IRENA Project Navigator

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IRENA Project Navigator Workshop
Training Day

IRENA Project Navigator and Renewable Energy Project Development

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CABO VERDE

Agenda

1. INTRODUCTION TO IRENA PROJECT NAVIGATOR
2. THE RET PROJECT DEVELOPMENT PROCESS: Overview
3. RET PROJECT DEVELOPMENT: Tools from the Project Navigator
    - Stakeholder Analysis
    - Risk Management
    - Power Purchase Agreement (PPA)
    - Levelised Cost of Electricity (LCOE)
    - Technical Concept On-Shore Wind Power Plant
    - Project Proposal Structure
4. CURRENT STATUS AND NEXT STEPS OF THE PROJECT NAVIGATOR
5. INTRODUCTION TO THE IRENA PROJECT NAVIGATOR PLATFORM

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INTRODUCTION
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PROJECT NAVIGATOR

IRENA Project Navigator

- IRENA's experience so far has shown that projects often have an innovative character due to specific conditions.
- It happens very often that neither the **project developer** nor the **involved governmental administration** has a realistic understanding of the process, the timelines and the necessary work steps to complete a bankable project proposal.
  - As a result, this may lead to higher project development costs and a higher risk of project failure.
- Usually the potential finance opportunities and the selection and funding process of the project proposals aren't transparent.

➔ **IRENA/IITC has taken the initiative to make the whole project development process, including the funding alternatives, more transparent and explicit**

Objectives

Project Navigator is a tool designed to:

- Improve the RET project proposals
- Increase the quality implementation of RET project proposals
- Adapt its guidelines to the project's specific conditions, aims and framework
- Facilitate an efficient use of funds
- Take into account all aspects when developing a RET project:
  - