7: Detailed evaluation of ground-mounted PV systems deployment in Flanders



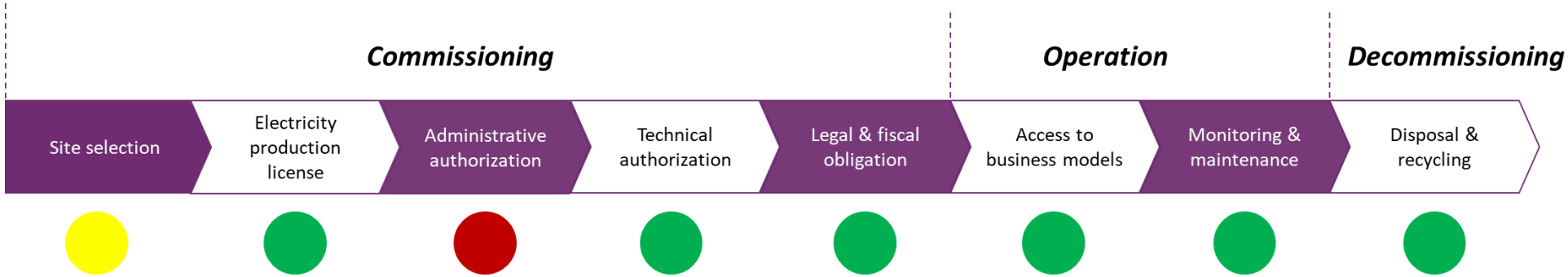


Table 3.8: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in Belgium (Flemish region)

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• Environmental permit required (no standardized procedure exists). • Difficulties to receive a permit for PV installations on agricultural land.	-	*Addressed to national/regional/local authorities:* • Surface optimization: (1) favour ground-mounted PV installations on uncultivated, abandoned, or degraded land and (2) develop agriPV.
Electricity production license	-	-	-
Administrative authorization	• Appeal possibilities: The large number of re-examinations causes significant delays. This can lead to a lot of unplanned expenses for project developers. • Ground-mounted PV installations do not fall under any existing legal framework. Like large	-	*Addressed to national/regional/local authorities:* • Code of conduct for application to reduce appeals quantities.

	rooftop PV systems, they are not popular in Flanders and therefore no new legislation is being passed for them.		• Adapted legal framework for ground-mounted installations.
Technical authorization	-	-	-
Legal & fiscal obligation	-	-	-
Access to business models	-	• Tenders (Green power calls) are organized by governments • Project-specific Green Power Certificates are allocated for ground-mounted systems but only if they are located on roadsides and marginal grounds.	-
Monitoring / Maintenance	-	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	

3.3.4 Belgium – Flanders – Rooftop PV

Currently, in Flanders in Belgium, the deployment of rooftop PV installations is not facing any obstacles.

Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV systems.

About the ***access to business models***, no major obstacle exists, as tenders are easily accessible as well as self-consumption scheme. This results in a step without constraints. Nevertheless, it is noteworthy that few costs impact slightly the ease of this step.

Table 3.9: Detailed evaluation of rooftop PV systems deployment in Flanders

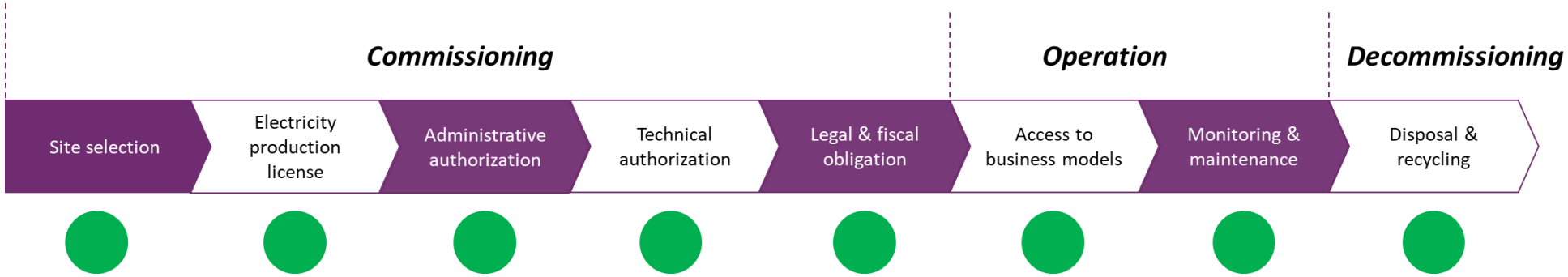


Table 3.10: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Belgium (Flemish region)

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	Large rooftop installations do not fall under any existing legal framework. Like ground-mounted systems, they are not popular in Flanders and therefore no new legislation is being passed for them.	The installation of rooftop PV systems is in the most cases exempt from the requirement to obtain a permit for urban development activities.	*Addressed to national/regional/local authorities:* • Adapted legal framework for large rooftop installations.
Technical authorization	Cost of main decoupling device need to be taken into account (6 000-8 000 €).	-	-

Legal & fiscal obligation	-	Capacity-based fee (called "prosumer tariff") is no longer applicable since it was linked to net-metering	-
Access to business models	• Excess electricity produced is no longer applicable to net-metering or feed-in tariff. PV owners/developers must therefore plan with the utility to purchase the excess electricity produced. • There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.	• Tenders (Green power calls) are organized by governments. • Savings on the electricity bill thanks to self-consumption. • For business and professionals, the federal government provides a 13,5% (2022) tax reduction on annual taxable income for energy savings-related investment.	-
Monitoring / Maintenance	-	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

3.3.5 Belgium – Wallonia – Ground-mounted PV

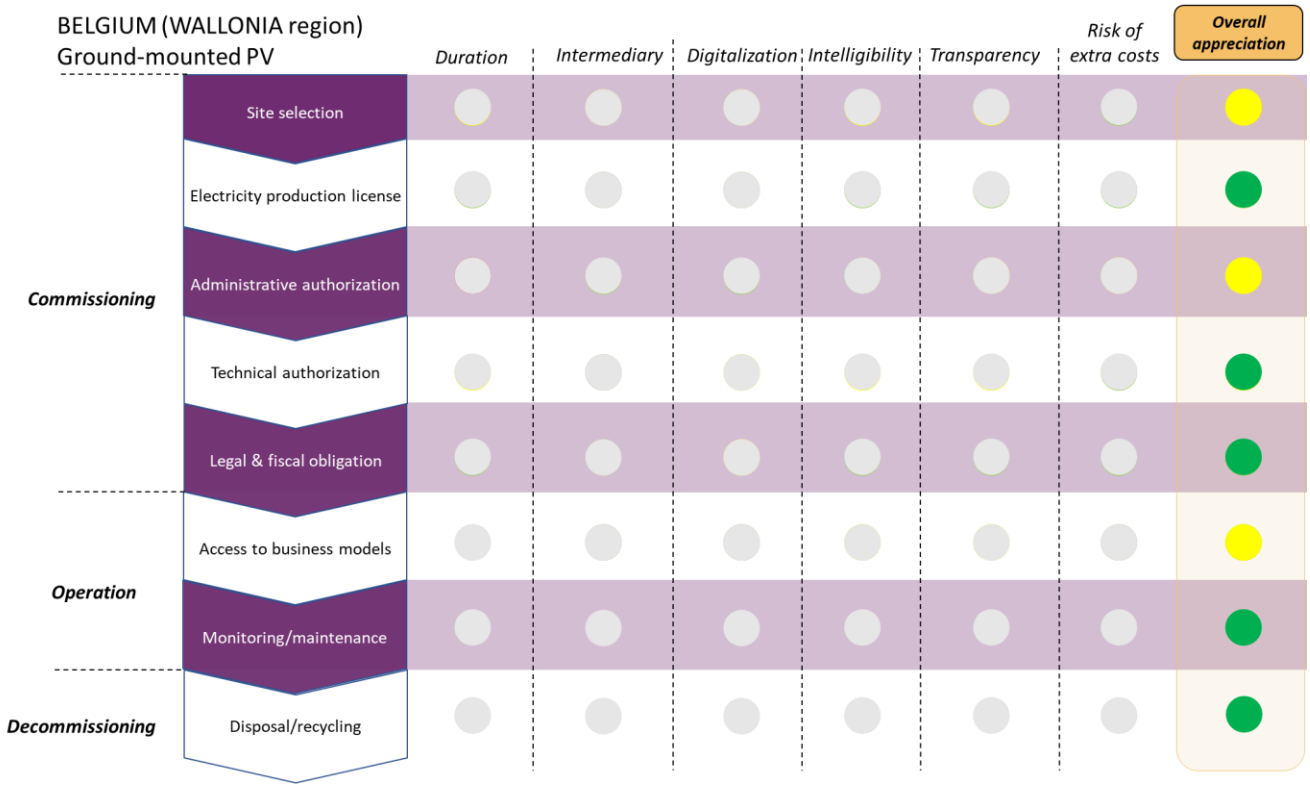
Currently, in Wallonia, the deployment of ground-mounted PV installations is facing minor obstacles. Commissioning steps (such as site selection and administrative authorization) meet many minor constraints as well as access to business models. These constraints result occasionally in delay of few months depending on potential extended duration of the different steps.

Indeed, due to many land-use conflicts during the ***site selection***, this step could take longer than expected.

Similarly for the ***administrative authorization***, cumbersome administrative and budgetary procedures make sometimes this step a serious impediment to deployment of ground-mounted PV in Wallonia.

Finally, about the ***access to business models***, no major obstacle exists, as green certificates (GC) are easily allocated. However, GC are not always well perceived due to a lack of clarity.

Table 3.11: Detailed evaluation of ground-mounted PV systems deployment in Wallonia



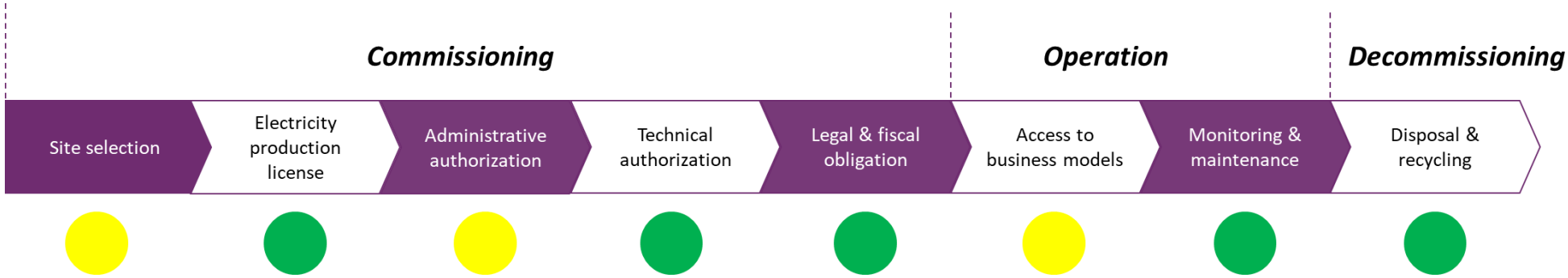


Table 3.12: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in Belgium (Walloon region)

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	Strong competition between agricultural activities and PV installations for required areas.	-	*Addressed to developers:* • Necessary to find combined uses of the surfaces, like certain applications of agrivoltaism, or on industrial waste lands, etc.
Electricity production license	-	-	-
Administrative authorization	Cumbersome administrative and budgetary procedures.	-	*Addressed to national/regional/local authorities:* • Procedure simplification.
Technical authorization	-	-	-

Legal & fiscal obligation	-	-	-
Access to business models	Non-clarity around GC.	• Green certificate scheme is applicable (Regulator regularly adapt level of this certificate following the market trends, for instance 1st January 2022, a decrease of the support level was planned but due to recent increase of material price, the initially planned decrease has been suspended). • Trends organised by governments.	-
Monitoring / Maintenance	-	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	

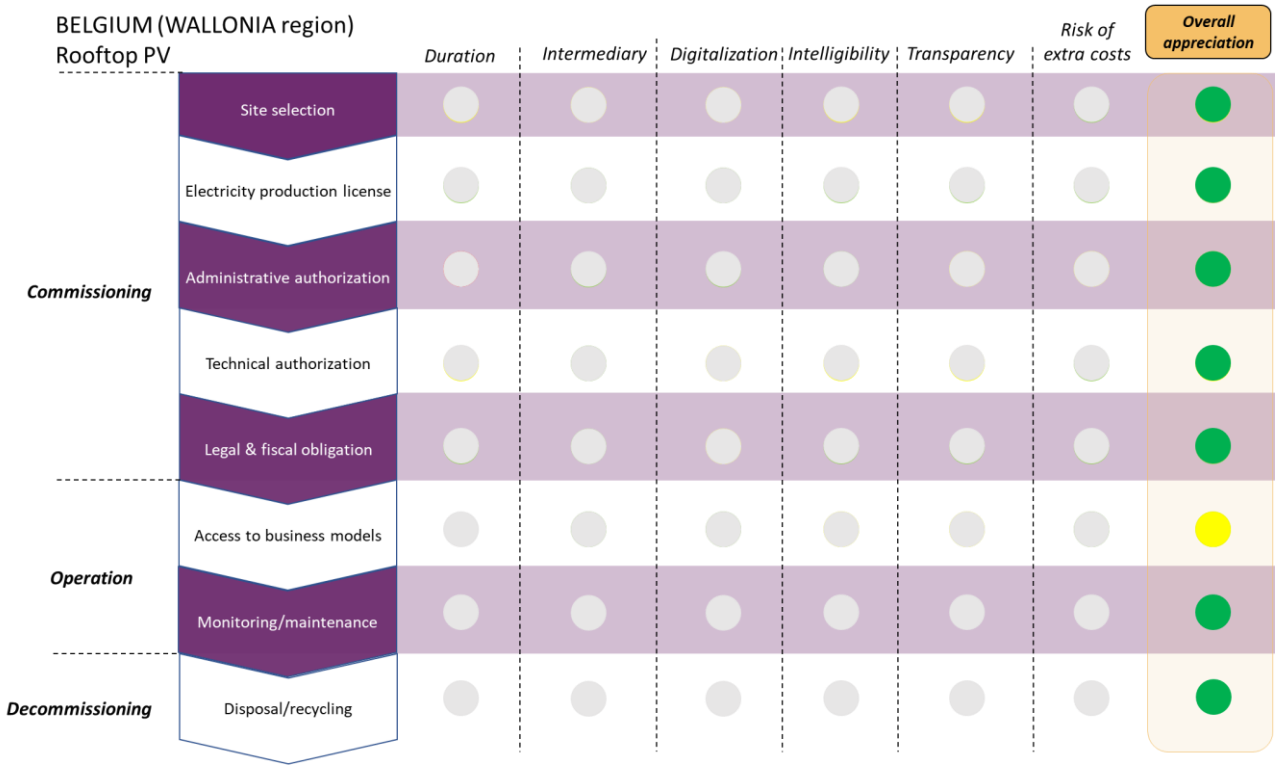
3.3.6 Belgium –Wallonia – Rooftop PV

Currently, in Wallonia, the deployment of rooftop PV installations is facing minor obstacles. The "access to business models" is the only step meeting minor constraints.

Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV system.

About ***access to business models***, no major obstacle exists, as adapted green certificates (GC) are easily accessible as well as self-consumption scheme. Nevertheless, GC are not always well perceived due to a lack of clarity. Concerning shared generation, final law/text of the legal framework for energy communities is not yet ready.

Table 3.13: Detailed evaluation of rooftop PV systems deployment in Wallonia



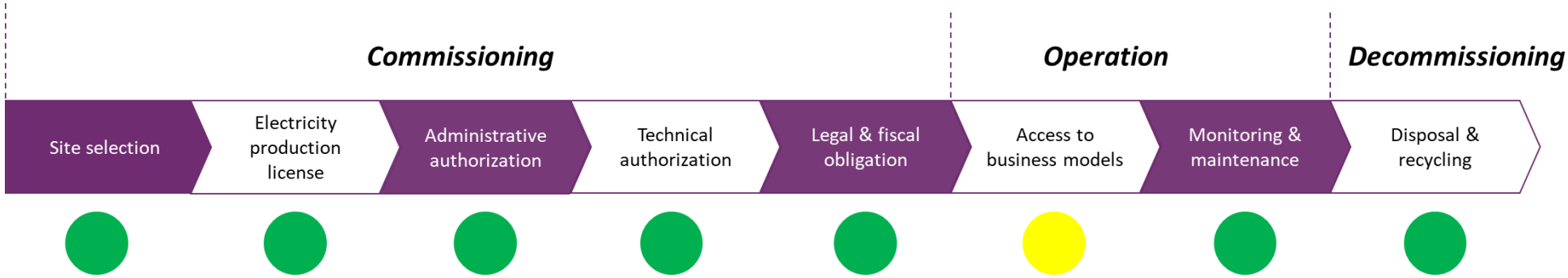


Table 3.14: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Belgium (Walloon region)

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	-	Not subject to urbanism permission. This remains valid if the modules do not extend beyond the edges of the roof.	-
Technical authorization	Cost of main decoupling device need to be taken into account (6 000-8 000 €).	-	-
Legal & fiscal obligation	-	-	-
Access to business models	Net-metering end is announced (not alternative announced yet). • Risk of not buying GC. Indeed, due to booming of PV installations, there is an	• Green certificate scheme is applicable to large installations (> 10kW) (Regulator regularly adapt level of this certificate following the market	*Addressed to national/regional/local authorities:* • Finalize text of the legal framework for energy communities.

	excess of supply of GC resulting in a lack of demand of these GC. Specific demand should be made, but the waiting list is long causing often delays. Non-clarity around GC. • There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.	trends, for instance 1st January 2022, a decrease of the support level was planned but due to recent increase of material price, the initially planned decrease has been suspended). • Self-consumption is allowed. • For business and professionals, the federal government provides a 13,5% (2022) tax reduction on annual taxable income for energy savings-related investment.	
Monitoring / Maintenance	-	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

3.4 France – Ground-mounted PV

Currently, in France, the deployment of ground-mounted PV installations is facing multiple obstacles. Commissioning steps (such as site selection, administrative and technical authorization) meet many minor constraints as well as disposal/recycling of the system at the end-of-life.

Indeed, due to many land-use conflicts during the ***site selection***, this step could take longer than expected. In addition, non-simplified procedures and non-digitalized mapping for this scarce eligible land make this site selection step facing even more issues.

Concerning ***electricity production licensing***, ground-mounted PV systems deployment encountered no obstacles during this step.

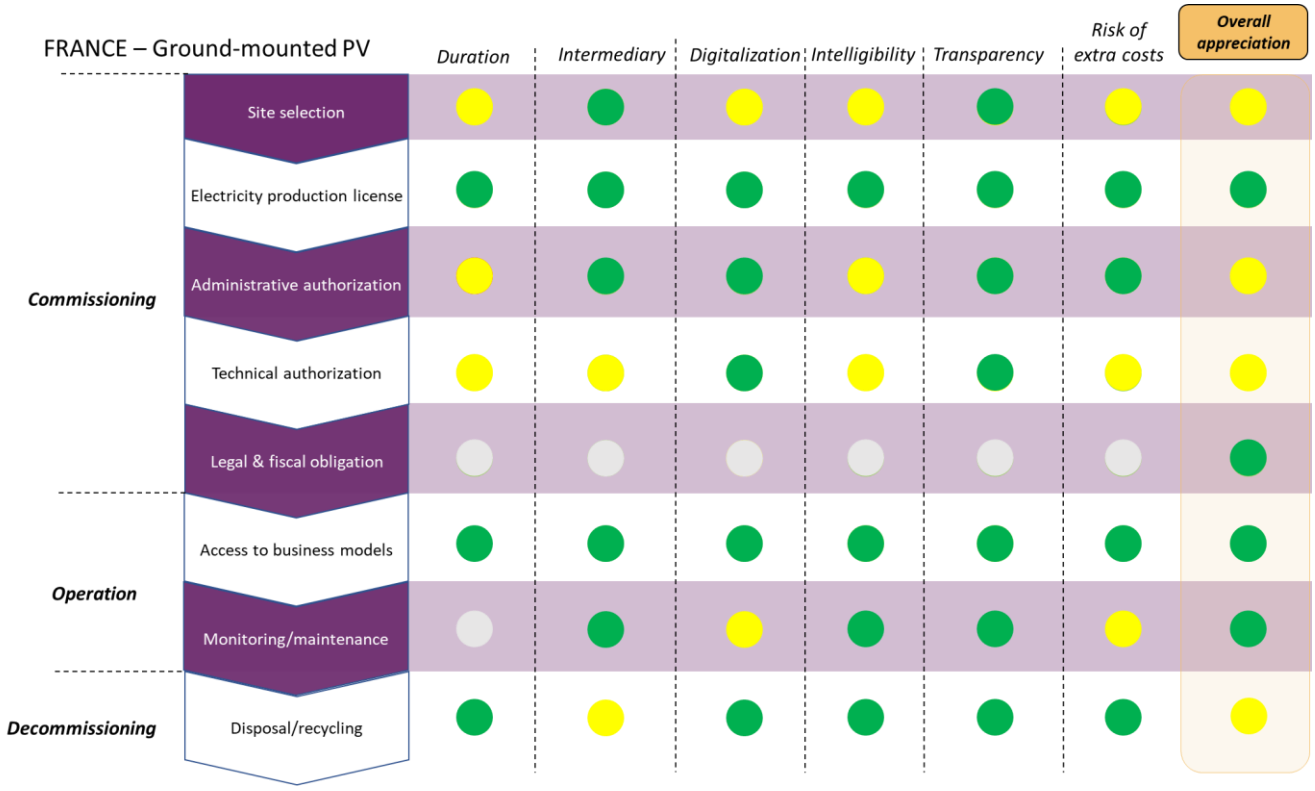
About ***administrative authorization***, multiple procedures make this step sometimes delayed. In addition, these procedures are depending on federal states, resulting in a completely inconsistent and unclear application system across the country.

Regarding ***technical authorization,*** step issues exist as well. First, significant delays are faced during the acquisition of the grid connection permit mainly due to overwhelmed grid operators. In addition, extra costs could hinder the deployment of ground-mounted PV installations in France.

About the ***access to business models***, no major obstacle exists, as tenders or feed-in premium are easily accessible. This results in a step without constraints. Nevertheless, it is noteworthy that few departments/regions have their own PV support schemes, impacting slightly the intelligibility of this step.

Lastly, ***disposal/recycling*** of ground-mounted PV installations is hindered by the number of intermediaries involved in the recycling/dismantling of modules/electrical equipment.

Table 3.15: Detailed evaluation of ground-mounted PV systems deployment in France



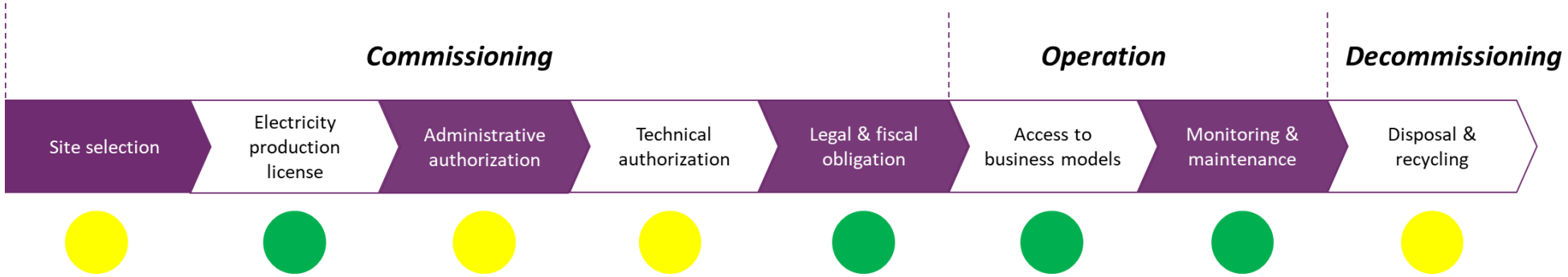


Table 3.16: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in France

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• The availability of compatible land is scarce. High competition for the eligible land. • Not authorized to implement projects in agricultural zones (in general, even if it tends to change for relevant agrivoltaic projects). • Process achievable in few weeks. But due to land availability and overwhelmed local authorities, delays of few months appear.	• Many publicly available cartographies to know the restrictions (environmental constraints, building constraints, etc.). Urbanism constraints easily accessible. State services usually quite accessible. • Concerning call for tender, it is lead/organised by the French energy regulation commission (CRE) in order to have easier and faster developments. • Bonus in call for tenders for degraded land (but degraded land's availability is more and more scarce).	*Addressed to national/regional/local authorities:* • Surface optimisation with already occupied areas (such as vertical PV in agricultural zone, PV carports, PV covering highways, etc). • Procedure simplification and automation (online procedure)
Electricity production license	• Cost depends on the region.	Not needed for solar projects below 50 MWp.	-

	• Aggregation fee (a standard cost at the construction and next an annual fee is applicable).		
Administrative authorization	• Required authorization: Environmental impact assessment, local authorities' consent (public inquiry) and grid authorization. Can take at least 1 year to obtain. • Inconsistent framework due to departmental differences.	Unique authorization process gathering all the permits needed (building permit, environmental impact assessment (EIA), water law etc…).	*Addressed to national/regional/local authorities:* • Preliminary meeting with the administrative service "guichet ENR", to have a first advice before submitting documentation to ease the process.
Technical authorization	• A few months to obtain grid connection offer from grid operator. • Grid operator often overwhelmed by the demands. • Delivery point installation and VRD (roads and networks). • Fee per MW to be paid (40 000 to 80 000 €/MW) + grid connection costs (TURPE). • Conformity checks sometimes lead to unexpected delays and/or extra costs.	• Grid connection permit: Offer is well defined (for instance, the maximal duration for the grid operator to provide an answer). • Grid code compliance: Already applicable legislation is clear. Developer must supply proof that his installation is compliant.	-
Legal & fiscal obligation	-	-	-
Access to business models	-	Call for tenders published by CRE (with restrictions on eligible lands) for a "remuneration complement" (price paid above market price). Feed in tariff for projects up to 500 kWp (an option also exists to enter private PPAs). The tariff is guaranteed at a certain value. If the market price is higher than this value, we sell at the market price. If the market price is lower, we sell at the	-

		guaranteed price (that imply to stop the assets during negative price periods).	
Monitoring / Maintenance	There is a legal obligation to manage the vegetation as well as the verification of the installation (electrical and fire). This leads sometimes to unexpected extra costs.	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	• Organizations exist/operate such as SOREN (previously PV CYCLE France) which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer. • Similarly for electrical components, organisms such as ECOLOGIC and ECOSYSTEM ensure the free collection of electronic waste.	-

3.5 France – Rooftop PV

Currently, in France, the deployment of rooftop PV installations is not facing any major obstacles. Commissioning steps (such as administrative and technical authorization) meet many minor constraints.

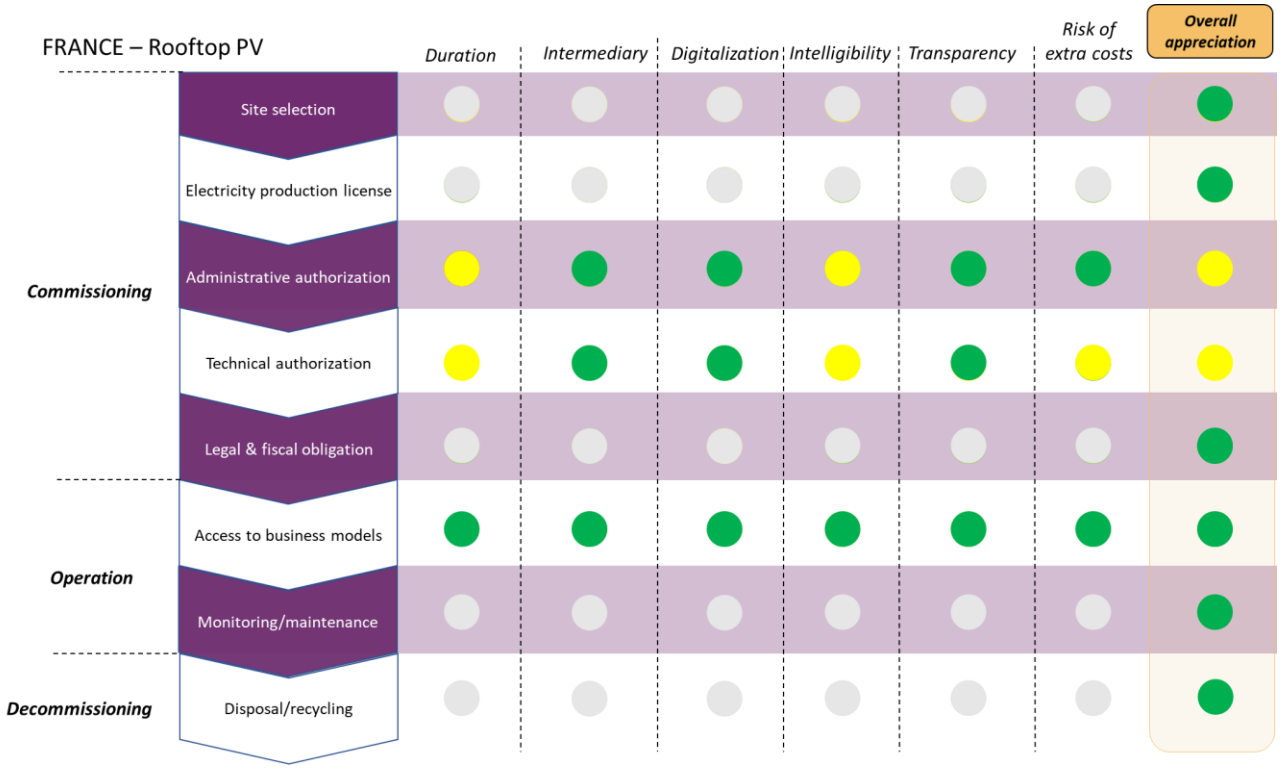
Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV systems.

About ***administrative authorization***, multiple procedures make this step sometimes delayed. In addition, these procedures are depending on federal states, resulting in a completely inconsistent and unclear application system across the country.

Regarding the ***technical authorization,*** step issues exist as well. First, significant delays are faced during the acquisition of the grid connection permit mainly due to overwhelmed grid operators. In addition, extra costs could hinder the deployment of rooftop PV installations in France.

Finally, about the ***access to business models***, no major obstacle exists, as feed-in tariff as well as self-consumption scheme are easily accessible. This results in a step without constraints. Nevertheless, it is noteworthy that for large rooftop installations, the obligation to participate to tenders hinders some developers.

Table 3.17: Detailed evaluation of rooftop PV systems deployment in France



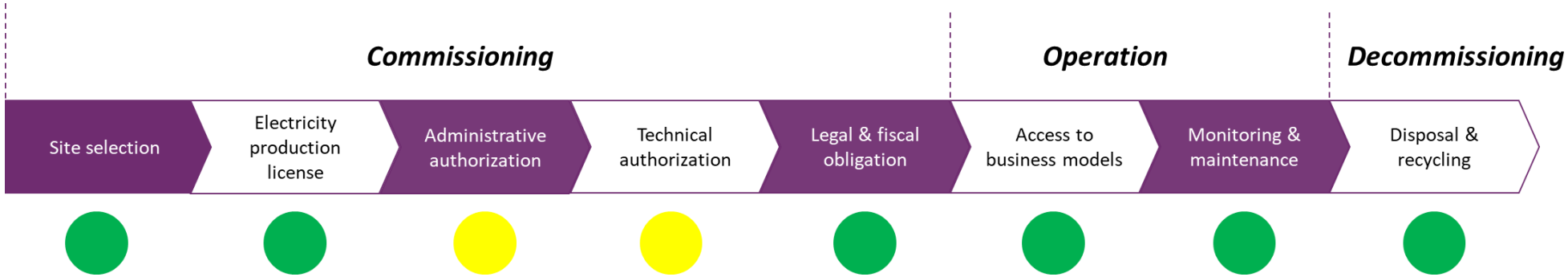


Table 3.18: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in France

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	• Multiplication of procedure with no standardized forms. • For self-consumption, an urbanism authorisation is required. In the case of a new construction, the permit shall be issued with the construction permit, otherwise it should be requested to the local authority (Mairie). • Inconsistent framework due to departmental differences. (Indeed, in		*Addressed to national/regional/local authorities:* • Procedure simplification.

	France each department has its own Urbanism Local Plan (Plan Local d'Urbanisme)).		
Technical authorization	• Connection request is mandatory for the PV plants with self-consumption and injection and for PV plants with full injection to the local distribution company (Enedis). • Delays in the grid connection process. • Conformity checks sometimes lead to unexpected delays and/or extra costs.	Connection request is not mandatory for PV plants that rely on self-consumption only.	*Addressed to grid operators:* • Grid connection procedure simplification.
Legal & fiscal obligation	-	-	-
Access to business models	• Obligation to go for tenders for installations larger than 500 kWp. • There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.	• Remuneration is obtained through classic feed-in tariff schemes. (Self-consumption is allowed). • Support level depends on the type of system (BAPV or BIPV). This depends also in the size of the system. BIPV investment premiums can be received if the landscape integration criteria are respected. • Energy communities (called also collective self-consumption, "autoconsommation collective") concept exist already since years in national decrees. Perimeter and other conditions are regularly modified thanks to new decrees.	-
Monitoring / Maintenance	-	-	-
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other	• Organizations exist/operate such as SOREN (previously PV CYCLE France) which ensures the free collection of used solar	-

	electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • 3 €/kWp for waste management (wood, wiring, plastic, cartoon) at construction stage. (Obligation on the part of the PV system owner/project developer to set aside funds)	panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer. • Similarly for electrical components, organisms such as ECOLOGIC and ECOSYSTEM ensure the free collection of electronic waste.	

3.6 Germany – Ground-mounted PV

Currently, in Germany, the deployment of ground-mounted PV installations is facing multiple obstacles. Commissioning steps (such as site selection, administrative and technical authorization) meet many minor constraints.

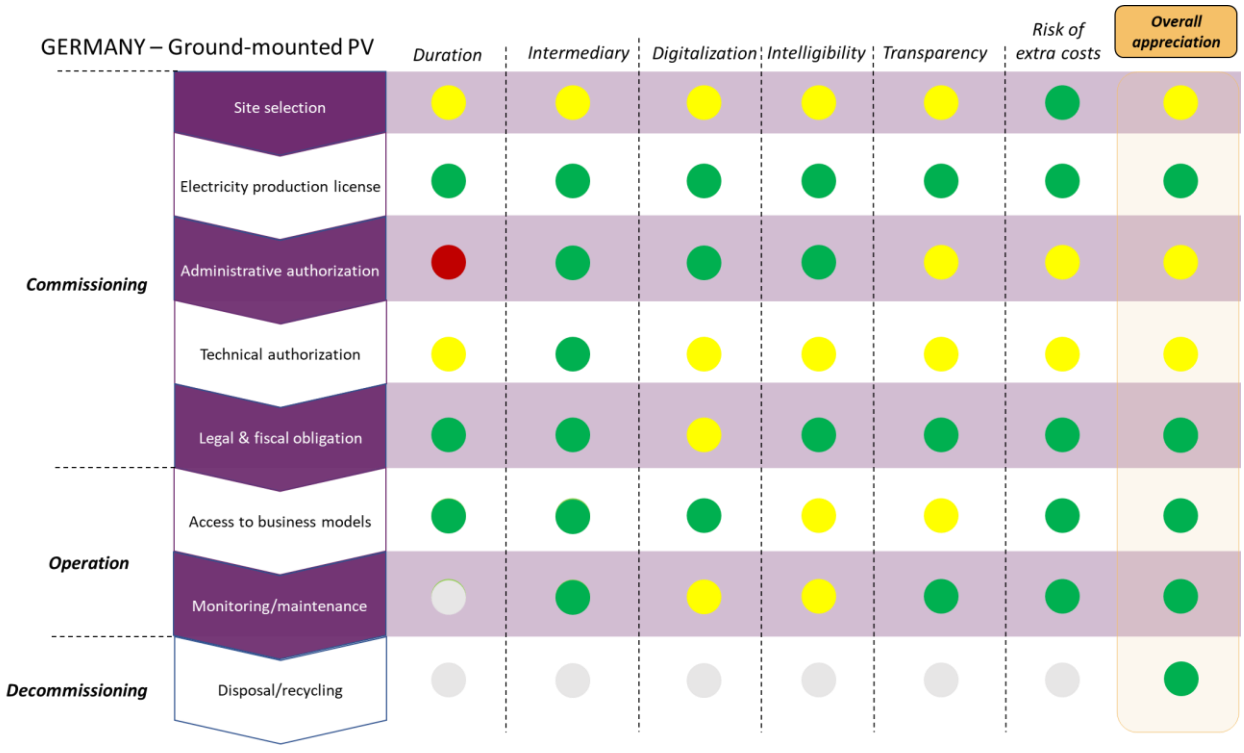
Indeed, due to many land-use conflicts during the ***site selection***, this step could take longer than expected. In addition, overwhelmed administrative structures for this scarce eligible land make this site selection step facing even more issues.

Concerning ***electricity production licensing***, ground-mounted PV systems deployment encountered no obstacles during this step.

About ***administrative authorization***, multiple complex procedures make sometimes this step highly delayed. In addition, transparency issues as well as risks of extra costs make this step a potential barrier to the deployment of ground-mounted PV installations in Germany.

Regarding the ***technical authorization*** step issues exist as well. Indeed, extra costs (from connection study and/or conformity certificate) may slow down the deployment of ground-mounted PV installations.

Table 3.19: Detailed evaluation of ground-mounted PV systems deployment in Germany



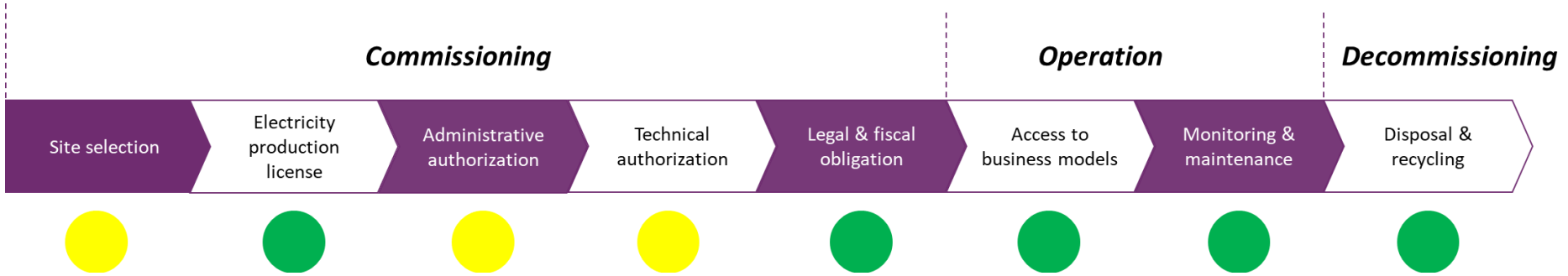


Table 3.20: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in Germany

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• Land availability. For several years, project developers have complained the increasing difficulty in locating available development lands for a variety of reasons. • One important impediment is the rising cost of project companies to build ground-mounted PV systems in rural towns (with small administrative structures). They are frequently overwhelmed with dozens of offers in a variety of fields.	-	*Addressed to federal and local authorities:* • Regional planning at a higher level could provide a more holistic picture, providing guidance and relieving municipalities of some of their responsibilities. • Digitalized map of eligible land. • Simplified procedure.
Electricity production license	-	The construction and operation of generating stations is not subject to specific licensing requirements under German energy law. The general provisions of planning and building law are	-

		applicable as are the requirements of environmental law.	
Administrative authorization	• Complexity of procedures. • 1,5-2 years for administrative authorization. • Understaffed authorities.	• Incomplete applications are already being processed, while missing documents are subsequently requested and handed in, accelerating the process when ready. • Administrative process is available online through electronic communication and web-interfaces. • Guidelines and documents templates are available.	*Addressed to national/regional/local authorities:* • Simplified and digitalized procedures. • Reduce the maximum delays of issuance. • Expansion of administrative authorities' staff. • Training of administrative authorities' staff.
Technical authorization	• Some low risk of extra cost for the grid connection if a rural location is not supplied. • In fact, some grid operators charge a price of 1 500€ for a connection study. • A conformity and a power plant certificate, which costs between 15 000 and 20 000 €, may also be requested by the grid operator.	-	*Addressed to grid operators:* • Simplified procedures. • Reduction of fees. • Harmonization of procedure.
Legal & fiscal obligation	All electricity consumers pay the EEG tax on the electricity they consume. This tax amounts to 0,065 €/kWh in 2021.	-	-
Access to business models	-	Remuneration can be obtained through feed-in tariff scheme or feed-in premium scheme, directly (below 750kWp) or via tenders (above 750kWp) organized by governments.	-
Monitoring / Maintenance	-	-	-

Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

3.7 Germany – Rooftop PV

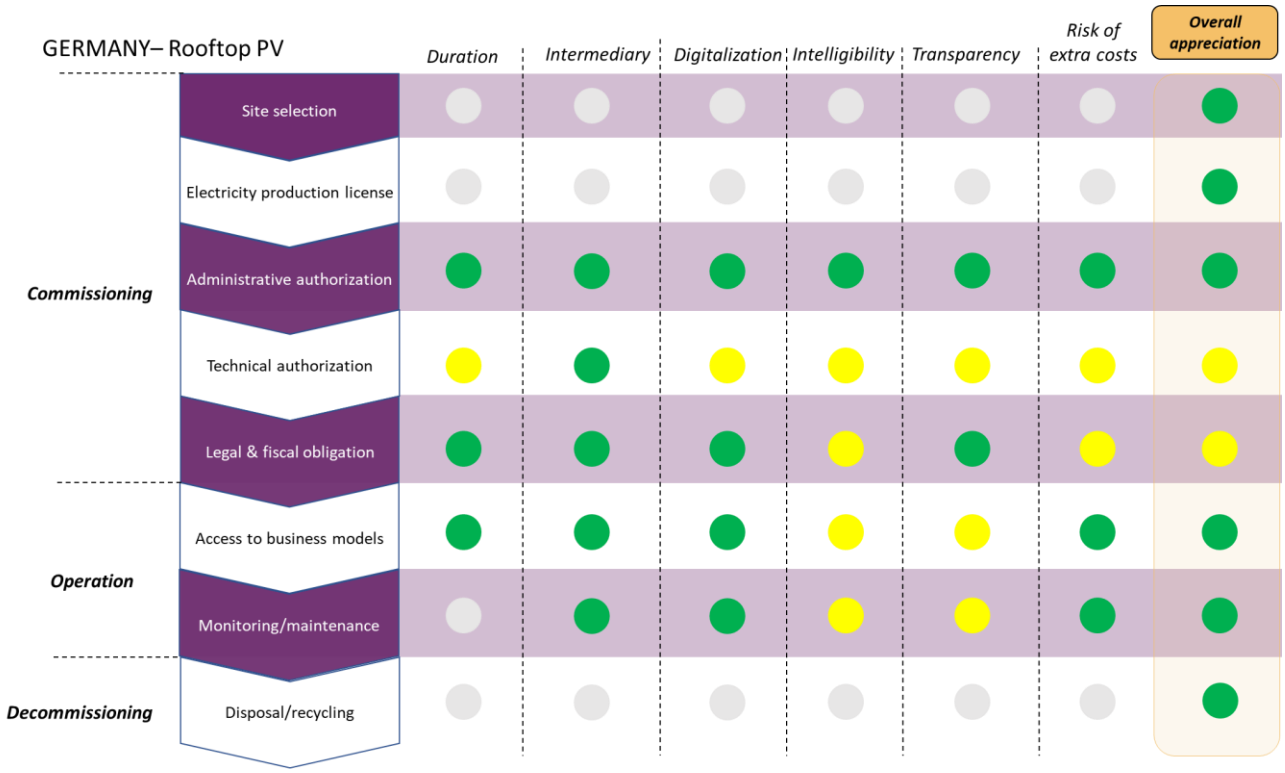
Currently, in Germany, the deployment of rooftop PV installations is facing only minor obstacle. Commissioning steps (such as technical authorization and legal & fiscal obligation) meet many minor constraints.

Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV systems.

Concerning the ***technical authorization***, step issues appear. First, delays are faced during the acquisition of the grid connection permit mainly due to overwhelmed grid operators. In addition, extra costs could hinder the deployment of rooftop PV installations in Germany.

Finally, in additions to taxes, ***legal & fiscal obligation*** in Germany includes for each PV plant (of a certain size) that it is necessary to create an associated company, potentially leading to additional complexity and/or cost.

Table 3.21: Detailed evaluation of rooftop PV systems deployment in Germany



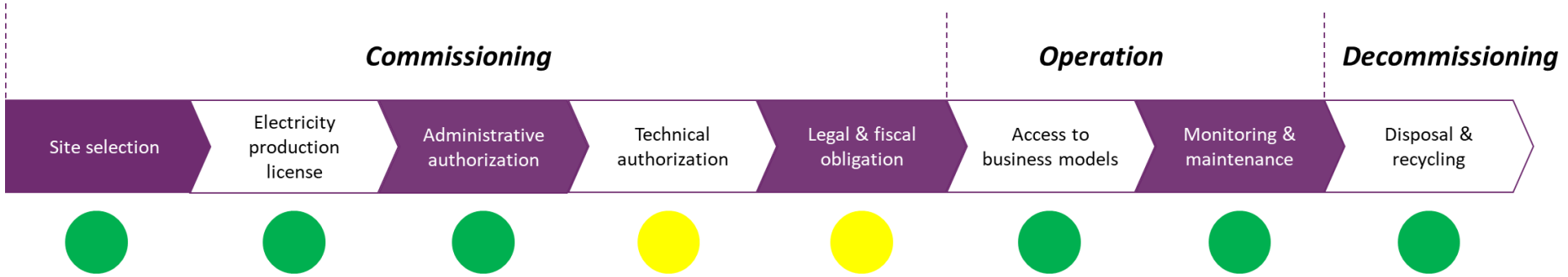


Table 3.22: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Germany

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	-	No requirement for rooftop PV systems is necessary.	-
Technical authorization	Depends on size of PV system. Systems over 30 kWp need a permission from the grid operator.		*Addressed to grid operators:* • Simplified procedures. • Harmonization of procedure.
Legal & fiscal obligation	• All electricity consumers pay the EEG tax on the electricity they consume. This tax amounts to 0,065 €/kWh in 2021. • Tax and trading laws discourage small rooftop PV system operators.	For PV systems with an installed capacity > 10 kWp and with a self-consumption rate higher than 30%, this EEG tax is also applied to self-consumed electricity but at a reduced rate (only 40% of the tax i.e. 0,026 €/kWh needs to be paid).	*Addressed to federal and local authorities:* • Tax reduction. • Development of trading rules to ensure cost-effective and viable environment for small rooftop PV system operators.

	• The complexity of registering a commercial corporation is a significant hurdle for operators of small rooftop PV installations.		• Progressive anti-bureaucratic legal measurements.
Access to business models	• Obligation to go for tenders for installations larger than 750 kWp. • There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers. In addition, there's still a lot of reluctance from the utilities.	• Remuneration can be obtained through feed-in tariff scheme or feed-in premium scheme, directly (below 750kWp) or via tenders (above 750kWp). • Self-consumption is allowed. • Energy communities (called also Mieterstrom, the neighbour solar supply model) concept exist already since years in national decrees. Thanks partly to Mieterstrom, Germany is the European country with the largest number of community energy initiatives.	*Addressed to federal and local authorities:* • Further increase the capacity limit which obliges to go for tenders (for example, up to 1MWp or more).
Monitoring / Maintenance	-	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

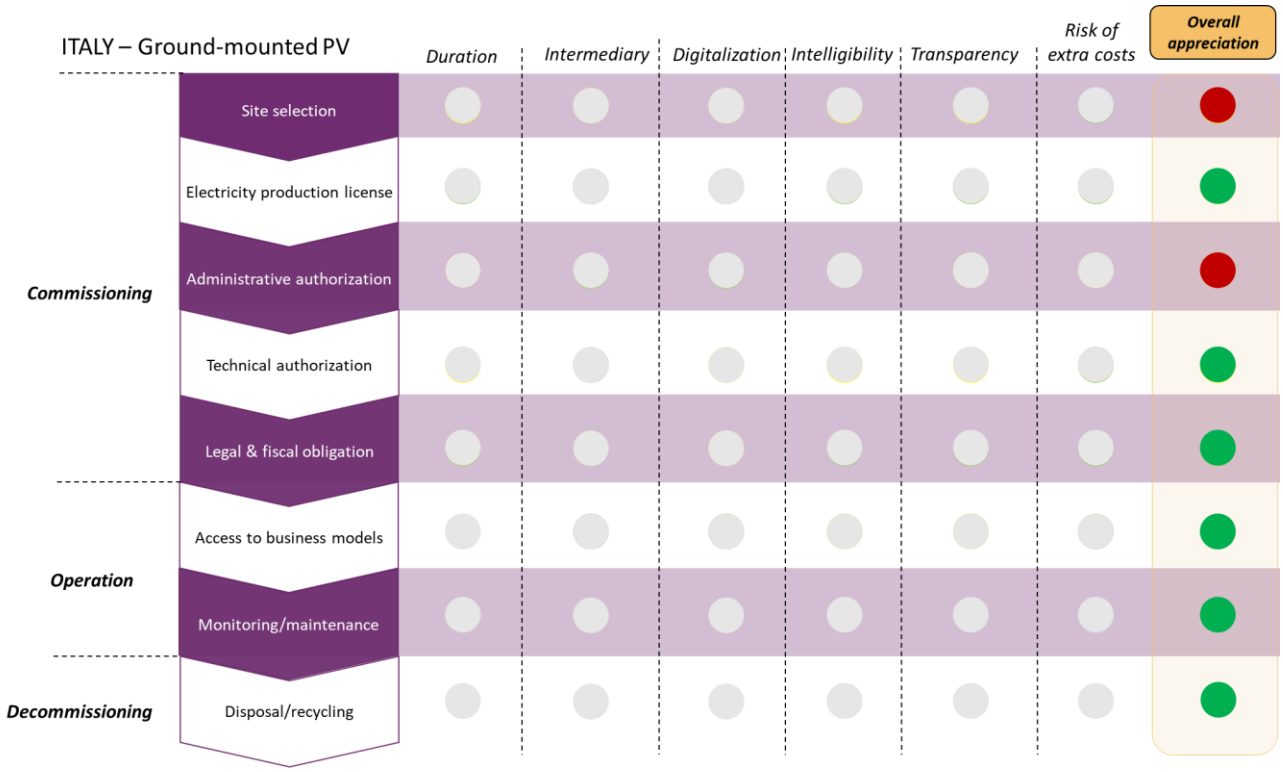
3.8 Italy – Ground-mounted PV

Currently, in Italy the deployment of ground-mounted PV installations is facing multiple obstacles. Commissioning steps (such as site selection and administrative authorization) meet major constraints.

Indeed, due to many land-use conflicts or restrictions during the ***site selection***, this step could take longer than expected, sometimes even being blocked. In addition, slow soil rehabilitation process for this scarcely eligible land makes this site selection step facing even more problematic.

About the ***administrative authorization***, multiple procedures make this step sometimes delayed. In addition, the high influence of superintendencies and a lack of collaboration between public administrations severely hinder the deployment of ground-mounted PV installations in Italy.

Table 3.23: Detailed evaluation of ground-mounted PV systems deployment in Italy



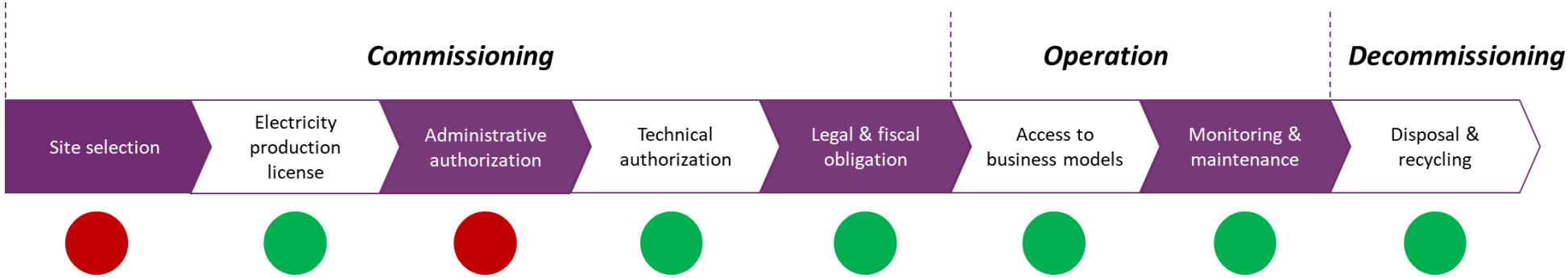


Table 3.24: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in Italy

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• Agriculture and ground-mounted PV installations have a land use conflict. • Recent decree (March 2022) introduces the possibility of accessing incentives also for ground-mounted installations on agricultural land. Only if they cover no more than 10% of the agricultural area. • Delays in site selection process. • The process of soil rehabilitation is too slow.	Surface optimization (ground-mounted PV installations on uncultivated, abandoned, or degraded land).	*Addressed to national/regional/local authorities:* • Simplified and standardized procedure. • Surface optimisation with already occupied areas (such as vertical PV in agricultural zone, PV carports, PV covering highways, etc). • Reduce maximum delays of issuance.
Electricity production license	-	-	-

Administrative authorization	• Multiplication of procedures. • High influence of superintendencies and lack of collaboration between public administrations. • Lack of staff and insufficient training. • Lack of public participation and information.	Regulation to repower project exist. But existing plant modifications are frequently deemed important, requiring project developers to repeat the entire process.	*Addressed to national/regional/local authorities:* • Simplified procedure. • Staff training for public administration and for coordination between public institution. • Competent authority should provide clear guidance to project developers on permitting procedures at the start of the application process. • Reduction of maximum delays of issuance. • Ease process for repowering installations.
Technical authorization	• Grid capacity is insufficient • Project developer must pay the responsible grid operator a fee for obtaining the cost estimate (from 100 € up to 50 kWp to 2500 € for 1000 kWp and more) • Must pay to the Manager of Electricity Services (GSE) a fee to cover the costs of management, verification and control.		*Addressed to grid operators:* • Public support to extend grid capacity.
Legal & fiscal obligation	-	PV plants (up to 500kW) are eligible for a reduced VAT of 10% (instead of 20%).	-
Access to business models		• Tenders organised by governments. • A new consumption scheme in Italy is called "Sistema Efficiente di Utenza" (SEU, System of Efficient Use). It's a system in which one or more power production plants operated by a	

		single producer are connected through a private transmission line to a single end user located in the same site.	
Monitoring / Maintenance	-	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

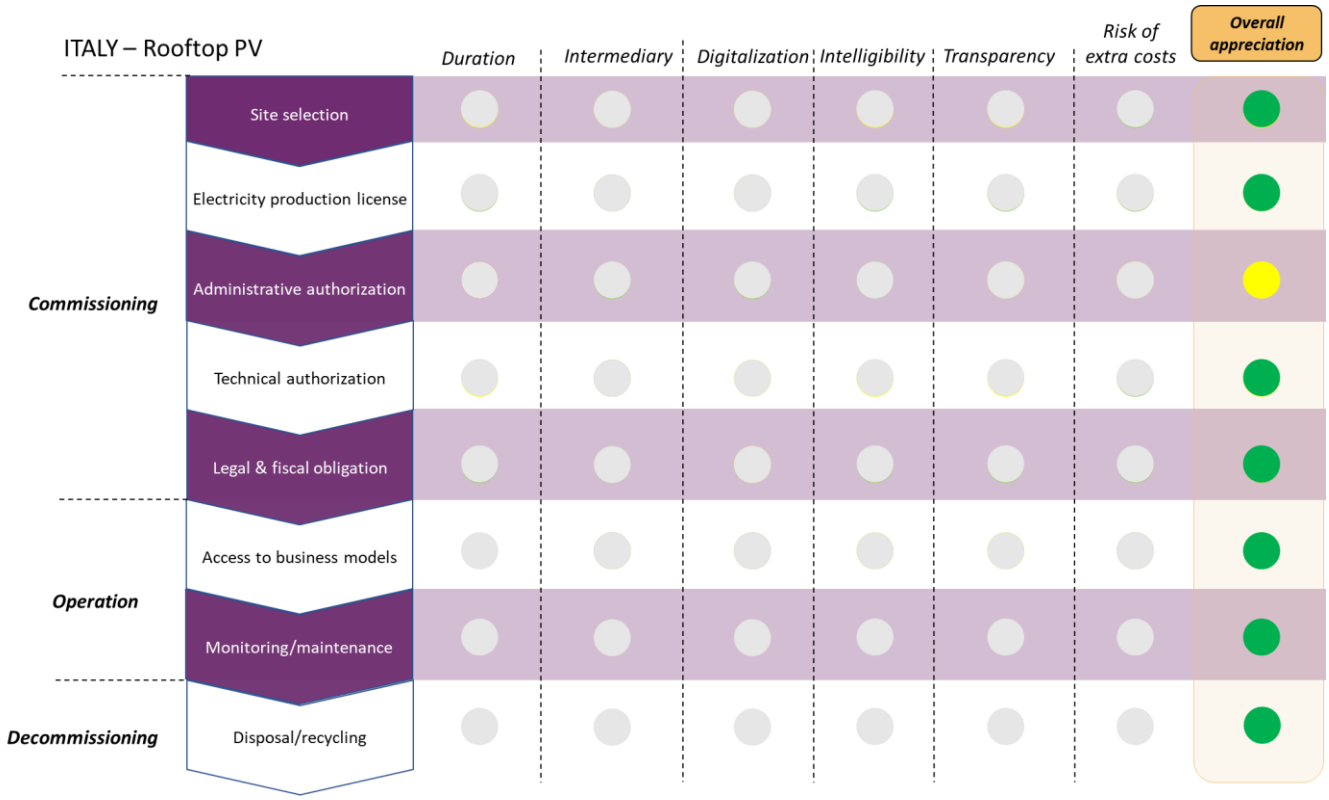
3.9 Italy – Rooftop PV

Currently, in Italy the deployment of rooftop PV installations is facing only minor obstacles. Commissioning steps such as “administrative authorization” meet minor constraints.

Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV system.

About ***administrative authorization***, multiple procedures make this step sometimes delayed. In addition, a high influence of superintendencies and a lack of collaboration between public administrations hinder the deployment of rooftop PV installations in Italy.

Table 3.25: Detailed evaluation of rooftop PV systems deployment in Italy



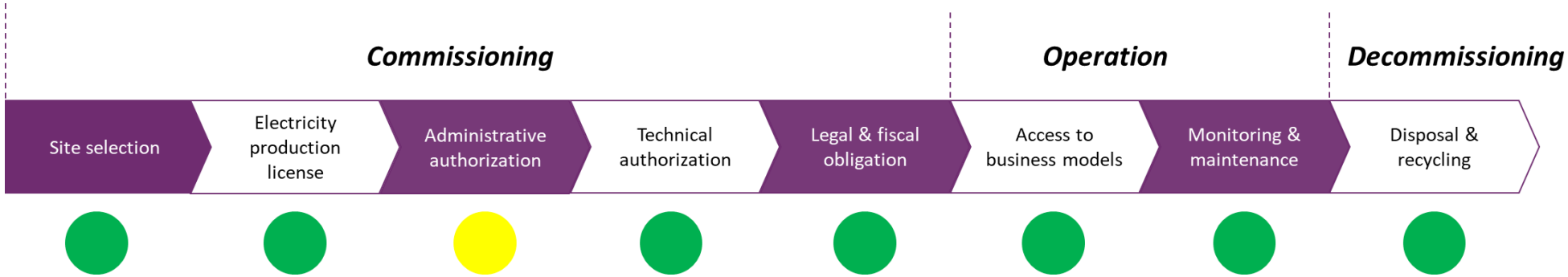


Table 3.26: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Italy

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	• Multiplication of procedures. • High influence of superintendencies in administrative authorization procedure and lack of collaboration between public administrations. • Lack of staff and insufficient training. • Lack of public participation and information.	Single model for PV and simplified authorization procedure (below 20kW).	*Addressed to national/regional/local authorities:* • Rising the capacity limit to access to single model for PV and simplified Authorisation procedure. • Staff training for public administration and for coordination between public institution.

			• Competent authority should provide clear guidance to project developers on permitting procedures at the start of the application process. • Reduction of maximum delays of issuance. • Repowering installation easy process.
Technical authorization	Must pay to the Manager of Electricity Services (GSE) a fee to cover the costs of management, verification and control.	-	-
Legal & fiscal obligation	-	• PV plants (up to 500kW) are eligible for a reduced VAT of 10% (instead of 20%). • Possibility to receive a real estate tax reduction for buildings equipped with renewable energy installation from the municipality. • No charges are applied for self-consumed electricity.	-
Access to business models	There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.	• For small systems (< 100 kWp), installations are promoted through a "dedicated withdrawal" agreement with GSE at a guaranteed minimum price ("Ritiro Dedicato"). "Ritiro Dedicato" is a simplified purchase/resale arrangement rather than a "classical" feed-in tariff. • Self-consumption is allowed. • Net-billing is applicable. • A new consumption scheme in Italy is called "Sistema Efficiente di Utenza" (SEU, System of Efficient Use). It's a system in which one or more power production	-

		plants operated by a single producer are connected through a private transmission line to a single end user located in the same site.	
Monitoring / Maintenance	-	-	-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

3.10 Poland – Ground-mounted PV

Currently, in Poland, the deployment of ground-mounted PV installations is facing multiple obstacles. Commissioning steps (such as site selection, administrative, technical authorization, and legal & fiscal obligations) meet many minor constraints.

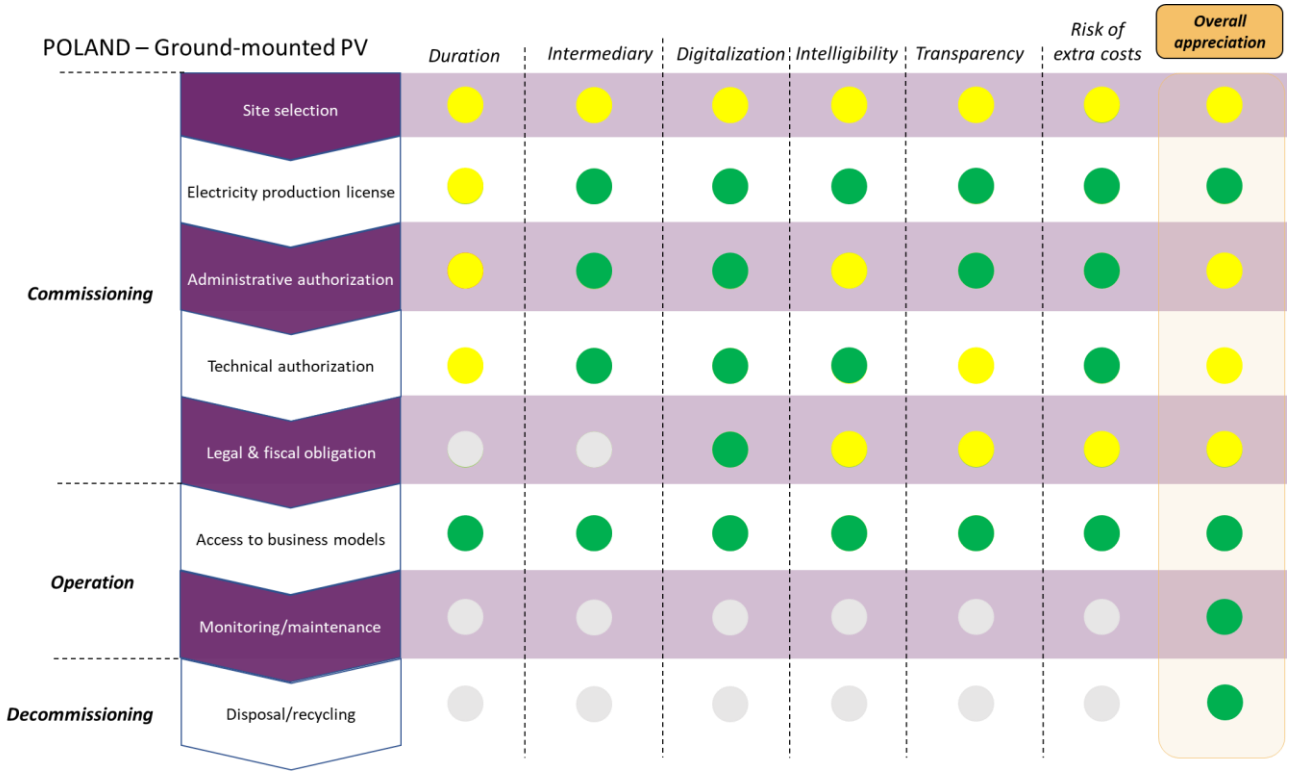
Indeed, due to many competitions during the ***site selection***, this step could take longer than expected.

About the ***administrative authorization***, multiple procedures make this step often delayed. In addition, adoption of a Local Spatial Plan (LSP) and the related appeals procedures require at least one year (in the best case).

Concerning the ***technical authorization*** step issues exist as well. Indeed, delays are faced during the acquisition of the grid connection permit mainly due to highly detailed request documentation.

Regarding the ***legal & fiscal obligation,*** tax legislation is complex and inconsistent. Indeed, there is different interpretation of the law from local authorities compared to administrative courts.

Table 3.27: Detailed evaluation of ground-mounted PV systems deployment in Poland



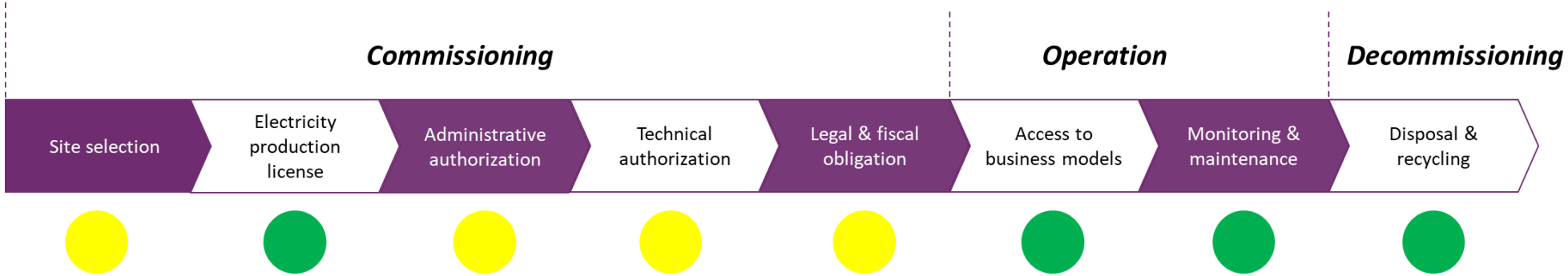


Table 3.28: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in Poland

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• High opportunity for the development of ground-mounted PV. However, in some cases, too high landlords' expectations (lease). • Fee (for agent's commission or other) is based on the PV land lease (typically equal to 3 months lease). Total cost = 1 500 € for 1 MW system.		*Addressed to national/regional/local authorities:* • Digitalized map for eligible land in accordance with regionals plans of development.
Electricity production license	Necessary for each plant above 1 MW.		
Administrative authorization	• Multiplications of procedures. • Adoption of a Local Spatial Plan (LSP) and the related appeals procedures require at least one year (including the consultation phase) in	Simplified procedure including the decision on environmental conditions, the location decision (spatial planning procedure) and the	*Addressed to national/regional/local authorities:* • Adopting regional strategies for renewable energy development could be one way to speed up the LSP process. The

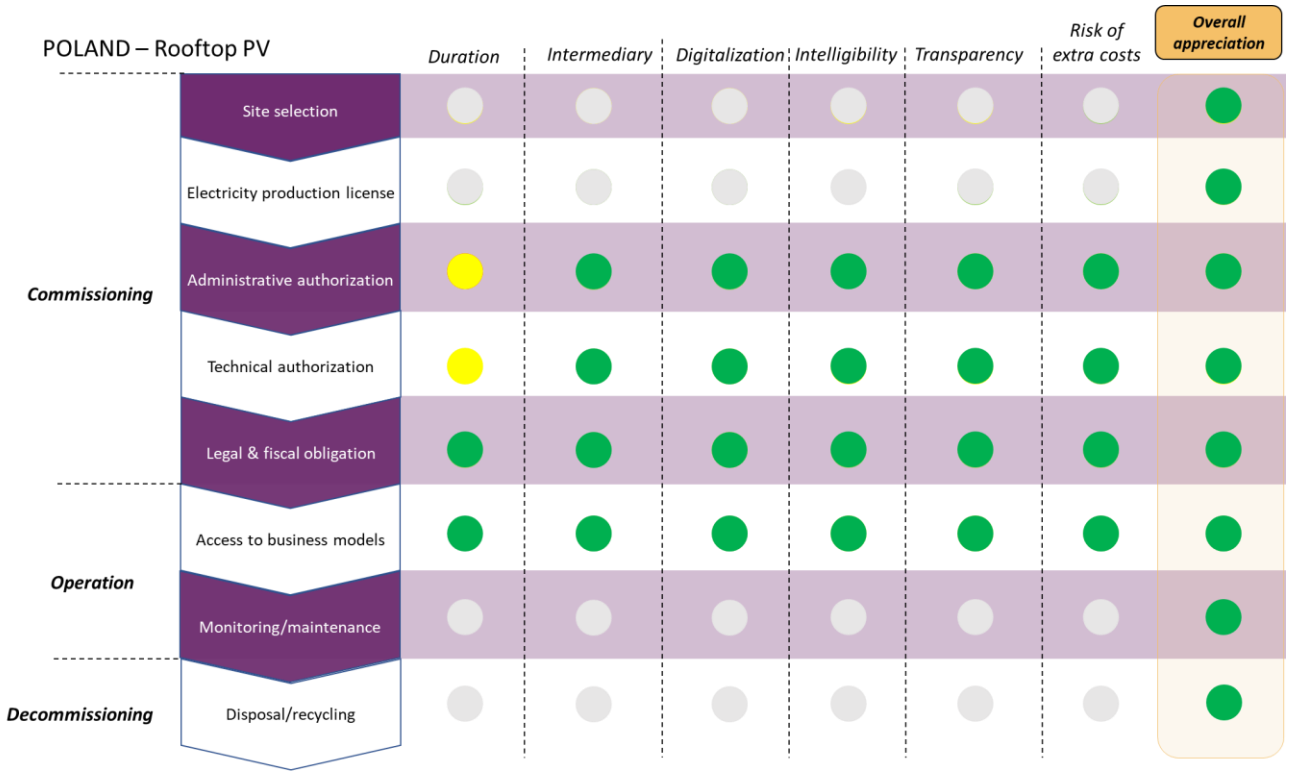
	the best-case scenario, but generally 2-3 years or more.	construction permit exists (Obligation of public consultation).	obligation to select sites dedicated for renewable energy projects should be spelled out in local government entities' Studies of Conditions and Directions of Spatial Development (SCDSP). • Reduction of the maximum delays of issuance.
Technical authorization	• Formal request required. High level of details required (Timing = 120 days). • Deposit of 6 500 € per MWp required. • Projects above 1MWp are more expensive and more complicated. Permission for high voltage lines' connection takes more time to obtain. The final cost depends on necessary CAPEX for the connection line. The design is also more expensive (area, maps). • Inverters must be approved. • Small inverters producers may not be able to submit all the necessary documentation.	1MWp projects are the most popular in Poland. Generally, it is quite straightforward to connect to medium voltage lines. In the Polish energy auction system, there is a separate category for photovoltaics up to 1 MW.	*Addressed to grid operators:* • Simplified procedure for local testing of inverters.
Legal & fiscal obligation	Uncertainties in interpretation of the Property Tax Law for PV projects: • Tax legislation is complex and inconsistent. (Different interpretation of the law from local authorities compared to administrative courts).	• Property tax exemptions as it is the case for rooftop PV. • All fees and deposits are fully refundable at sale.	*Addressed to national/regional/local authorities:* • Local authority and community relations are crucial. Worth considering to be built at early stage (environmental).
Access to business models	• All 1 MWp plants winning the auction are eligible for banking or resale. • Cash deposit of 13 000 € is required (settled once energy sales started, otherwise not refundable).	Auctions based on Contract for Difference (CfD). Contract-for-Difference as larger installations supporting scheme (47,6 – 54,6 €/kWh).	

Monitoring / Maintenance	-	-	-
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • Organizations exist such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. However, their activities in Poland are still limited.	Typical lease agreement with landlords includes a self-obligation of the project owner to demolish the entire construction at the end of its life cycle.	*Addressed to organizations:* • Expand organization recycling activities (local collection and recycling).

3.11 Poland – Rooftop PV

Currently, in Poland, the deployment of rooftop PV installations is facing no obstacles.

Table 3.29: Detailed evaluation of rooftop PV systems deployment in Poland



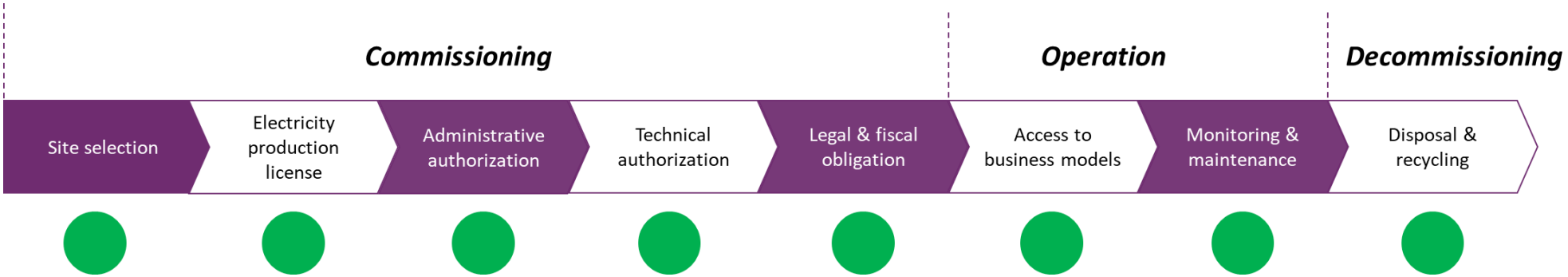


Table 3.30: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Poland

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	Technical survey for additional load on the roof is necessary.	Only building permit is required (with fire safety consultancy).	
Technical authorization	Grid Connection Requirements takes up to 5 months to obtain.		*Addressed to grid operators:* • Reduce issuance delays.
Legal & fiscal obligation	-	Property tax exemption	-
Access to business models	There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy	• For systems below 50 kWp, net-metering is applicable (soon replaced by net-billing). • Self-consumption is allowed.	*Addressed to national/regional/local authorities:* • Development of a legal framework for energy communities' scheme.

	Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.	• Concerning systems between 50 and 500 kWp, there is an obligation for utility companies to buy excess electricity at a guaranteed minimum price.	
Monitoring / Maintenance			
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • Organizations exist such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. However, their activities in Poland are still limited.	-	*Addressed to organizations:* • Expand organization recycling activities (local collection and recycling).

3.12 Slovakia – Ground-mounted PV

Currently, in Slovakia, the deployment of ground-mounted PV installations is facing multiple serious obstacles. Steps such as site selection, legal & fiscal obligations and access to business models meet many minor constraints. Commissioning steps as electricity production license, administrative and technical authorization, and recycling are facing major constraints.

Indeed, due to many land-use conflicts during the ***site selection***, this step could take longer than expected.

Concerning the ***electricity production licensing***, multiple required licences make this step often delayed.

About the ***administrative authorization***, local authorities do not respect the legally stipulated periods for the issuance of specific statements and/or decisions. This results often in important delays.

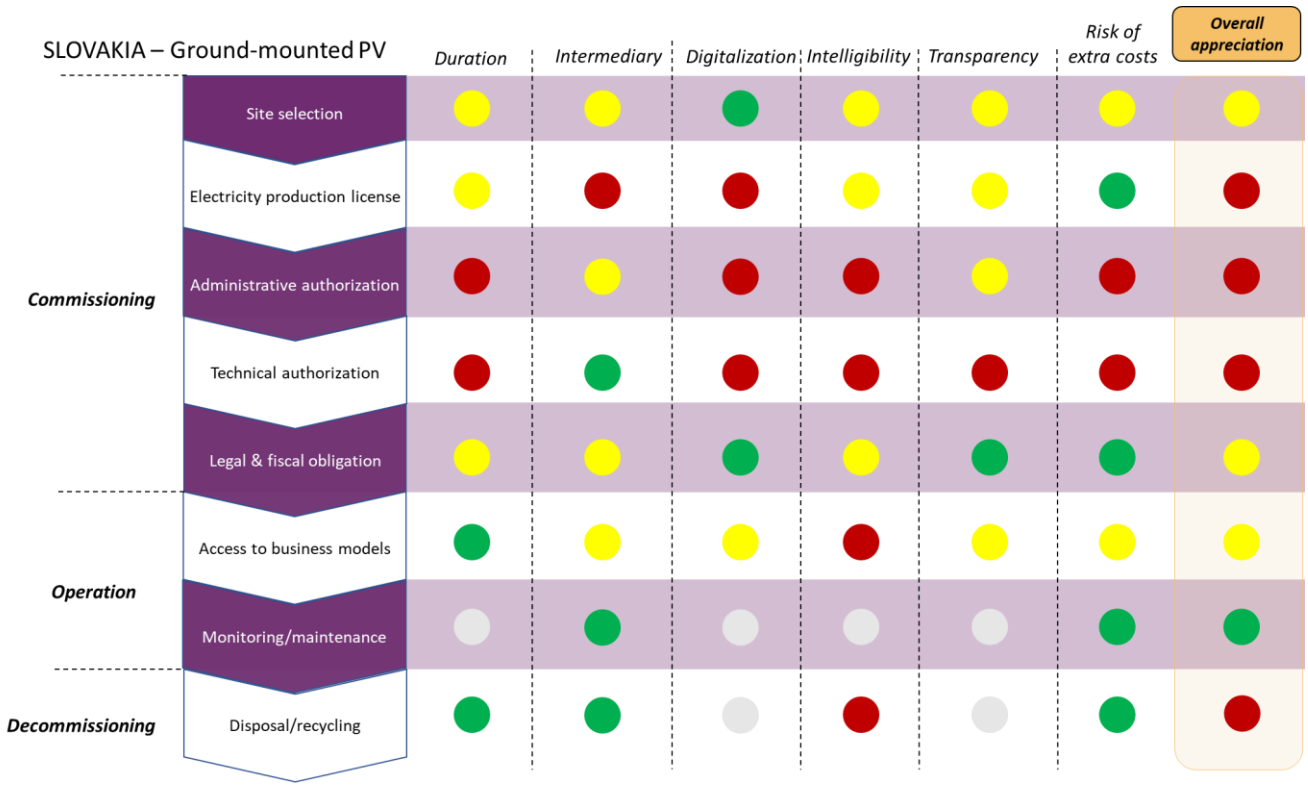
Regarding the ***technical authorization***, due to grid operators that are fully booked for grid connection plus important grid connection fees, this step is a serious blocking step for the deployment of ground-mounted PV in Slovakia.

With respect to ***legal & fiscal obligations***, frequent changes in legislation cause inconsistent and unclear situation.

About the ***access to business models***, no major obstacle exists, as feed-in premium schemes are accessible. However, there are no legal schemes for support of large-scale PV and the energy market for GOs.

Finally, environmental legislation does not create a suitable environment for the creation of sustainable business models including ***recycling***. No official recycling scheme for PV modules exists.

Table 3.31: Detailed evaluation of ground-mounted PV systems deployment in Slovakia



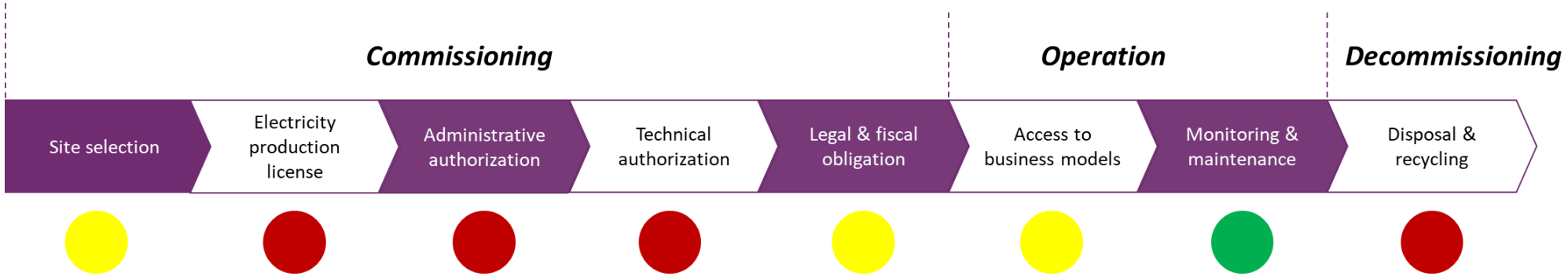


Table 3.32: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in Slovakia

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• Poor access to land due to strong competition with agricultural lands (Fee exists for agricultural land status to change). • Perhaps the most difficult part of the site selection process is finding a suitable and accessible grid connection point in the vicinity of the potential site. • Diverse entities prolong the environmental impact assessment (EIA) process. Multiplication (and higher complexity) of procedure when capacity increases. This results often to delays.	• Slovak cadastre fully digitalized and published. • Publicly accessible online map of agricultural land quality.	*Addressed to national/regional/local authorities:* • Simplified site selection procedure. • Rising the capacity limit to access to simplified procedure
Electricity production license	• Special licence is needed from the Ministry of Economy for construction of all PV installations above 500 kWp. (6 months)	Ministry of Economy has recently proposed to increase the power limit to 2 MWp in case of the	*Addressed to grid operators:* • Rising the capacity limit for issuing licenses.

	• Electricity production license from the Regulator of Network Industries (RONI) is required. (2 months) • Obtaining a license to supply electricity starts at 2 000€ and depends on the scale of activities.	special licence for construction of all electricity generators.	
Administrative authorization	• Local authorities do not respect the legally stipulated periods for the issuance of specific statements and/or decisions. • Total administrative authorization costs 5 000 – 20 000 €/MWp.		*Addressed to national/regional/local authorities:* • Staff training/hiring. • Process optimization (e.g., through digitalization).
Technical authorization	• Distribution system operators (DSOs) have announced a connection moratorium. Since December 2013, the entire Slovak RES sector has been facing a connection moratorium (so-called Freeze Status) because all three regionals' DSOs stopped issuing licenses (except for so-called Small Sources up to 10 kWp). As of January 2021, the DSO is not accepting requests for an opinion on connection to the distribution grid, denying thus access to the grid. In fact, when requested the DSOs are obliged to disclose the capacity data for any individual connection point. Unfortunately, none of the DSOs fulfilled this obligation completely. • Remote control system required. • Grid code compliance: Several stages produce delays (typically takes 6 months). • Total technical authorization costs 150 000 – 200 000 €/MWp.		*Addressed to grid operators:* • Obligation for grid operators to fulfil their responsibilities. • Public support (through subsidy) for remote control system.
Legal & fiscal obligation	Frequent changes in the legislation that produces inconsistent and unclear situation.	Electricity from renewable sources is partly exempted from tax (1,32 €/MWh are deducted).	*Addressed to national/regional/local authorities:* • Long-term strategy for PV market.

Access to business models	• There are no legal schemes for support of large-scale PV and the energy market for GOs • In the auction mentioned, a bid bond should be paid upon entering, with a value of 75 000 €/MWp. The financial security can be in the form of bank guarantee or direct money transfer to OKTE's account. There is only this one-stage bid bond which is returned in case of not winning in the auction, or in case of winning it is returned upon.	For systems between 500 kWp and 2 MWp, participation in the auction is a pre-requisite. The feed-in premium is set to a maximum of 84,98 €/MWh.	*Addressed to national/regional/local authorities:* • Develop supporting legislation.
Monitoring / Maintenance	-	-	-
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • No recycling facilities in Slovakia. • Environmental legislation doesn't create a suitable environment for the creation of sustainable business models. • Organizations exist such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. However, their activities in Slovakia are still limited.	-	*Addressed to organizations:* • Expand organization recycling activities (local collection and recycling).

3.13 Slovakia – Rooftop PV

Currently, in Slovakia, the deployment of rooftop PV installations is facing multiple obstacles. Steps such as administrative authorization, access to business models and recycling meet many minor constraints, only technical authorization is facing major constraints.

Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV system.

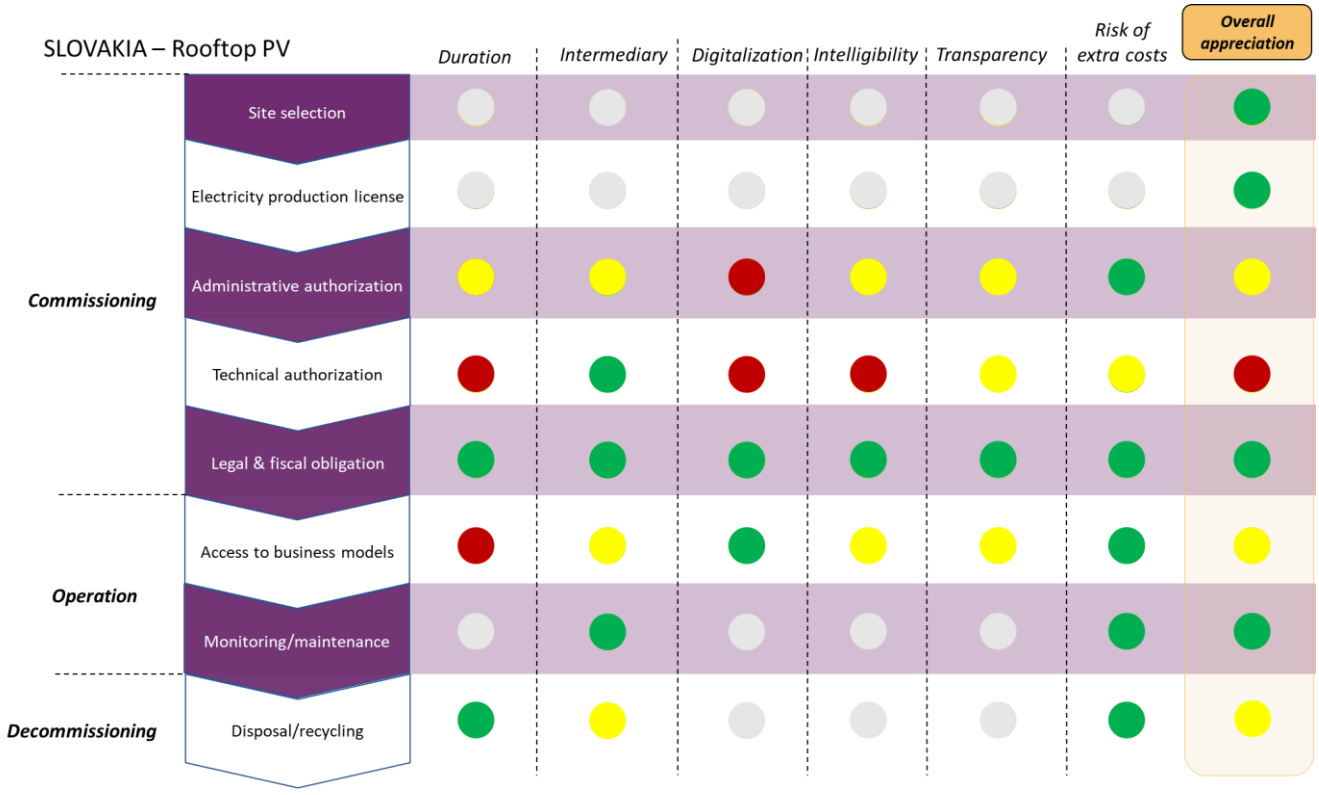
About the ***administrative authorization***, the permitting process is not unified across municipalities, which sometimes results in requirement for a full building permit as opposed to a much simpler notification. In addition, the whole process is not digitalized which leads to delays.

Concerning the ***technical authorization***, producers connected to local distribution networks often struggle because the operators of these networks are regularly denied access to the regional grids and occasionally, they deny grid connection of their potential prosumers. In addition, the process of grid connection permitting is largely non-digitalized, which leads to unnecessary delays. All in all, these constraints make this step a serious impediment to the deployment of rooftop PV systems in Slovakia.

Regarding ***access to business models***, no major obstacle exists, as feed-in tariff as well as self-consumption scheme are easily accessible. However, there is a limited access to advanced business models: providing flexibility or delivering surplus electricity to the grid are not yet legislatively supported (even though the situation is currently changing).

Lastly, no official ***recycling*** scheme for PV modules exists.

Table 3.33: Detailed evaluation of rooftop PV systems deployment in Slovakia



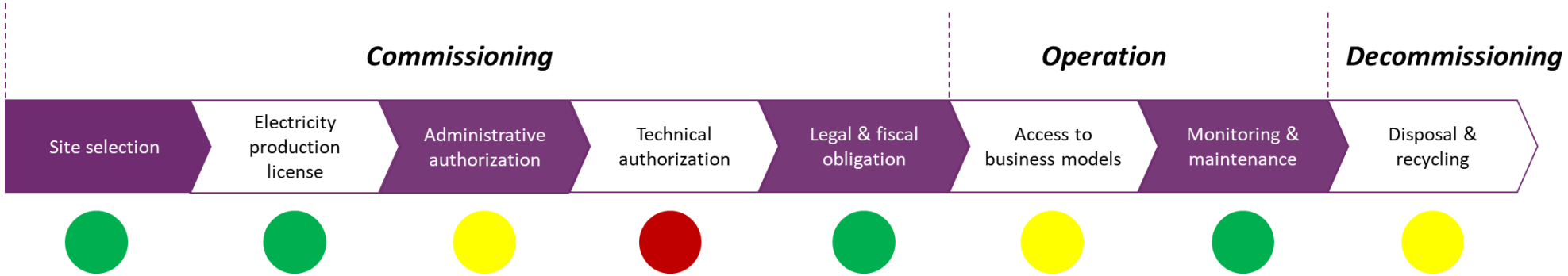


Table 3.34: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Slovakia

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	• Diverse entities prolong the environmental impact assessment (EIA) process. • Insufficient statical parameters of the roofs (mostly for older buildings) and deteriorating technical conditions of the roof cover are common constraints for deployment PV installations. • Also, there are rather strict statical requirements for snow loads.	Increased regulatory pressure to improve buildings' energy performances.	*Addressed to national/regional/local authorities:* • Standardized and simplified procedure. • Staff training (and team growth). • Digitalization of procedures.

	• The permitting process is not unified across municipalities, which sometimes results in requirement for a full building permit as opposed to a much simpler notification. Even in case of notifications the respective personnel at local building offices sometimes struggles with the scope of necessary documents. • The whole process is not digitalized which leads to delays.		
Technical authorization	• Grid connection permit: There is currently sufficient free capacity for PV projects with installed power up to 500 kWp. However, producers connected to local distribution networks (local grids serving e.g., for industrial areas and commercial centre) struggle with a major constraint because the operators of these networks are regularly denied access to the regional grids and occasionally, they deny grid connection of their potential prosumers. The process of grid connection permitting is largely non-digitalized, which leads to unnecessary delays. • Installation of the remote-control system is required. • Several stages produce delays (typically takes 6 months).	The process of getting a grid connection permit (i.e., grid connection contract) has been greatly improved since 2020 when the legislation of "Local source" was firstly introduced into the Renewable Energy Act no. 309/2009.	*Addressed to grid operators:* • Obligation for grid operators to fulfil their responsibilities. • Public support (through subsidy) for remote control system.
Legal & fiscal obligation		Electricity from renewable sources is partly exempted from tax (1,32 €/MWh are deducted).	-
Access to business models	• Limited access to advanced business models: providing flexibility or delivering of surplus		-

	electricity to the grid that are not yet legislatively supported. • There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.		
Monitoring / Maintenance	-		-
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • Recycling fees from special organizations eligible for electronic waste disposal. • No official recycling schemes for PV modules. • Organizations exist such as PV CYCLE which ensures the free collection of used solar modules at the end of their life. However, their activities in Slovakia are still limited.	-	*Addressed to organizations:* • Expand organization recycling activities (local collection and recycling).

3.14 Spain – Ground-mounted PV

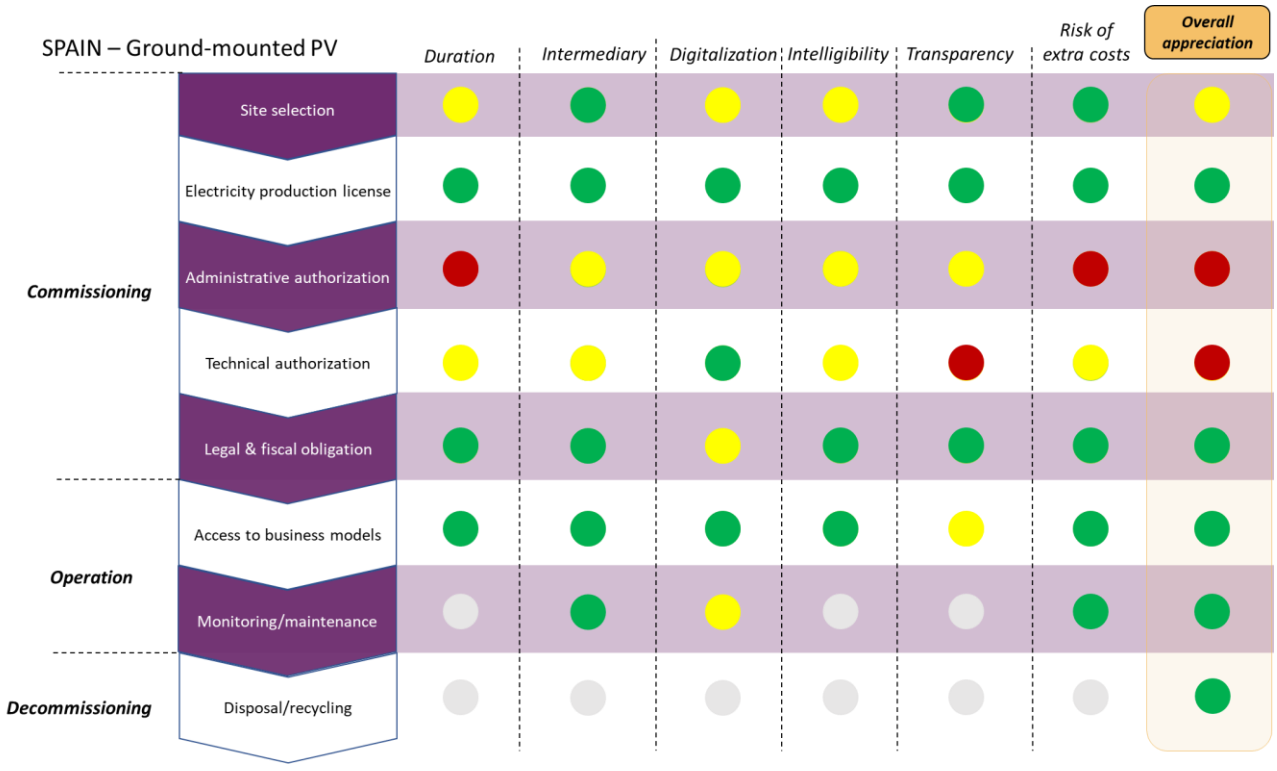
Currently, in Spain the deployment of ground-mounted PV installations is facing multiple obstacles. Commissioning steps (such as site selection) meet many minor constraints, but administration authorization and technical authorization are the commissioning steps facing major constraints.

Indeed, due to many land-use conflicts during the ***site selection***, this step could take longer than expected. In addition, non-simplified procedures and non-digitalized procedure for this eligible land make this site selection step even more complex.

About the ***administrative authorization***, multiple procedures make this step sometimes delayed. In addition, some procedures are on national level while others at regional level, resulting in completely inconsistent and unclear application system. Significant delays are often reported.

Concerning the ***technical authorization*** step, serious issues exist as well. First, significant delays are faced during the acquisition of the grid connection permit. Moreover, there is a lack of transparency in the submission of access and connection permits and a lack of information creating inconvenience for developers. All in all, these constraints make this step a serious impediment for the deployment of ground-mounted PV systems in Spain.

Table 3.35: Detailed evaluation of ground-mounted PV systems deployment in Spain



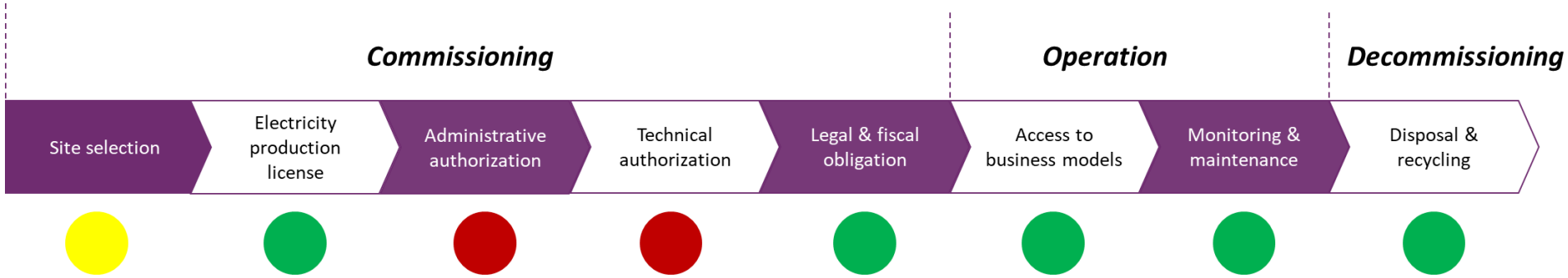


Table 3.36: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in Spain

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	• High competition for eligible land. • When it comes to negotiating site contracts, the lack of transparency in the process of obtaining access and connection permits can cause problems and uncertainty. (Amplified by the new access and connection rules and the organization of capacity tenders). • 200 €/ha per year of land reservation.	Improvements since regulation changed, forcing the developer to consult the information about available capacity on nodes and apply for a specific connection point accordingly.	
Electricity production license			
Administrative authorization	• Multiplication of procedure (duration of up to 2 years) vary a lot depending on National Level or Autonomous Community level.		*Addressed to national/regional/local authorities:*

	• There is a lack of consistency in administrative procedures (due to Autonomous Communities, municipality specifications). • Different timing based on the procedure (regional vs. national) and even different interpretation of the same legal documentation from regions to regions. • Unclarity and delays for repowering of installations. (If the project developer decides to add more capacity to the installations, it is needed to go through the whole process again (including the access and connection permits). • Once the deadlines for the acquisition of permits have been set by the directives, even more stress in put on the plannings and any substantial modification must be avoided in order not to have to go through a second Public Information period. • Total administrative cost of approx. 650 € (maximum limit of approx. 15 000€)		• Simplified procedure and harmonization between public administrations. • Reduce the maximum delays of issuance. • Ease process for repowering installation (simplified administrative procedure).
Technical authorization	• Delays in grid access and connection permits. • Lack of transparency in the submission of access and connection permits and lack of information creating inconvenience for developers. • 10% of total interconnection costs to be paid in advance to REE. • Grid code compliance study costs approximately 30 000 €	Government will push TSO to reinforce the grid so that more renewable capacity can be integrated (between 2023 and 2025).	*Addressed to grid operators:* • Rising capacity limit to access simplified procedure. • Standardized forms. • Code of conduct for administrative application to reduce rejected projects and complexity of procedures.
Legal & fiscal obligation	• 7% tax on the revenues associated with injected electricity (called Tax on the Value of Electricity Generation) must be paid. Due to exceptional	Local tax reduction (case-by-case).	

	measures taken to reduce the electricity cost, now in 0,5%. • 3 000€ for min capital of SPV.		
Access to business models	• Corporate PPA market in Spain used to be flourishing, now it is slowly decreasing so offtake securisation gets more complicated even though possible. Indeed, there are huge uncertainties on the future electricity prices. High electricity prices make the direct sale of electricity more profitable • Auction participation cost is approximately 800 €/MW, according to private PPA schemes.	Trends organised by governments.	*Addressed to national/regional/local authorities:* • Develop alternative to sold electricity surplus.
Monitoring / Maintenance			
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	• Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer. • Obligation of recycling fee for PV plant owners / operators, which could help business models in recycling (e.g., France)	

3.15 Spain – Rooftop PV

Currently, in Spain the deployment of rooftop PV installations is facing many obstacles. Commissioning steps (such as administrative authorization, technical authorization, and legal & fiscal obligation) meet many minor constraints, but access to business models is facing major constraints.

