IRENA PROJECT NAVIGATOR

IRENA
International Renewable Energy Agency

#InterSolar2017

Technical and Market Requirements for Solar PV Distributed Generation

Mini-grids & Residential PV Project Development

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IRENA PROJECT NAVIGATOR

Access practical information, tools and guidance for the development of bankable renewable energy projects

- A **learning section** with easy-to-access knowledge materials
- An **interactive workspace** to develop projects and track progress
- An **online search engine** to find renewable energy funding sources

NEW **Obtain project development guidance with 50+ tools for:**

Utility-scale Solar PV | Onshore Wind | Woody Biomass | Mini/ Microgrids | Geothermal Power | Solar Home Systems | Small Hydropower

www.irena.org/navigator

IRENA Panelists

Roland Roesch is the Senior Programme Officer, Renewable Energy Markets and Technology Dialogue at the International Renewable Energy Agency (IRENA). He worked for 15 years in the Oil & Gas and Utilities Industry as General Manager Power at Shell and Head of Division at E.ON. Preceding that, he worked as an Energy Market Consultant for Lahmeyer International and as researcher for renewable energies.

Simon Benmarraze is Analyst, Project Navigator at the International Renewable Energy Agency (IRENA). He has 7 years of experience in the renewable energy sector with expertise in project development, business development, capacity building and collaboration with policy, business, finance & academic stakeholders.

IRENA and the Project Navigator

Mini-Grids Project Development

Residential PV Project Development

Toolkit & Case Study

International Renewable Energy Agency

MANDATE

To promote the widespread adoption and sustainable use of **all forms of renewable energy (RE)** worldwide

OBJECTIVE

To serve as a **network hub**, an **advisory resource** and an **authoritative, unified, global voice** for renewable energy

SCOPE

All renewable energy sources produced in a **sustainable manner**

Project Development challenge

Challenges

The IRENA Project Navigator aims to strengthen the project development base, enhance the quality of proposals and increase their bankability, attracting better financing conditions.

- ✓ Most countries know they have RE potentials. However, they lack the projects to achieve the desired deployment.
- ✓ Conditions inherent to certain countries/regions translate into high costs and financial risks, *e.g.* SIDS.
- ✓ Stakeholders involved in a project often lack the know-how to complete a bankable project proposal.
- ✓ Fund securement process and financing options themselves aren't transparent.

Project Navigator platform overview

Learning Section

- Project development and technical guidelines
- Best practices
- Examples & Case Studies

Start a Project

- Personal and private workspace
- Tools, templates, checklists
- Stepwise approach
- Track your progress
- Export documents

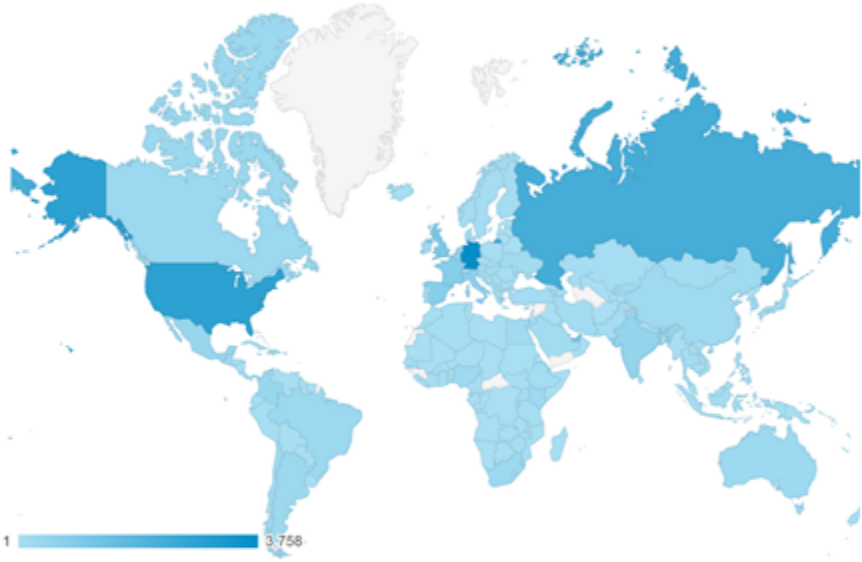
Financial Navigator

- Information on multiple funds
- Filter by region and technology
- Information includes fund types, requirements and contact details among others.

Project Navigator platform development

Current

- 3100+ registered users
- 600+ Projects in 190+ countries
- Online Technical Concept Guidelines:
  - Onshore Wind
  - Utility-scale PV
  - Bioenergy (Woody Biomass)
  - **Mini-grid applications**
  - **Residential PV**
  - Small Hydro



Roadmap

- New Technical Concept Guidelines
- **Outreach activities including workshops with project developers and governements**
- Case studies with IRENA member countries
- Strengthen cooperation with international partners

Technical Concept Guidelines

IRENA Project facilitation platforms

Cooperation with IRENA platforms

Global Atlas FOR RENEWABLE ENERGY

What you see

What is happening

Who's making it happen

Partner Countries

Cooperation with IRENA platforms

SUSTAINABLE ENERGY MARKETPLACE

PROJECTS

- Ensure visibility for projects
- Identify investors and advisors
- Share data

FINANCIERS

- Originate deals
- Project development support
- Co-financiers
- Find relevant country data