Trivially, the ***site selection*** and ***electricity production licensing*** steps are not applicable to rooftop PV systems.

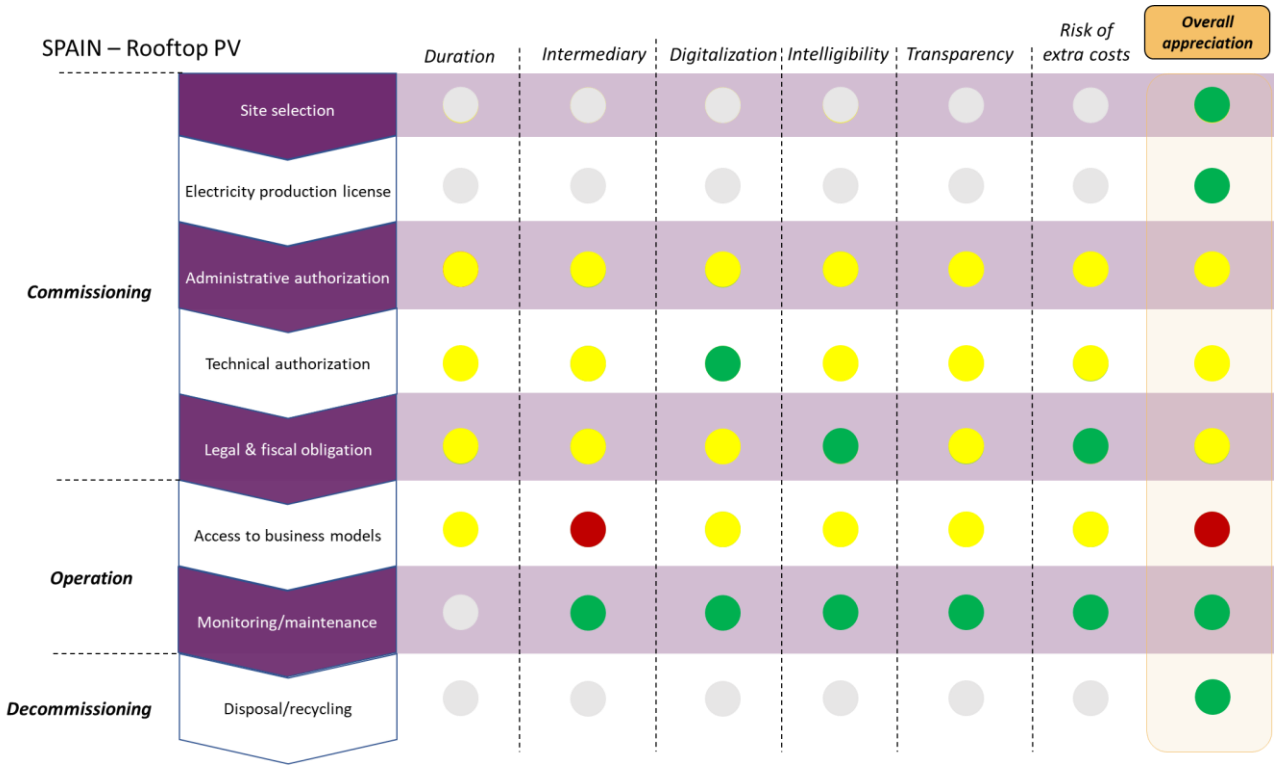
About ***administrative authorization***, multiple procedures make this step often delayed. In addition, municipalities are sometimes requiring additional reports, resulting in completely inconsistent system.

Concerning the ***technical authorization*** step, issues exist as well. Many minor issues are faced during this step. Indeed, it requires a legalisation project to be submitted and accepted by the DSO which usually is a long process.

Regarding ***legal & fiscal obligation***, tax and trading rules deter operators of small rooftop PV systems.

Finally, about ***access to business models***, self-consumption schemes with/without compensation are accessible. However, legal framework is still under development resulting in unclear application. In addition, for instance, for collective self-consumption it is necessary to interact with the DSO and the utilities of every prosumer causing many delays (even worse in case of any modification in the arranged energy communities).

Table 3.37: Detailed evaluation of rooftop PV systems deployment in Spain



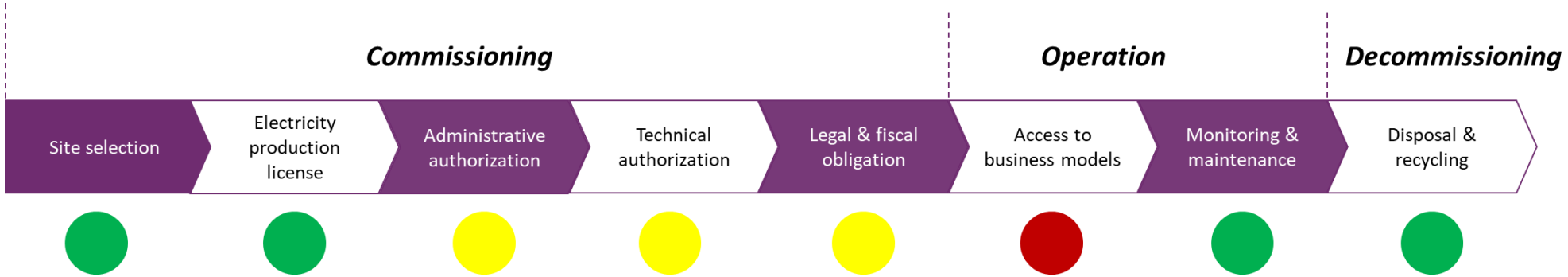


Table 3.38: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in Spain

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	• Some municipalities require additional technical reports, like load analysis of the building, to provide work license. • Only 20% of municipalities have online procedures. • Total administrative cost approx. 500 €. This includes work license required by some regional Governments (6 of 17) and administrative authorization (Industry Ministry).		*Addressed to national/regional/local authorities:* • Standardization of technical requirements for work license (engineering technical report, waste management plan, load analysis).

Technical authorization	• Requires a legalisation project to be submitted and accepted by the DSO (long process) when nominal power is higher than 10 kWp. • Technical requirements regarding BTM (Behind-The-Meter) storage solutions are still under development. • Total grid connection permit cost approx. 300 € (Not required for installations with lower nominal power than 15kWp or 100kWp without zero grid injection kit.)	• Grants covering up to 40% of the installation costs are launched from time to time in different Autonomous Communities. • Now most of the Regions are allocating funds for the investment on PV through the EU Recovery Funds.	*Addressed to grid operators:* • Reduce of the maximum delays of issuance. • Simplified and digitalized procedure. • Standardization of technical requirements. • Certification process should ease the development of new zero injection kits allowing to work with unbalanced systems and EMS (Energy Management System) controlling jointly PV, storage and flexible loads.
Legal & fiscal obligation	• 7% tax on the revenues associated with injected electricity (called Tax on the Value of Electricity Generation) must be paid. • Tax and trading laws discourage small rooftop PV system operators. • The complexity of registering a commercial corporation is a significant hurdle for operators of small rooftop PV installations.	The “Sun tax”, which was applicable for all systems above 10 kWp doing self-consumption has been removed in 2018.	*Addressed to national/regional/local authorities:* • Tax on the Value of Electricity Generation should be reduced. As of 2022, reduced to 0,5% to control high electricity prices. • Progressive anti-bureaucratic legal measurements. • Development of trading rules to ensure cost-effective and viable environment for small rooftop PV system operators.
Access to business models	• There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". However, it is not yet highly developed, as regulatory frameworks are recent or not yet completely transcribed into	Self-consumption schemes (with/without compensation) are applicable. While excess PV production is valued either through net-billing scheme (for systems < 100 kWp) or at wholesale electricity price (for systems > 100 kWp).	• Development of a legal framework for energy communities (dynamic environment with incentives and simplified procedure). • Net-billing possibility should be extended to higher PV capacities than 100kWp for large prosumers.

	national law. Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers. In addition, any modification is only allowed once a year, making it difficult to add new members or adjusting parameters to real needs. • Modifications on the regulation regarding sharing coefficients of collective self-consumption (firstly constant, now variable but not dynamic), due to the technical difficulties argued by the DSOs.		• Sharing coefficients in collective self-consumption must be dynamic.
Monitoring / Maintenance	-	-	-
Disposal / recycling	• In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components. • 3 €/kWp for waste management (wood, wiring, plastic, cartoon) at construction stage. (Obligation on the part of the PV system owner/project developer to set aside funds)	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

3.16 The Netherlands – Ground-mounted PV

Currently, in Netherlands, the deployment of ground-mounted PV installations is facing many obstacles. Commissioning steps (such as site selection and technical authorization) as well as access to business models meet many minor constraints, only administrative authorization is facing major constraints.

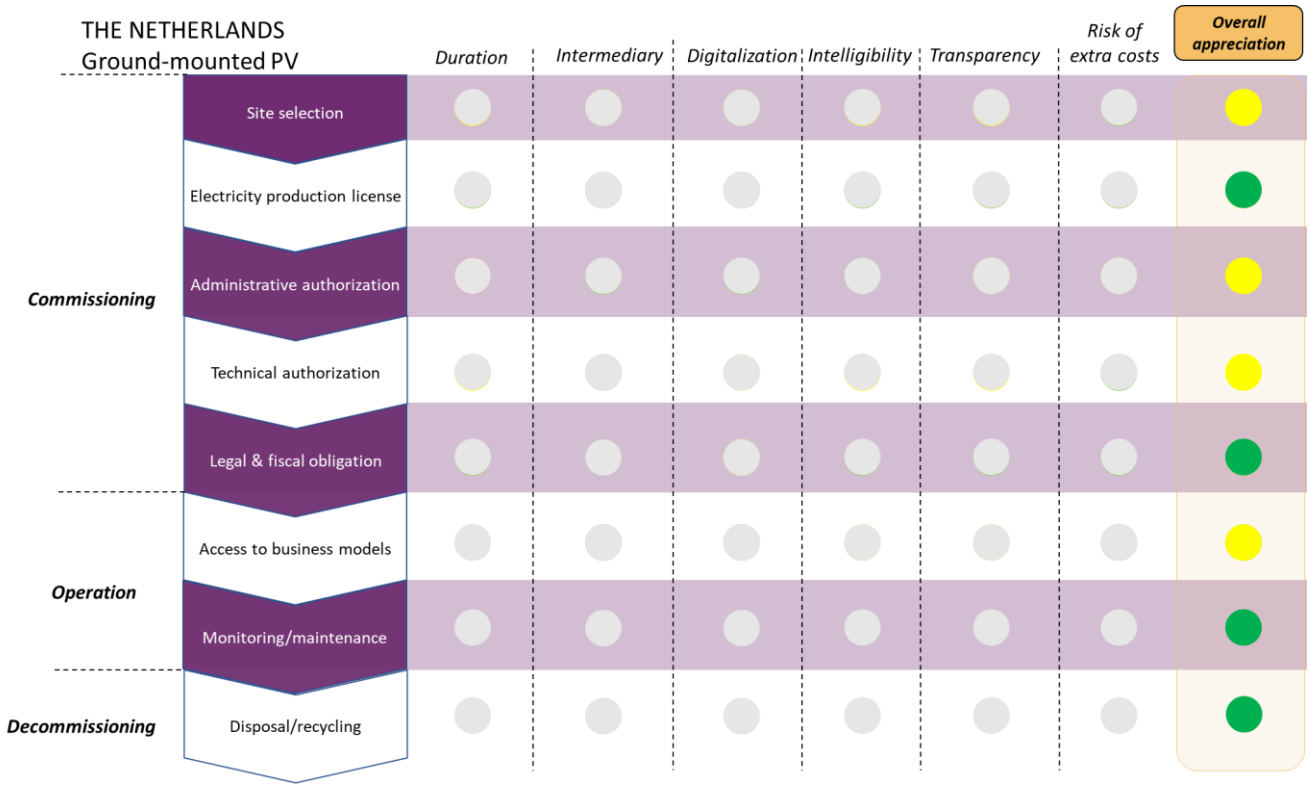
Indeed, during the ***site selection***, it is difficult to search for eligible land, making this step longer than expected.

About ***administrative authorization***, multiple procedures make this step sometimes delayed.

Concerning the ***technical authorization*** step issues exist as well. Indeed, a specific time frame for connecting these plants is specified in the terms of the agreement negotiated by the parties, however, no legal framework around this arrangement exists.

Regarding ***access to business models***, net-metering or feed-in premium (SDE++) are easily accessible. However, realization period for PV to be eligible for the SDE++ subsidy sometimes cause problems. Indeed, the PV project must be completed within two years of the grant decision being made. If the project is not completed within that deadline, the project developer is not eligible for another year of SDE++ funding. This results in a slightly constraining step.

Table 3.39: Detailed evaluation of ground-mounted PV systems deployment in the Netherlands



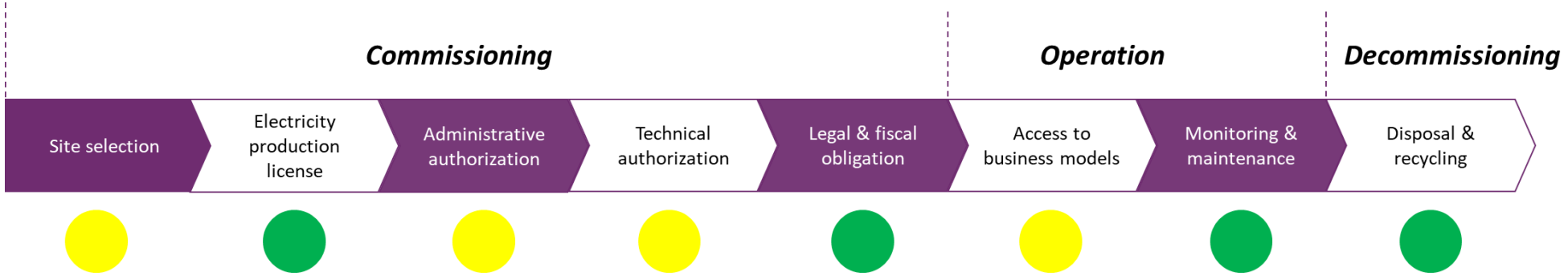


Table 3.40: Summary of economic and legal constraints, opportunities, and recommendations for ground-mounted PV system in the Netherlands

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	Difficulties with searching eligible land. Moreover, development of solar parks (on agricultural land) led to a rise of land prices. As a result, there is a reluctance from both concerned (agricultural industry and solar industry).		*Addressed to national/regional/local authorities:* • Digitalized map of eligible land. • Surface optimization: (1) favour ground-mounted PV installations on uncultivated, abandoned, or degraded land and (2) develop agriPV.
Electricity production license			
Administrative authorization	• Multiplication of permits and procedures: An All-in-One Permit for Physical Aspects is always required for ground-mounted PV	• Code of conduct to simplify procedures. (Environmental organizations also signed the Code of Conduct, resulting in a good	*Addressed to national/regional/local authorities:*

	systems (This also applies to floating PV systems). • A Water Permit is required for PV installations on waterways.	collaborative arrangement between developers of ground-mounted PV projects and opposing entities. The Code is primarily concerned with effective management and practice. It even has a complaint system in place if the rules are not followed, as well as its own evaluation committee made up of officials from the sector and environmental organizations).	• Simplified and harmonized procedure.
Technical authorization	• Grid is highly congested. These grid bottlenecks reduce the chance of development of PV installations. Moreover, grid congestion management does not appear as effective yet. • A certain "transport Indication" is required (i.e., time frame for connecting these plants is specified in the terms of the agreement negotiated by the parties), but no legislative framework exists (in addition, no possibilities to negotiate for transport indication, neither to apply a second time).	• Public map of grid availability exists. • Grid operators invest in expanding, maintaining, and strengthening the electricity network.	*Addressed to grid operators:* • Grid congestion management improvement. • Develop legislative framework to clarify grid connection permit and ensure more transparency.
Legal & fiscal obligation		Federal Tax Incentives for businesses and professionals (45% reduction on annual taxable income).	
Access to business models	The PV project must be completed within two years of the grant decision being made. If the project is not completed within that deadline, the project developer is not eligible for another year of SDE++ funding.	• Feed-in premium (≥ 15 kWp) is applicable (so-called SDE++). • Investment aid is applicable for system between 15 and 100 kWp. • Trends organised by governments.	

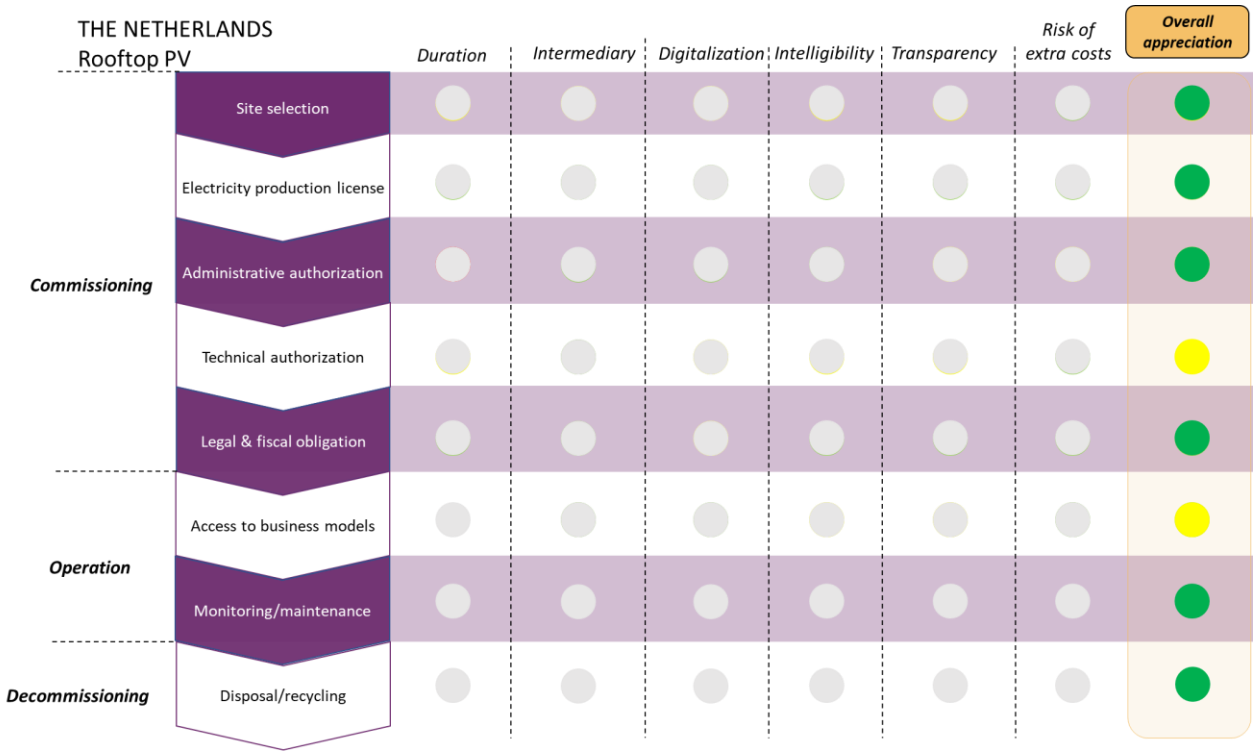
Monitoring / Maintenance			
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	-

3.17 The Netherlands – Rooftop PV

Currently, in Netherlands, the deployment of rooftop PV installations is facing no restrictive obstacles.