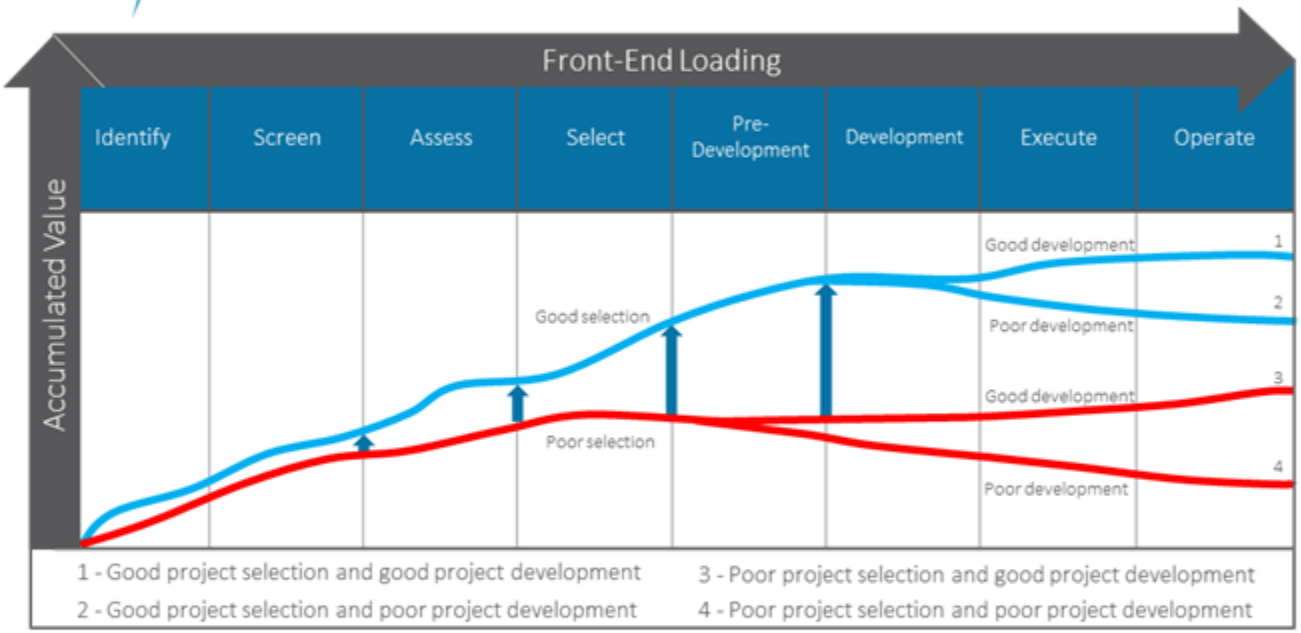
SERVICES & TECHNOLOGIES

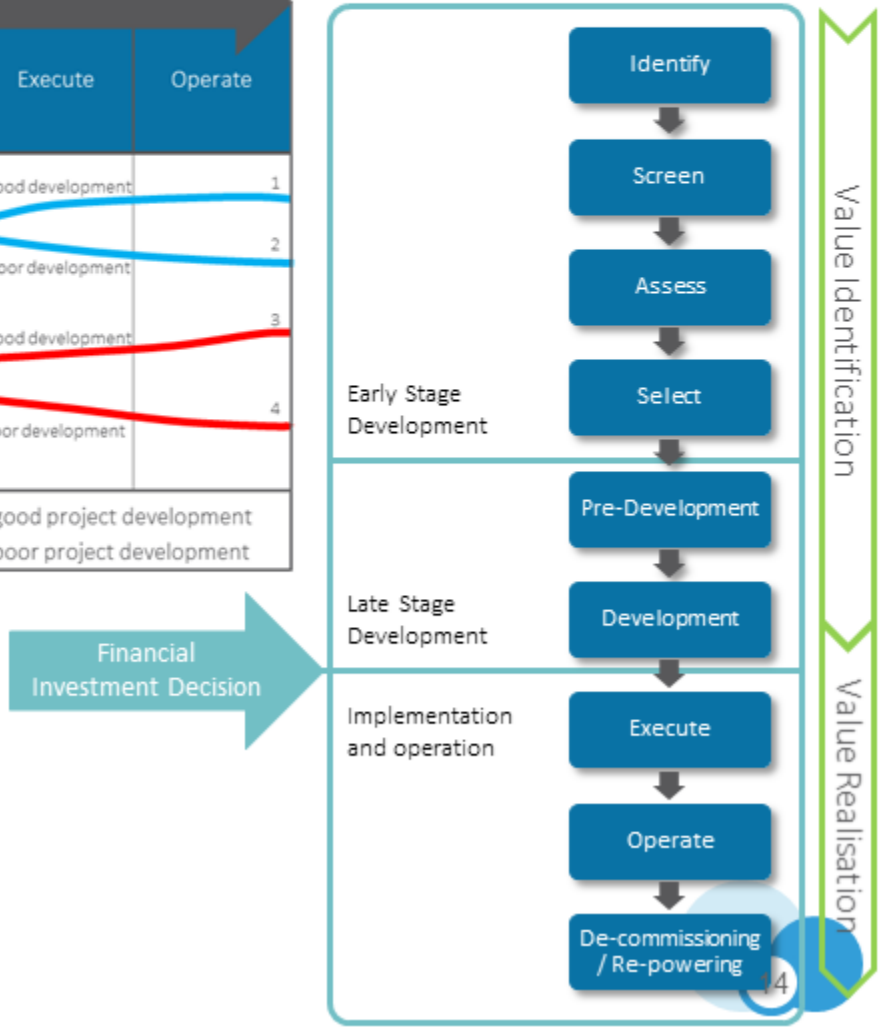
- Originate new customers
- Find partners in project development / financing consortia

PROJECT HOST COUNTRIES

- Promote project portfolios
- Promote enabling investment environments

Project development process





IRENA and the Project Navigator

Mini-Grids Project Development

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Toolkit & Case Study

Early stage project development phases

Identification | Screening | Assessment | Selection | Pre-development | Development | Construction | Operations | Decommissioning

- Identify potential project opportunities
- Screen options and discard unfeasible projects
- Perform a preliminary technical assessment
- Evaluate project options on qualitative and quantitative metrics, and their risks:
  - Operational aspects, financial metrics, revenue certainty, reliability, funding availability, etc.

Late stage project development phases

Identification | Screening | Assessment | Selection | **Pre-development** | **Development** | Construction | Operations | Decommissioning

- Preparations for detailed design, financing and construction of the project:
  - Define suitable technologies.
  - Identify operational and site constraints.
  - Estimate preliminary costs and obtain technical specification sheets.
- **Model performance based on historical and projected loads, yield estimates, tariffs and operational regulations.**
- Finalize financial model and risk management plan
- Finalize contractual agreements and permits

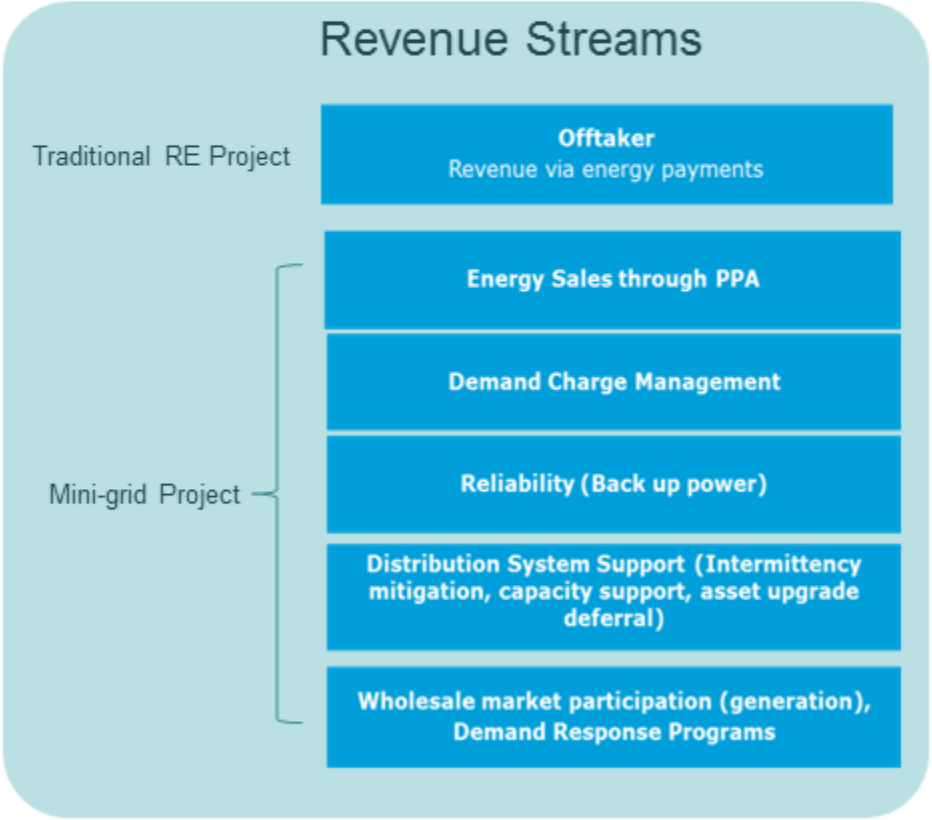
Project implementation and operation

Identification > Screening > Assessment > Selection > Pre-development > Development > **Construction** > **Operations** > **Decommissioning**

- Start construction of the project; ensure it is completed on time and on budget
- Testing and Commissioning
- Execute and audit O&M procedures to achieve contractual performance guarantees
- Refurbishing or decommissioning

Bankability requirements for Mini-Grids

- **Revenue certainty**
- Conservative estimates:
  - Fixed and variable expenses
  - Revenues
- Warranties and guarantees
- Independent verification of assumptions



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Residential PV Project Development

Toolkit & Case Study

Bankability requirements for Residential PV

- **Warranties provided by the equipment supplier and installer.**
  - Typical technical requirement is compliance with IEC standards for all SHS or PPS components.
  - The guaranteed power output of Solar PV modules with a minimum of 90% until year 10 and 80% in year 25 and the over 12 years warranty for workmanship and material defects, instill confidence to anybody involved in the project.
- **Project documentation.**
  - Technical due diligence including: assessment of local conditions, technical assessment and concept for civil, mechanical and electrical works, yield assessment, as well as contract, design and CAPEX / OPEX review.

Bankability requirements for Residential PV

- **Financing arrangements for SHS or PPS are more straightforward, as for large-scale Solar PV power plants.**
  - Financing of SHS and PPS is done either on a full equity basis, or in combination with subsidies through directly paid incentives, or through subsidized loans and tax reliefs.
- **Documentation to provide an overview is useful as a basis for discussions with banks.**
  - Datasheets of main components, stating minimum values for Solar PV modules and inverters, demonstrating compliance with international standards.
  - Yield estimation.
  - Quotations from suppliers, manufacturers, engineers, installers, and utilities as applicable.