Indeed, concerning ***access to business models***, net-metering or feed-in premium (SDE++) are easily accessible. However, realization period for PV to be eligible for the SDE++ subsidy sometimes cause problems. Indeed, the PV project must be completed within two years of the grant decision being made. If the project is not completed within that deadline, the project developer is not eligible for another year of SDE++ funding. This results in a slightly constraining step.

Table 3.41: Detailed evaluation of rooftop PV systems deployment in the Netherlands



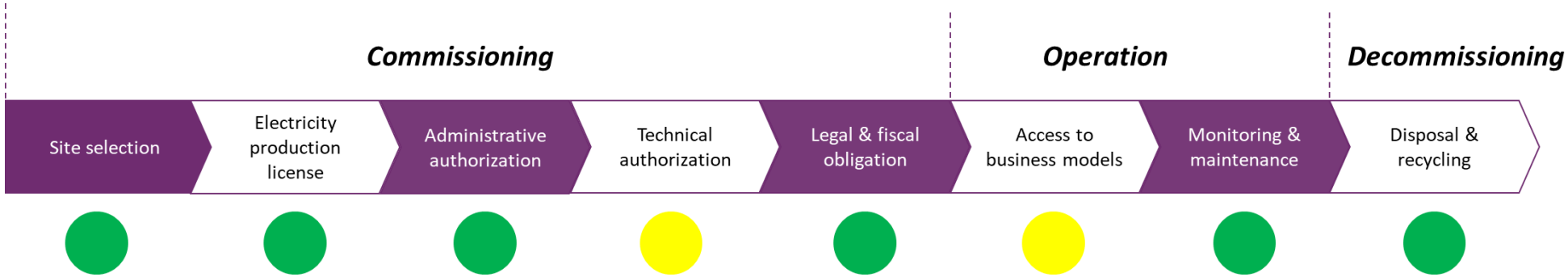


Table 3.42: Summary of economic and legal constraints, opportunities, and recommendations for rooftop PV system in the Netherlands

PV deployment steps	Constraints *(Elements that usually slow down the deployment of PV installations)*	Opportunities *(Elements already present in this specific country, that could accelerate the deployment of PV installations)*	Recommendations *(Suggested elements that are not yet present in the country and may help accelerate the deployment of PV installations)*
Site selection	-	-	-
Electricity production license	-	-	-
Administrative authorization	-	Rooftop PV systems are usually exempt from requiring a permit.	-
Technical authorization	Grid is highly congested. These grid bottlenecks reduce the chance of development of PV installations. Several PV system owners claim to have been left without access to the grid despite the completion of their rooftop installation. Moreover, grid congestion management does not appear as effective yet.	Grid operators invest in expanding, maintaining, and strengthening the electricity network.	*Addressed to grid operators:* • Grid congestion management improvement.

Legal & fiscal obligation		• Federal Tax Incentives for businesses and professionals. • 45% reduction on annual taxable income.	
Access to business models	• Long realization periods for PV. To be eligible for the SDE++ subsidy, the PV project needs to be realized within 2 years from the moment of the granting decision. • There is a growing interest in energy communities (i.e., shared generation or peer-to-peer), based on the definition given by the European Commission on "Renewable Energy Community" and "Citizen Energy Community". Moreover, some specific restrictions/conditions (local perimeter such as same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.	• Net-metering (< 15 kWp) is applicable. • Self-consumption is allowed. • Feed-in premium (≥ 15 kWp) is applicable (so-called SDE++). • Investment aid is applicable for system between 15 and 100 kWp (so-called ISDE). • Collective self-consumption (called also “postcode roos”) concept exist already since years in national decrees. Initially, it was a tax discount that is refunded directly to each member of a cooperative. Since April 2021, it has been replaced by a Cooperative Energy Generation Subsidy Scheme (SCE), replacing tax rebates with subsidies.	-
Monitoring / Maintenance	-		-
Disposal / recycling	In accordance with the WEEE directive, there is a legal obligation for manufacturers to recycle PV modules, as well as other electrical components of PV systems, at the end of their useful life. However, the ease of this step can be hindered in some cases by the number of intermediaries involved in the process of collecting modules and other components.	Organizations exist/operate such as PV CYCLE which ensures the free collection of used solar panels at the end of their life. This free of charge comes from a small prior payment, paid by the end customer.	

4 BUSINESS MODELS

4.1 Characterisation of business models

Until recently, most of the business models applied to solar PV systems, whether distributed or centralized, relied on **subsidies**. These subsidies can be of various forms: direct capital subsidies, green certificates for each kWh generated, advantageous tariff for the fed-in electricity, net metering or net billing.

All in all, these "conventional" business models applied to solar PV systems can be described in function of five main parameters: the type of ownership, the type of self-consumption (if applicable), the valuation method of the (excess) electricity, the additional benefits, as well as the additional costs and taxes. For each of these parameters, different options exist, which are highly dependent of the legal framework(s) existing at various levels (local, regional, national or supranational).

Note that multiple other parameters could have been selected to characterize business models designed for solar PV systems, such as the stakeholders involved, the sales channel(s) used or the main objective(s) of the project (profit generation, energy independency…). The parameters presented and discussed here have been selected as they are directly related to the **legal and economic constraints or opportunities** treated in this report. That is to say, the possible options for these parameters directly depend on the applicable legal frameworks, and that they have economic consequences due to their central role in business model's definition.

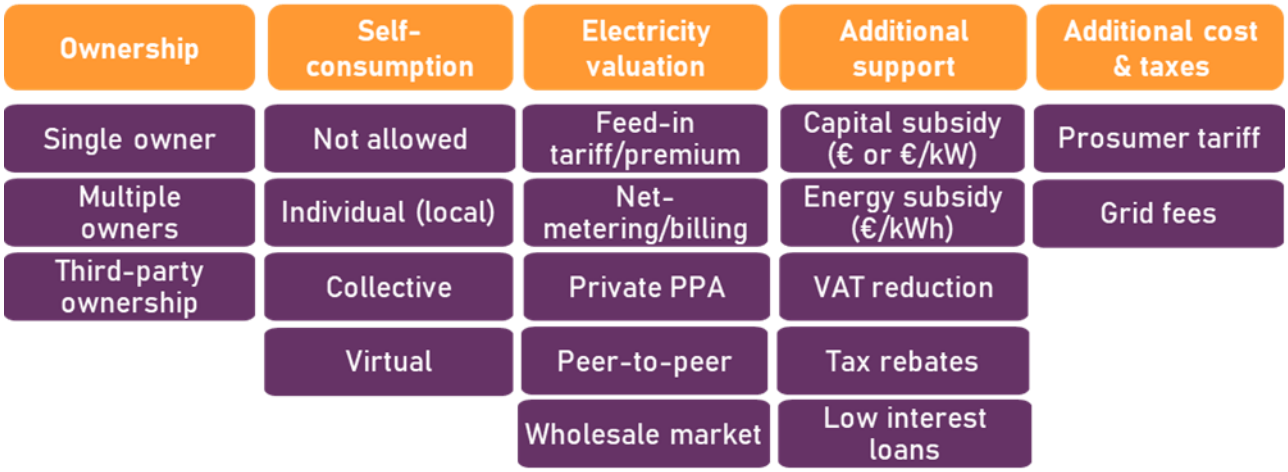


Figure 4.1: Simplified overview of the main parameters used to characterize business models applicable to solar PV systems

The diagram here above shows in a simplified way the different options possible for these five main business model's parameters.

- Regarding the "**ownership**" parameter, three options are presented, with the most straightforward being the single ownership, typically encountered for rooftop PV installations, in particular in the residential and commercial segments. Other types of ownership exist, with the "multiple owners" options, for instance when a special purpose vehicle is established for a utility scale PV system, gathering different investors, or in the case of some energy communities. Third-party ownership means that the owner of the system is different from the stakeholder self-consuming the produced PV electricity. It is specific to the distributed segment. Individual self-consumption, also called "local", means that PV electricity is consumed on site by a single user. This is most straightforward and conventional type of self-consumption. Collective self-consumption is very similar, the only difference is that within the same building, multiple consumption points exist, such as in the case of a multifamily housing. Finally, virtual self-consumption means that production and consumption

occur at different locations and that the link is not direct, such as a in the case of an energy community at the scale of a neighbourhood.

- Then, the "**self-consumption**" parameter's options indicate how the produced electricity is self-consumed (if allowed) and applies to distributed PV applications.
- The options for "**electricity valuation**" parameter indicate how the electricity that is not self-consumed (in the case of distributed PV applications) or the entire electricity production is valued (in the case of centralized, ground-mounted PV systems).
- "**Additional support**" parameter is quite broad and gathers the other available sources of economic support, direct or indirect, aside of electricity valuation. These options are potentially both applicable to distributed and centralized PV systems.
- Finally, the "**Additional cost and taxes**" parameters aim at listing exceptional cost and taxes linked to the installation of a solar PV system. This mainly concerns distributed PV applications but could also relate to centralized PV ones.

4.2 Conventional business models

Based on this simplified template diagram, the typical business models applied to distributed (rooftop) or centralized (ground-mounted) PV system today in various countries can be described. Some of these representations are listed afterwards, using a simplified colour code. For each parameter, options can be highlighted in purple, hidden in light purple, or stripped with a mix of both colours. The purple indicates that this option is applicable for this parameter, in the case of the described business model. Light purple indicates that this is not applicable, while the stripped colour mix indicate that this option is applicable in certain cases only.

Note that not all business models for all analysed countries, but only the most typical ones.

On the diagrams shown below, four conventional business models applied to **rooftop PV installations** in the studied countries are represented:

1. The first one on the top left (Figure 4.2) has historically been witnessed in Germany and France, and still exists. It is both applicable to small-scale (residential) PV systems and medium-scale ones (commercial up to 750kWp in Germany and up to 500kWp in France). In such business model, the investor usually is the owner of the system and benefits from the produced electricity, which is self-consumed locally (i.e., in the building). The excess electricity is injected into the grid, valued via a feed-in tariff (in France) or, more recently, via a feed-in premium (in Germany). These are secured for a period of 20 years. In such case, the excess electricity is sold at approximately the wholesale market price. The difference with the feed-in value is then covered by the government through the premium, in order to reach a total value per kWh equal to the amount agreed upon.
2. The second business model, shown on the top right (Figure 4.3), has historically been witnessed in France, and still exists. It is both applicable to small-scale PV systems (residential) PV systems and medium- to large-scale ones (industrial up to 8 000kWp). In such business model, the investor usually is the owner of the system and self-consumption is forbidden. The total electricity produced is injected into the grid, valued via a feed-in tariff (in the case of systems up to 500kWp). For small-scale residential systems, an investment premium exists as well, under the form of an amount provided in € per each kWp installed. For rooftop PV systems bigger than 500kWp (up to 8 000kWp), tenders are organised, and participants are bidding for a feed-in premium and self-consumption is also not allowed, as the entire production has to be injected into the grid. These feed-in tariffs and premiums are secured for a period of 20 years.
3. The third conventional business model presented on Figure 4.4 has been historically applied in the Netherlands, Italy and Belgium to residential rooftop PV systems. It is still applied in the two formers, and only remains in Belgium in the region of Wallonia. In such business model, the investor usually is the

owner of the system and benefits from the produced electricity, which is self-consumed locally (i.e., in the building). The excess electricity is injected into the grid, valued at the full retail electricity price (in the case of net-metering) or at the partial retail electricity price (in the case of net-billing). It is worth noting that in the case of net-metering in Wallonia, a prosumer tariff is applied to PV systems' owners.

4. The fourth and last business model presented focuses on the case of residential PV systems installed in Brussels, Belgium. It has been existing since 2020, replacing the net-metering based business model that had existed for many years in the region. Under such business model, the investor usually is the owner of the system and benefits from the produced electricity, which is self-consumed locally (i.e., in the building). The excess electricity is injected into the grid and valued at the wholesale market price of electricity (or at a higher value), depending on the amount agreed upon in the contract signed between the owner of the system and the buying utility company. In addition, the PV system owner benefit from "green certificates" for a duration of 10 years, i.e. a subsidy given for each MWh produced.

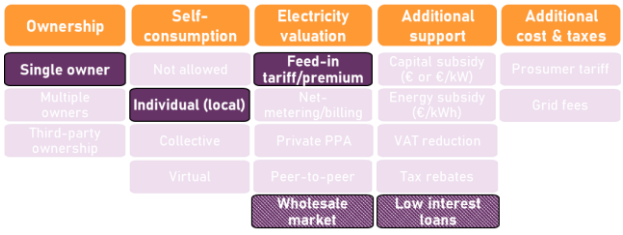


Figure 4.2: Conventional business model 1 – Residential and C&I rooftop PV (Germany, France)

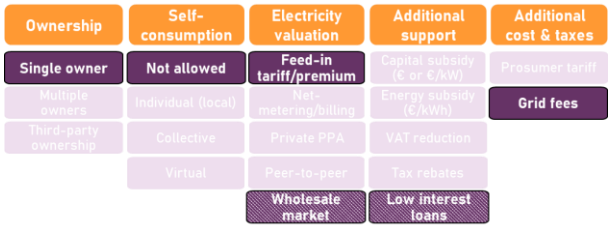


Figure 4.3: Conventional business model 2 – Residential and C&I rooftop PV (France)

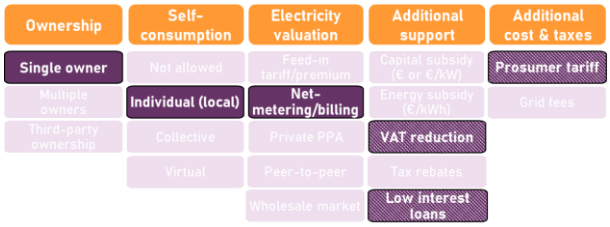


Figure 4.4: Conventional business model 3 – Residential rooftop PV (Belgium (Wallonia), Netherlands or Italy)

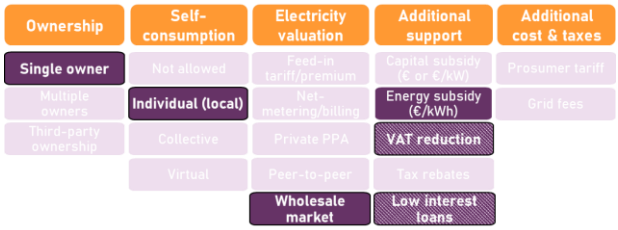


Figure 4.5: Conventional business model 4 – Residential rooftop PV (Belgium (Brussels))

Focusing then on **centralized, ground-mounted PV systems**, various typical business models can be identified as well. These are presented on the two diagrams below:

1. The first conventional business model is relatively similar to what was described above for rooftop PV systems, in the case of a feed-in tariff or feed-in premium based business model. In such business model, historically witnessed in many countries, the entire production of the ground-mounted PV plant is valued via a feed-in tariff. Or, in other words, sold through a PPA with the government. More recently, in many countries (France, Germany, Netherlands, among others), the feed-in tariffs have been replaced by feed-in premiums. In such case, the PV electricity produced is sold on the market and the government then covers the difference (if any) with the agreed upon feed-in premium.

2. The second business model is specific to Belgium and has been applied for many years to ground-mounted PV installations in Wallonia and Flanders. In this case, the entire electricity production of the ground-mounted PV systems is sold on the market or through a private PPA, and a subsidy is received for each MWh produced, on a yearly basis. These are called "green certificates" and are (or were) attributed for a duration of 10 or 15 years. Note that in Flanders, this system has been recently replaced by tenders. Nonetheless, the system remains quite similar, as applicants bid through this tender for a bonus (in €/kWh) to be received for each kWh produced, in addition to the value received on the market or through the private PPA they established.

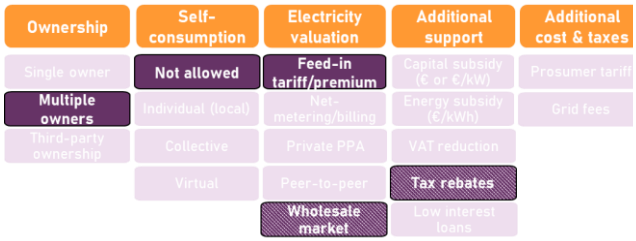


Figure 4.6: Conventional business model 1 – Ground-mounted PV (France, Netherlands, Germany, Spain, Poland or Italy)

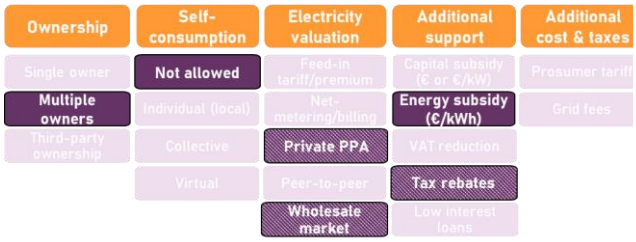


Figure 4.7: Conventional business model 2 – Ground-mounted PV (Belgium)

These conventional business models all have in common to be based on subsidies (feed-in tariff, net-metering, energy-based subsidies) or partial subsidies (feed-in premium). In many countries, these business models remain the most common. Nevertheless, as the sector is maturing, business models are slowly shifting away from subsidy reliance, being increasingly linked to the market value of PV electricity and reliant on self-consumption, in the case of distributed PV systems.

4.3 Advanced business models

As evoked in the previous section, business models applied to solar PV systems are less and less subsidy reliant, as support schemes are being phased out in many European countries. The concept of "feed-in premium" replacing the older "feed-in tariff" concept is the best example of this trend. In this section, non-conventional business models, called "advanced", will be presented. These business models are called "advanced" because they remain uncommon in many locations. In some cases, this can be explained by the fact there more economically attractive alternatives exist. For others, there simply is a lack of appropriate regulatory framework(s). Another possible explanation is that these regulatory framework(s) exist but are new. Thus, stakeholders' awareness remains low, explaining the limited spread out of such business model. Finally, in a few cases, the regulatory framework(s) allowing to set up such advanced business models have been existing for quite some time (such as in Germany or France, for instance), but the level of complexity is so high and the economic attractiveness so limited, that they remain exceptional.

On the diagrams below, four advanced business models applicable to rooftop PV systems are presented. Some details are provided here:

1. The first advanced business model for rooftop PV systems at the top left (Figure 4.8) is very straightforward. It is totally independent of subsidies and relies on self-consumption as well as on the sales of the excess electricity on the electricity market, typically through an intermediary such as a utility company. This is a slight variance of the conventional business model 4 (Figure 4.5). The difference is that in this case, there is no subsidy to complement the revenues coming from self-consumption and electricity sales on the market.
2. The advanced business model 2 presented on the diagram on the top right (Figure 4.9) is also heavily relying on self-consumption. The difference is that the excess electricity is in this case valued through peer-to-peer exchange. For instance, by selling the energy to a neighbour. Such business model could exist in a small-scale energy community if the right regulatory framework is enacted.
3. The advanced business model 3 described on the diagram at the bottom left (Figure 4.10) also leverages the concept of energy community. In such business model, the production of the rooftop PV system, which is owned by multiple investors, is self-consumed in the same building through multiple consumption points (i.e., electric meters). The electricity that is not self-consumed can be either sold on the market, or through peer-to-peer, with a neighbouring building for example.

4. The last advanced business model presented also relies on the concept of energy community (Figure 4.11). The difference with the two previous ones is that the perimeter of the community is here significantly enlarged. Indeed, in this case the multiple owners of the PV systems are spread out across multiple buildings and share its generation. Each of the owner is self-consuming a part of the production, based on an agreed upon distribution key. Furthermore, the revenues generated by selling the excess electricity on the electricity market are also shared among PV systems' owners.

Note that in the case of the two last business models, third-party ownership is also possible, with an external entity owning and operating the rooftop PV system.