Business models for Residential PV

Business Model	Pro	Con
Self-consumption / Net metering	– Benefit from decreasing LCOE of Solar PV electricity – Partial protection against electricity price increases – Decrease dependency on external power supply	– Rather low self-consumption rate for private households during the day – Relatively high investment for end-user
PPA with spatially related consumption	– Benefit from decreasing LCOE of Solar PV electricity – Partial protection against electricity price increases – Decrease dependency on external power supply	– Potential price risk if the electricity sales price suddenly drops
Leasing models	– Benefit from decreasing LCOE of Solar PV electricity – Partial protection against electricity price increases + Decrease dependency on external power supply + Benefit also for end-users with rather scarce equity	+ O&M not being duly performed could lead to decreased electricity generation with constant leasing rate + Risk of non-payment for users with rather scarce equity
Micro grids with Solar PV	– Benefit from decreasing LCOE of Solar PV electricity compared to fossil fuelled generation – Increased reliability of electricity supply	– Insufficient knowledge about existing load profiles and consumers' ability to pay could negatively impact the cash flow
Off-grid PPS with pay-as-you-go financing	– Benefit from decreasing LCOE of Solar PV electricity – Benefit also for end-users with rather scarce equity	– Risk of non-payment for users with rather scarce equity

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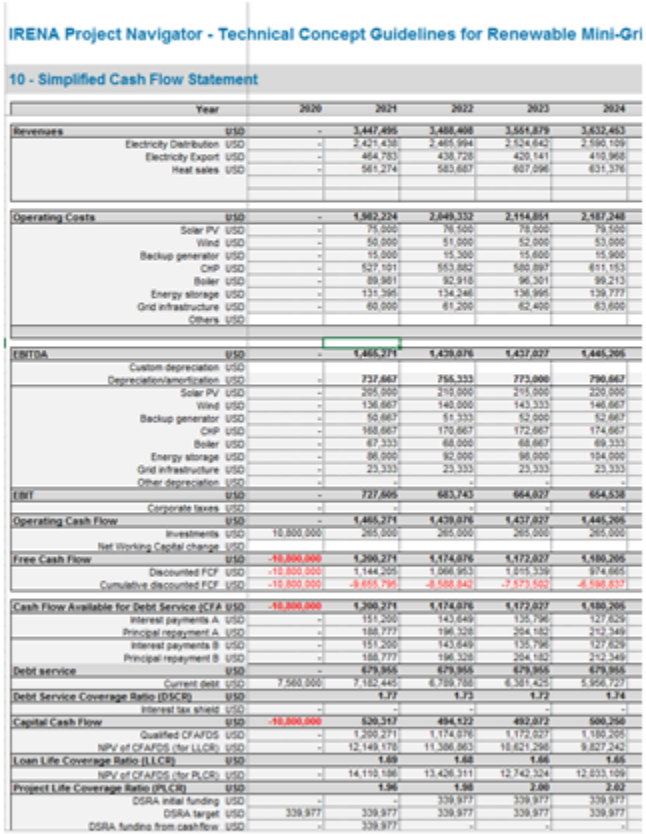
Mini-Grids Project Development

Residential PV Project Development

Toolkit & Case Study

Toolkit: Project Evaluation Models



IRENA Project Navigator - Technical Concept Guidelines for Renewable Mini-Gri

10 - Simplified Cash Flow Statement

Year		2020	2021	2022	2023	2024
Revenues	USD	-	3,447,495	3,488,408	3,551,879	3,632,453
Electricity Distribution	USD	-	2,421,438	2,465,994	2,524,642	2,590,109
Electricity Export	USD	-	464,783	438,728	420,141	410,968
Heat sales	USD	-	561,274	583,687	607,096	631,376
Operating Costs	USD	-	1,982,224	2,049,332	2,114,851	2,187,248
Solar PV	USD	-	75,000	76,500	78,000	79,500
Wind	USD	-	50,000	51,000	52,000	53,000
Backup generator	USD	-	15,000	15,300	15,600	15,900
CHP	USD	-	527,101	553,882	580,897	611,153
Boiler	USD	-	89,961	92,918	96,301	99,213
Energy storage	USD	-	131,396	134,246	136,995	139,777
Grid infrastructure	USD	-	60,000	61,200	62,400	63,600
Others	USD					
EBITDA	USD	-	1,465,271	1,439,076	1,437,027	1,445,205
Custom depreciation	USD					
Depreciation/amortization	USD	-	737,667	756,333	773,000	790,667
Solar PV	USD	-	205,000	210,000	215,000	220,000
Wind	USD	-	136,667	140,000	143,333	146,667
Backup generator	USD	-	50,667	51,333	52,000	52,667
CHP	USD	-	168,667	170,667	172,667	174,667
Boiler	USD	-	67,333	68,000	68,667	69,333
Energy storage	USD	-	86,000	92,000	98,000	104,000
Grid infrastructure	USD	-	23,333	23,333	23,333	23,333
Other depreciation	USD	-	-	-	-	-
EBIT	USD	-	727,605	683,743	664,027	654,538
Corporate taxes	USD	-	-	-	-	-
Operating Cash Flow	USD	-	1,465,271	1,439,076	1,437,027	1,445,205
Investments	USD	10,800,000	265,000	265,000	265,000	265,000
Net Working Capital change	USD					
Free Cash Flow	USD	-10,800,000	1,200,271	1,174,076	1,172,027	1,180,205
Discounted FCF	USD	-10,800,000	1,144,205	1,066,953	1,015,339	974,665
Cumulative discounted FCF	USD	-10,800,000	-9,655,796	-8,588,842	-7,573,502	-6,598,837
Cash Flow Available for Debt Service (CFA	USD	-10,800,000	1,200,271	1,174,076	1,172,027	1,180,205
Interest payments A	USD	-	151,200	143,649	135,796	127,629
Principal repayment A	USD	-	188,777	196,328	204,182	212,349
Interest payments B	USD	-	151,200	143,649	135,796	127,629
Principal repayment B	USD	-	188,777	196,328	204,182	212,349
Debt service	USD	-	679,955	679,955	679,955	679,955
Current debt	USD	7,560,000	7,182,445	6,789,788	6,381,425	5,956,727
Debt Service Coverage Ratio (DSCR)	USD		1.77	1.73	1.72	1.74
Interest tax shield	USD	-	-	-	-	-
Capital Cash Flow	USD	-10,800,000	520,317	494,122	492,072	500,250
Qualified CFAFDS	USD	-	1,200,271	1,174,076	1,172,027	1,180,205
NPV of CFAFDS (for LLCR)	USD	-	12,149,178	11,386,863	10,621,296	9,827,242
Loan Life Coverage Ratio (LLCR)	USD		1.69	1.68	1.66	1.65
NPV of CFAFDS (for PLCR)	USD	-	14,110,186	13,426,311	12,742,324	12,033,109
Project Life Coverage Ratio (PLCR)	USD		1.96	1.98	2.00	2.02
DSRA initial funding	USD	-	-	339,977	339,977	339,977
DSRA target	USD	339,977	339,977	339,977	339,977	339,977
DSRA funding from cashflow	USD	-	339,977	-	-	-

Models include on production simulation & sensitivy analysis

Toolkit: Project Evaluation Models

Stakeholders can understand relationship between system performance & project returns

Toolkit: Scorecards

IRENA Project Navigator - Technical Concept Guidelines for Mini-Grids

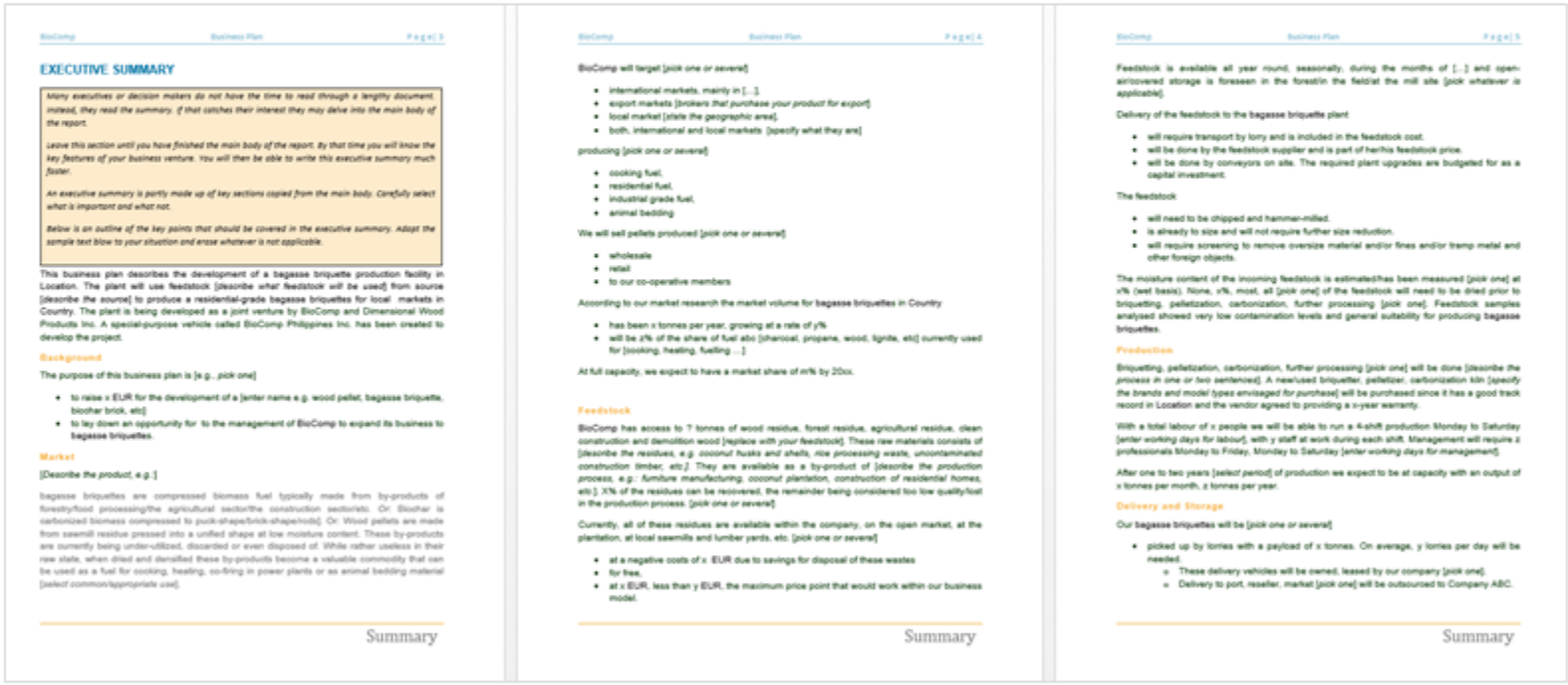
1 - Project Screening Tool

				Total Screening Score	Option 1 30%	Option 2 34%	Option 3 24%	Option 4 33%
1	*Siting & Logistics*	Criteria	Guidance on criteria	Impact on Project	Score 28	Score 32	Score 22	Score 31
	1.1	Land availability	How available and suitable is the real estate?	Real estate may not be not be available. Real estate suitable under single ownership is more ideal than multiple ownership	Fair	Fair	Good	Fair
	1.2	Leasing/owning requirements	What is the complexity of the leasing/owning requirements?	Complex leasing or ownership requirements may have a negative impact on the project in terms of cost and scheduling.	Good	Excellent	Poor	Good
	1.3	Distribution system infrastructure	What is the quality of the distribution system infrastructure (a non-existing distribution system would be graded "poor")	Construction of distribution system may entail additional costs and planning requirements. 3rd party entity ownership and operation of the distribution system may require additional resources to be included in the project.	Excellent	Fair	Poor	Fair
	1.4	Renewable production capability	What is the quality of the solar/wind production capability?	Environmental conditions may inhibit renewable production, or substantial investment is required to modify topographical or site conditions for renewable production. Production may be too low because of low solar insolation or low wind production capability	Fair	Very Good	Fair	Fair
	1.5	Fossil fuel access	How convenient is the access to fossil fuel reserves ?	Substantial investment may be required for direct access to fossil fuel reserves.	Good	Excellent	Fair	Very Good

1 - Risk assessment

					a) Initial risk assessment				b) Post-mitigation risk assessment			c) Risk mitigation effectiveness
#	Project phase	Risk category	Risk description	Impact category	Likelihood	Impact severity	Risk rating (initial)	Proposed mitigation measures	Likelihood	Impact severity	Risk rating (post mitigation)	Risk mitigation effectiveness
2	1) Identification	Research	Having insufficient information; Site visit and desk study do not provide enough information (on expected temperatures and subsurface permeability) for having confidence in the presence of a geothermal resource.	Financial	Likely	Severe	High		Unlikely	Significant	Medium	Effective
2	1) Identification	Construction	Working area is not appropriate; An appropriate working area cannot be selected, because other activities on site are blocking an eventual concession-right for the geothermal project.	Financial	Certain	Significant	High		Likely	Significant	High	Not effective
3	1) Identification	Market	No financial possibilities; No financing possibilities found, for the geothermal development in the area	Financial	Rare	Moderate	Low		Rare	Minor	Low	Not effective
4	1) Identification	Organisational	Political and regulatory instruments have not been identified yet; Political and regulatory instruments have not been identified yet and e.g. geothermal friendly polices have not been found	Financial	Unlikely	Significant	Medium		Likely	Significant	High	Detrimental