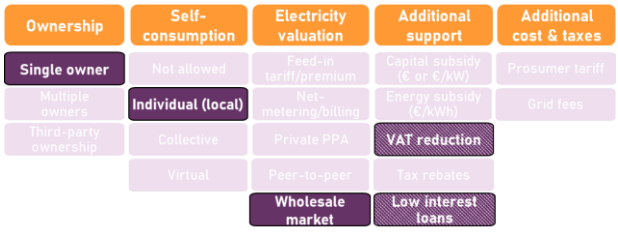


Figure 4.8: Advanced business model 1 – Rooftop PV system

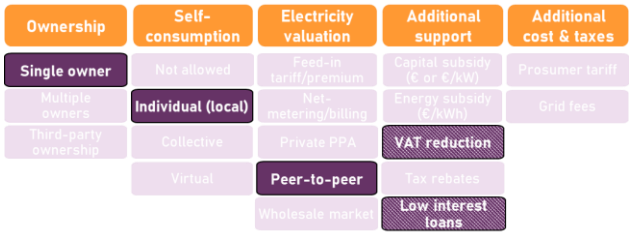


Figure 4.9: Advanced business model 2 – Rooftop PV system

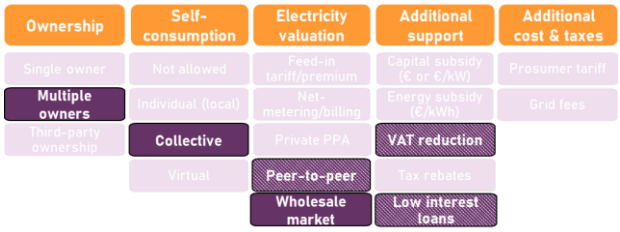


Figure 4.10: Advanced business model 3 – Rooftop PV system

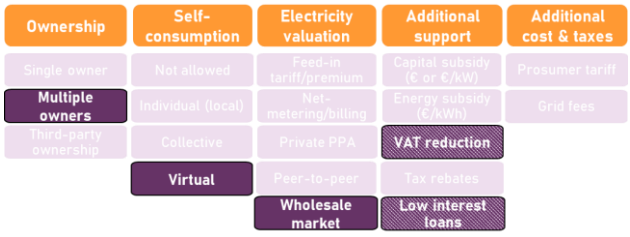


Figure 4.11: Advanced business model 4 – Rooftop PV system

Regarding advanced business models applicable to centralized, ground-mounted PV systems, the situation is less complex. The two business models presented on the diagrams below are advanced in the sense that they do not rely at all on subsidies. But these business models are not innovative: they already exist in multiple countries. However, they still represent a minority of business models applied to ground-mounted PV systems, as they are riskier and more complex to set up than subsidy-based business models, such as those relying on feed-in tariffs or feed-in premiums, presented previously on section 4.2.

1. The first advanced business model for ground-mounted PV systems, presented on the left (Figure 4.12), is based on a private power purchase agreement (PPA) signed with an end consumer. Many types of PPA are possible, should there be a direct link or not between the PV systems and the consumption point. In such business model, the production of the solar PV systems can be sold through multiple private PPAs, each serving a specific end consumer. It can also be completed by selling a share of the production on the electricity market.
2. The second advanced business model presented on the diagram on the right (Figure 4.13) is fully reliant on the market, as is sometimes called "merchant PV" business model. In this case, the entire production is directly sold on the wholesale electricity market. The advantage of such business model is that the PV system is independent of regulatory changes that could, for instance, impact the value of applicability duration of subsidies. On the other hand, it is extremely exposed to electricity prices' volatility, which makes it very risky.

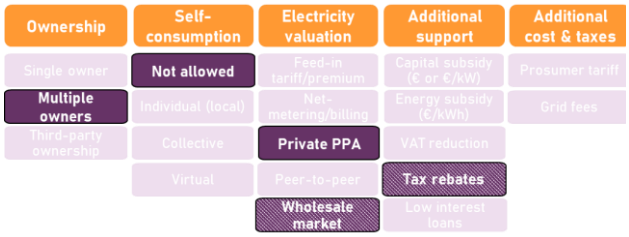


Figure 4.12: Advanced business model 1 – Ground-mounted PV system

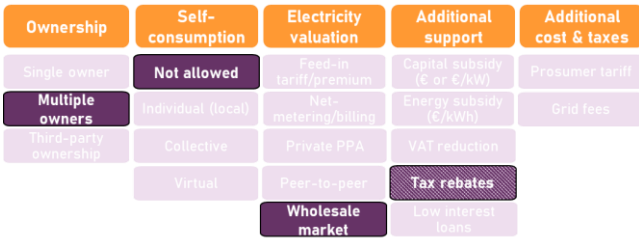


Figure 4.13: Advanced business model 2 – Ground-mounted PV system

4.4 Impact of legal and economic constraints

On the charts below, the business models presented above for solar PV rooftop and ground-mounted applications are placed according to two simplified axes. The horizontal axis relates to the way the (excess) electricity produced is valued, going from subsidy-based on the left, i.e. independent or partially independent of market's influence, to market-based on the right, i.e. fully dependent of electricity prices' fluctuations on the market. The vertical axis is focusing on legal constraints that can be faced to set up the listed business models, from no constraints at the bottom to many constraints at the top.

Focusing first on business models for rooftop PV applications, what clearly appears is that most of the conventional business models have been heavily subsidy-based, as already evoked. Currently, it is less the case as feed-in tariff and feed-in premium are much lower than in the past, but average self-consumption rates remain relatively low, especially in the residential segment (typically 30%) which demonstrates that conventional business models are still partially dependent on subsidies. The legal constraints faced to set up such business model are quite limited. On the other hand, the business models defined as advanced are much more dependent of electricity market trends and face more legal constraints to their implementations. These constraints can be of various nature, as developed on the country factsheets listed in Section 3. Among the main constraints witnessed, one can mention the fact that the regulatory frameworks defining what type of energy communities are allowed, including the activities they can undertake, are still missing, or poorly defined and/or too complex. This leads to an under representation of these business models for rooftop PV systems, even in countries where regulatory frameworks have been existing for multiple years (e.g., France with "A*utoconsommation collective*" or Germany with "*Mieterstrom*").

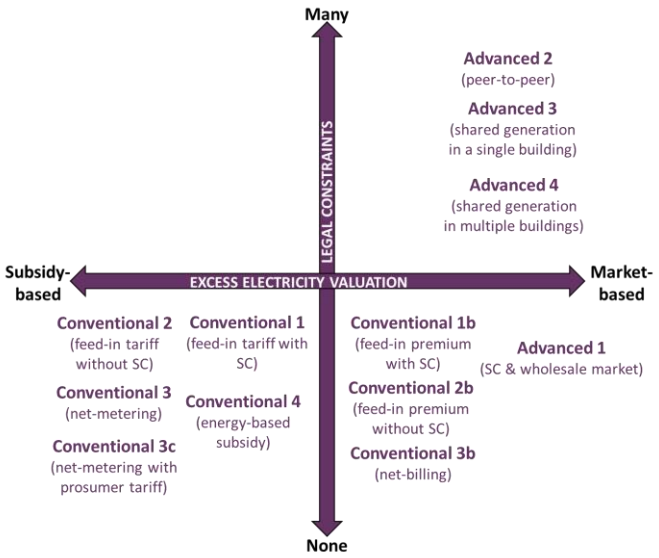


Figure 4.14: Positioning of rooftop PV business models in function of the associated legal constraints faced and the type of valuation for the excess electricity

It demonstrates that to maintain or improve the profitability of solar PV rooftop system in spite of the phase out of support schemes, there is still a lot of work to be done by decision-makers. Regulatory frameworks framing the set up and operations of energy communities must be enacted, with as understandable as possible rules, and sufficient freedom to use the public grid, for a fair remuneration. Even if there are no countries where the situation is critical, this is crucial to ensure the attractiveness of such business model and is part of the opportunities highlighted in section 3, as well as of the recommendations formulated.

Then, regarding the business models for ground-mounted PV systems, the situation is quite similar. The first thing that can be seen is that conventional business models are also heavily dependent on subsidies, to the exception of business models based on feed-in premiums, which are linked to average electricity market prices. The advanced business models shown are fully independent of subsidies, as they are based on private power purchase agreements or on the sale of the production on the wholesale electricity market. In the case of the business model "Advanced 2" relying on the sale of electricity on the market, the legal constraints are not heavier than in the case of convention business models. In some cases, these constraints could even be lowered, as there is no tender or application process to go through in order to receive the subsidies. On the other hand, when the business model is (partially) based on private PPA(s), the legal constraints might be heavier, as the contractual complexity can be increased, and the usage of the public grid (as the usage of private grid lines remain uncommon) can lead to some difficulties.

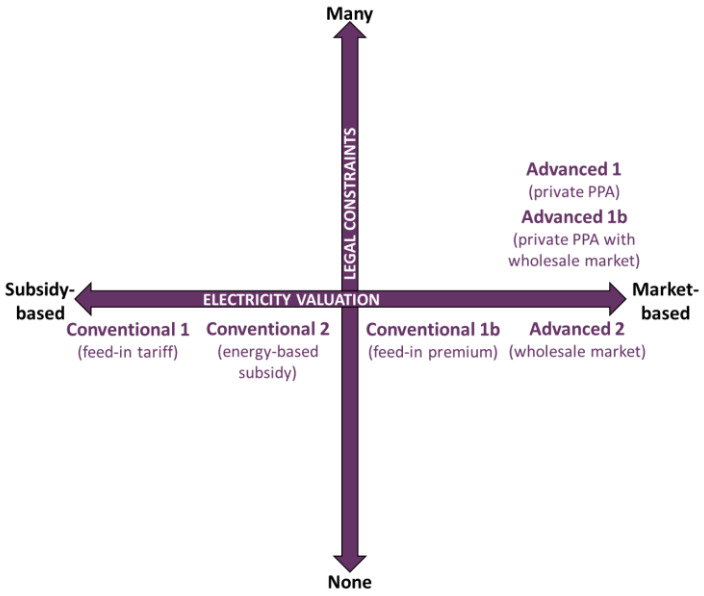


Figure 4.15: Positioning of ground-mounted business models in function of the associated legal constraints faced and the type of valuation for the excess electricity

All in all, although the situation seems less extreme than in the case of rooftop PV systems, it shows again that in order to fully exit the era of subsidy-based business models for ground-mounted PV while maintaining the profitability of solar PV, efforts are required on the regulatory side. Policymakers have a role to play to ensure that the right legal and business environment exist to allow the solar PV market boom necessary to achieve the decarbonisation of energy supply in Europe.

5 KEY TAKEAWAYS

Following the complete overview of the various legal/economic constraints and opportunities in each selected countries, a comparative analysis is conducted in this section. Note that although we analyse only a selection of European countries, it is considered that the situation in these selected countries can be seen as representative of the situation in the European Union, as all main solar PV markets are covered. Hence, the conclusions drawn for the set of countries studied in this report can be expanded to other countries in European Union.

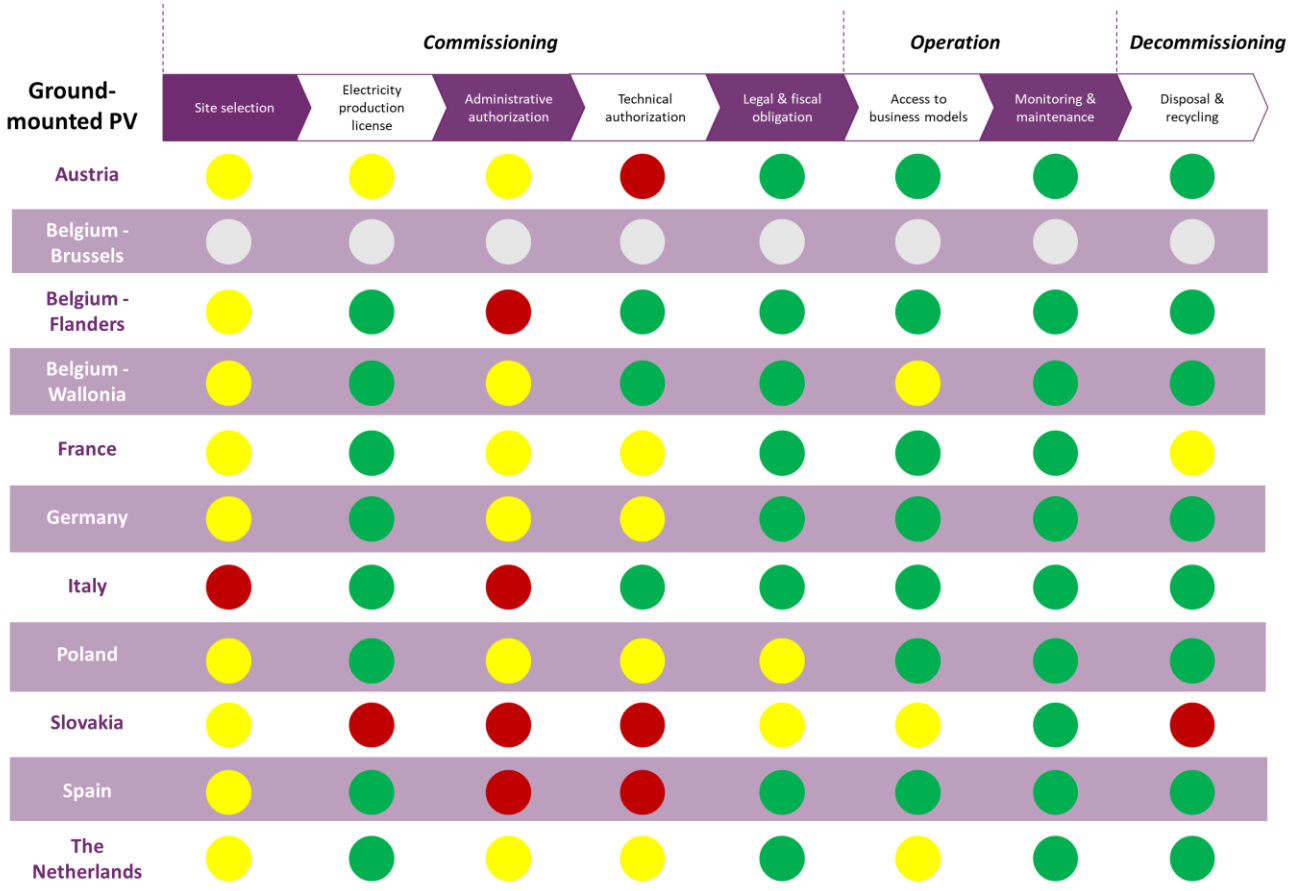
In this section, after highlighting the bottlenecks in the process of PV projects' deployment, solutions and suggestions to ease this process are presented, in line with the recommendations presented on the country factsheets of section 3.

The first conclusion that can be pointed out is that the legal/economic situation is very different between ground-mounted PV systems and rooftop PV systems. Thus, a separate analysis is conducted.

5.1 Ground-mounted PV

Regarding the deployment of ground-mounted PV in the analysed countries, three main steps seem to be mainly responsible of the slowdown of PV projects' development: *site selection, administrative authorization, and technical authorization*.

Table 5.1: Evaluation of ground-mounted PV systems deployment in Europe



Indeed, due to many land-use conflicts and the increased scarcity of suitable land, as defined by existing regulatory frameworks, the ***site selection*** frequently is a serious impediment to the deployment of ground-

mounted PV installations in European countries. Moreover, non-simplified procedures and non-digitalized mapping for this scarce eligible land make this site selection step facing even more issues. In conclusion, this land competition between the different sectors (agricultural, solar, etc) is among the main issues slowing down a potential massive development of ground-mounted in Europe. Fortunately, many solutions to solve this problem can be cited, such as an improved collaboration between involved parties. This could certainly help to reach an agreement concerning land competition, as resistance to change is often caused by a lack of awareness of the benefits of solar PV and possibilities exist to leverage synergies of use. Indeed, a good surface optimization could be achieved. Today, ground-mounted PV installations are mainly installed on non-cultivable, abandoned, or degraded land, but these areas are becoming scarce. Developing agriPV would allow to achieve a much wider deployment, through a combination of agricultural exploitation with solar energy production.

Regarding the ***administrative authorization*** step, this usually faces delays due to the multiplicity of procedures and intermediaries. In addition, these procedures are sometimes depending on regional or local authorities, resulting in an inconsistent and unclear application system across the country. Another frequently reported issue is the considerable quantity of appeals allowed, making the administrative authorities completely overwhelmed. A possible solution to these constraints could be a complete digitalization of the administrative procedure, combined with their simplification, thereby reducing procedures' complexity and the number of steps.

The last main step identified as a major bottleneck for the deployment of ground-mounted PV systems is the ***technical authorization*** step***.*** First, significant delays are often faced during the acquisition of the grid connection permit mainly due to overwhelmed grid operators but also due to highly detailed request documentations. Moreover, other issues can be cited, such as a lack of transparency of information in the submission of permits, the maximum capacity of the grid being approached in some areas, the limitation of the power that can be fed-in as well as unclear guidelines. As solutions, one can cite, trivially, a simplification of the procedure for the acquisition of the grid connection permit, as well as the digitalization of the procedure (i.e. automatic registration at the SCADA system of DSO, will be investigated in T6.3) or technical reinforcements of the grid, or the obligation to add storage systems to solar PV installations.

5.2 Rooftop PV

Regarding rooftop PV systems in Europe, three main steps seem to hinder their development: *administrative authorization, technical authorization*, and the *access to business models*.

Table 5.2: Evaluation of rooftop PV systems deployment in Europe

As for ground-mounted PV systems, the ***administrative authorization*** and the ***technical authorization*** steps generally face delays, for various reasons explained on the previous page.

The last main step identified as a bottleneck for the deployment of rooftop PV systems is the ***access to business models'*** step***.*** In contrast to ground-mounted PV systems, rooftop PV ones generally have access to a wider range of different business models, as already detailed in section 4. Although, as mentioned in the previous section, in many countries, uncertainties remain, mainly linked to the complexity of regulations framing advanced business models, when they exist. This results either in slowing down the deployment of the system or in impacting its revenues. In addition, many regional or local authorities have their own PV support schemes, impacting slightly the intelligibility of this step. Moreover, depending on the size of the installation, some countries oblige to participate to tenders, which can be a barrier for some project developers or investors. Concerning energy communities, unfortunately, it is still underdeveloped, in many countries, as regulatory frameworks are recent, or the European directive is not yet completely transcribed into national law. Furthermore, some specific restrictions/conditions (e.g., regarding the local perimeter of application, such as within the same buildings, blocks, etc or regarding tariffication) could lead to additional complexities and/or barriers.

5.3 Impact on the profitability of PV

An important element that should be pointed out is the potential impact on profitability of the factors listed above. In fact, regardless of the considered step along the whole process of PV deployment, delays can occur. However, not all these delays would have the same impact on the profitability of PV projects. Indeed, only the bottleneck steps (for ground-mounted PV: *site selection, administrative authorization, and technical*

authorization, for rooftop PV*: administration authorization, technical authorization, and the access to business models*) are facing sufficiently important delays or constraints, to cause significant extra costs or losses. As a result, the profitability of the PV project can be negatively impacted. Finally, instable/unclear framework leading to an increased complexity or non-favorable business models can also harm the profitability of PV.

5.4 Outlook

The constraints and obstacles highlighted in this report have already been identified by multiple stakeholders in the European solar PV sector, at national and supranational level. Recent international events have accelerated the urgency the tackle these issues in order to enable the massive and rapid deployment of solar PV systems on the continent. Due to the vulnerability of the European energy system, its dependence, insecurity of supply and the recent explosion of prices, some European countries are already facing critical economic and social consequences. As a result, decisions have been made in terms of investments in or development of solar PV installations. In this regard, the European Commission, has recently published its REpowerEU plan, which aims at ending European reliance on Russian gas before 2030. This plan includes among other recommendations to accelerate renewables permitting process. The objective is to reach a period as low as one-year permission process for ground-mounted solar PV projects, as opposed to the current average of two years.

As identified in this report, many steps (site selection, administrative procedures, etc) are key obstacles for investments/development in solar PV installations. The European strategy will look at how regulatory/economical bottlenecks may be removed to speed up renewable energy permitting and reduce the time it takes to implement projects and improve grid infrastructure.

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