5	2) Screening	Organisational	Stakeholders are not properly known	Financial	Unlikely	Significant	Medium		Unlikely	Minor	Low	Effective
6	2) Screening	Social	No public acceptance; The issue of public acceptance has not been addressed	Financial	Unlikely	Moderate	Medium		Unlikely	Minor	Low	Effective
7	2) Screening	Contracts and agreements	Missing surface exploration permit; A surface exploration permit has not been assigned for phase 3 'assessment'	Financial	Unlikely	Moderate	Medium		Unlikely	Minor	Low	Effective
8	2) Screening	Contracts and agreements	Incomplete identification of concession rights and licence issues	Financial	Likely	Moderate	Medium		Likely	Moderate	Medium	Not effective

Toolkit: Business Plan Template



BioComp Business Plan Page | 3

EXECUTIVE SUMMARY

Many executives or decision makers do not have the time to read through a lengthy document. Instead, they read the summary. If that catches their interest they may delve into the main body of the report.

Leave this section until you have finished the main body of the report. By that time you will know the key features of your business venture. You will then be able to write this executive summary much faster.

An executive summary is partly made up of key sections copied from the main body. Carefully select what is important and what not.

Below is an outline of the key points that should be covered in the executive summary. Adapt the sample text blow to your situation and erase whatever is not applicable.

This business plan describes the development of a bagasse briquette production facility in Location. The plant will use feedstock *[describe what feedstock will be used]* from source *[describe the source]* to produce a residential-grade bagasse briquettes for local markets in Country. The plant is being developed as a joint venture by BioComp and Dimensional Wood Products Inc. A special-purpose vehicle called BioComp Philippines Inc. has been created to develop the project.

Background

The purpose of this business plan is [e.g., *pick one*]

- to raise x EUR for the development of a [enter name e.g. wood pellet, bagasse briquette, biochar brick, etc]
- to lay down an opportunity for to the management of BioComp to expand its business to bagasse briquettes.

Market

[Describe the product, e.g.:]

bagasse briquettes are compressed biomass fuel typically made from by-products of forestry/food processing/the agricultural sector/the construction sector/etc. Or: Biochar is carbonized biomass compressed to puck-shape/brick-shape/rods]. Or: Wood pellets are made from sawmill residue pressed into a unified shape at low moisture content. These by-products are currently being under-utilized, discarded or even disposed of. While rather useless in their raw state, when dried and densified these by-products become a valuable commodity that can be used as a fuel for cooking, heating, co-firing in power plants or as animal bedding material *[select common/appropriate use]*.

Summary

BioComp Business Plan Page | 4

BioComp will target *[pick one or several]*

- international markets, mainly in […],
- export markets *[brokers that purchase your product for export]*
- local market *[state the geographic area]*,
- both, international and local markets *[specify what they are]*

producing *[pick one or several]*

- cooking fuel,
- residential fuel,
- industrial grade fuel,
- animal bedding.

We will sell pellets produced *[pick one or several]*

- wholesale
- retail
- to our co-operative members

According to our market research the market volume for bagasse briquettes in Country

- has been x tonnes per year, growing at a rate of y%
- will be z% of the share of fuel abc *[charcoal, propane, wood, lignite, etc]* currently used for *[cooking, heating, fuelling …]*

At full capacity, we expect to have a market share of m% by 20xx.

Feedstock

BioComp has access to ? tonnes of wood residue, forest residue, agricultural residue, clean construction and demolition wood *[replace with your feedstock]*. These raw materials consists of *[describe the residues, e.g. coconut husks and shells, rice processing waste, uncontaminated construction timber, etc.]*. They are available as a by-product of *[describe the production process, e.g.: furniture manufacturing, coconut plantation, construction of residential homes, etc.]*. X% of the residues can be recovered, the remainder being considered too low quality/lost in the production process. *[pick one or several]*

Currently, all of these residues are available within the company, on the open market, at the plantation, at local sawmills and lumber yards, etc. *[pick one or several]*

- at a negative costs of x EUR due to savings for disposal of these wastes
- for free,
- at x EUR, less than y EUR, the maximum price point that would work within our business model.

Summary

BioComp Business Plan Page | 5

Feedstock is available all year round, seasonally, during the months of […] and open-air/covered storage is foreseen in the forest/in the field/at the mill site *[pick whatever is applicable]*.

Delivery of the feedstock to the bagasse briquette plant

- will require transport by lorry and is included in the feedstock cost.
- will be done by the feedstock supplier and is part of her/his feedstock price.
- will be done by conveyors on site. The required plant upgrades are budgeted for as a capital investment.

The feedstock

- will need to be chipped and hammer-milled.
- is already to size and will not require further size reduction.
- will require screening to remove oversize material and/or fines and/or tramp metal and other foreign objects.

The moisture content of the incoming feedstock is estimated/has been measured *[pick one]* at x% (wet basis). None, x%, most, all *[pick one]* of the feedstock will need to be dried prior to briquetting. pelletization, carbonization, further processing *[pick one]*. Feedstock samples analysed showed very low contamination levels and general suitability for producing bagasse briquettes.

Production

Briquetting, pelletization, carbonization, further processing *[pick one]* will be done *[describe the process in one or two sentences]*. A new/used briquetter, pelletizer, carbonization kiln *[specify the brands and model types envisaged for purchase]* will be purchased since it has a good track record in Location and the vendor agreed to providing a x-year warranty.

With a total labour of x people we will be able to run a 4-shift production Monday to Saturday *[enter working days for labour]*, with y staff at work during each shift. Management will require z professionals Monday to Friday, Monday to Saturday *[enter working days for management]*.

After one to two years *[select period]* of production we expect to be at capacity with an output of x tonnes per month, z tonnes per year.

Delivery and Storage

Our bagasse briquettes will be *[pick one or several]*

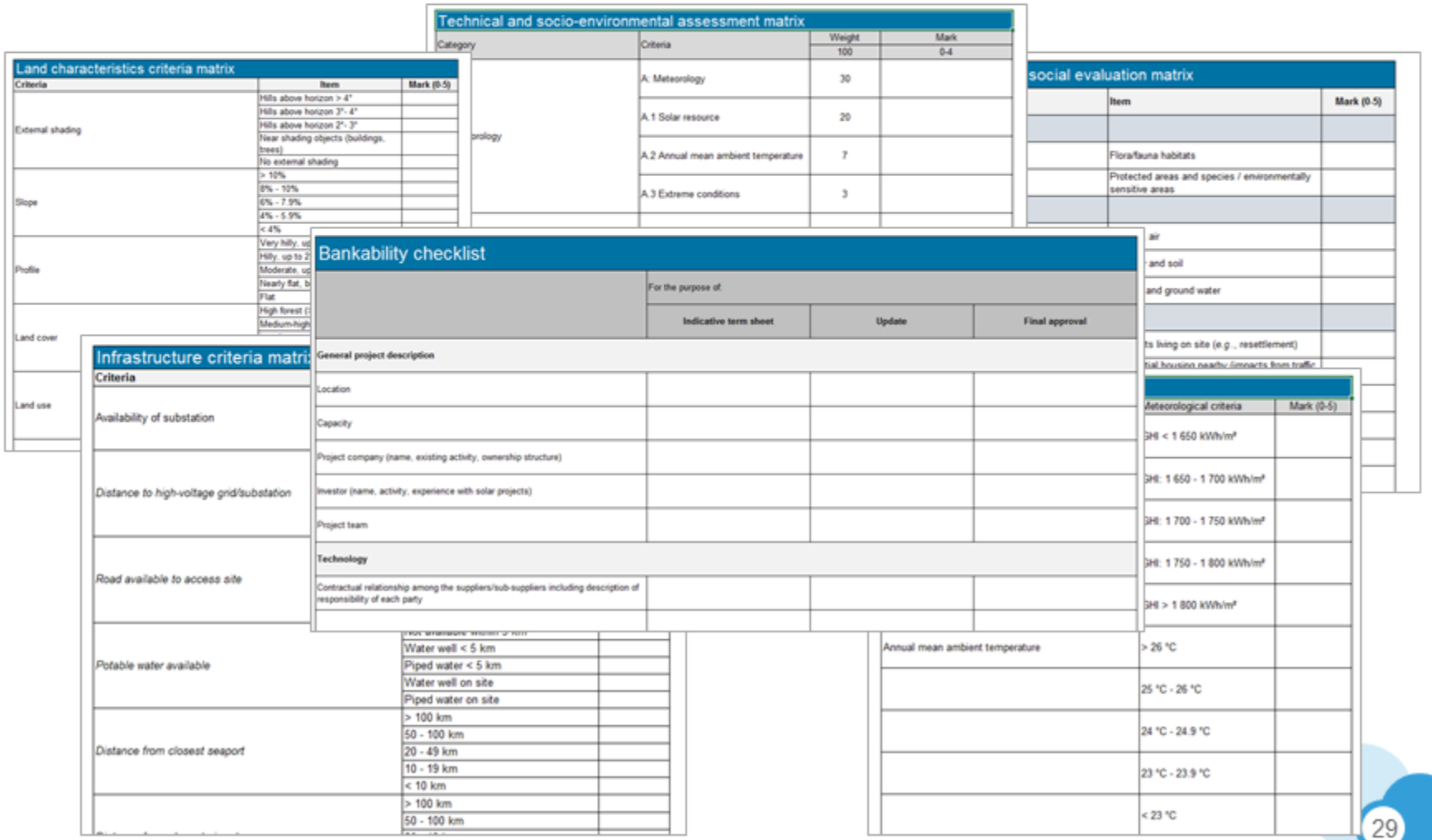
- picked up by lorries with a payload of x tonnes. On average, y lorries per day will be needed.
  - These delivery vehicles will be owned, leased by our company *[pick one]*,
  - Delivery to port, reseller, market *[pick one]* will be outsourced to Company ABC.

Summary

Toolkit: Contractual agreement guidelines

- Definition
- How does the Agreement work?
- Benefits & Risks for the involved parties
- Structure
- Typical legal terms
  - Why are they part of the Agreement?
  - What is usually the content of each section?
- Templates/ Example contracts

Toolkit: Project development forms



Technical and socio-environmental assessment matrix

Category	Criteria	Weight	Mark
		100	0-4
	A. Meteorology	30	
	A.1 Solar resource	20	
	A.2 Annual mean ambient temperature	7	
	A.3 Extreme conditions	3	

Land characteristics criteria matrix

Criteria	Item	Mark (0-5)
External shading	Hills above horizon > 4°	
	Hills above horizon 3°- 4°	
	Hills above horizon 2°- 3°	
	Near shading objects (buildings, trees)	
	No external shading	
Slope	> 10%	
	8% - 10%	
	6% - 7.9%	
	4% - 5.9%	
	< 4%	
Profile	Very hilly, up	
	Hilly, up to 2	
	Moderate, up	
	Nearly flat, b	
	Flat	
Land cover	High forest (	
	Medium-high	
Land use		

Bankability checklist

	For the purpose of:		
	Indicative term sheet	Update	Final approval
General project description			
Location			
Capacity			
Project company (name, existing activity, ownership structure)			
Investor (name, activity, experience with solar projects)			
Project team			
Technology			
Contractual relationship among the suppliers/sub-suppliers including description of responsibility of each party			

Infrastructure criteria matri

Criteria		
Availability of substation		
Distance to high-voltage grid/substation		
Road available to access site		
Potable water available	Water well < 5 km	
	Piped water < 5 km	
	Water well on site	
	Piped water on site	
Distance from closest seaport	> 100 km	
	50 - 100 km	
	20 - 49 km	
	10 - 19 km	
	< 10 km	
	> 100 km	
	50 - 100 km	

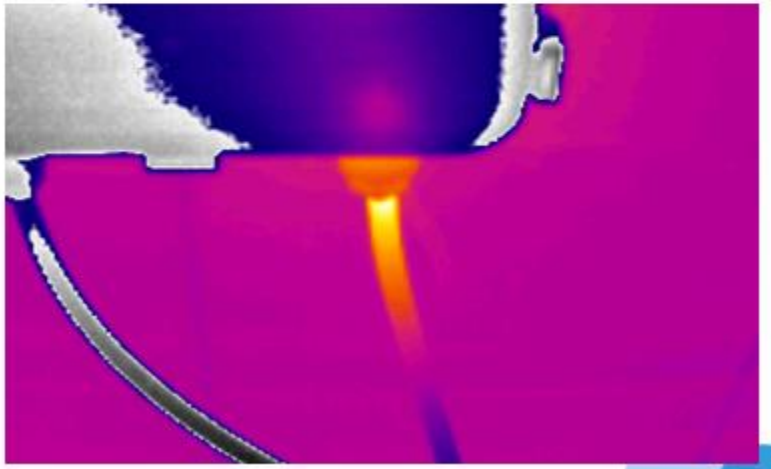
social evaluation matrix

	Item	Mark (0-5)
	Flora/fauna habitats	
	Protected areas and species / environmentally sensitive areas	
	air	
	and soil	
	and ground water	
	ts living on site (e.g., resettlement)	
	tial housing nearby (impacts from traffic	

Meteorological criteria	Mark (0-5)
GHI < 1 650 kWh/m²	
GHI: 1 650 - 1 700 kWh/m²	
GHI: 1 700 - 1 750 kWh/m²	
GHI: 1 750 - 1 800 kWh/m²	
GHI > 1 800 kWh/m²	
Annual mean ambient temperature > 26 °C	
25 °C - 26 °C	
24 °C - 24.9 °C	
23 °C - 23.9 °C	
< 23 °C	

Lessons learned for PV distributed projects

Lessons learned for PV distributed projects



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Register for our next webinar on **Residential PV systems** In June 2017

Follow the link or flash the QR code

http://bit.ly/2ooy22H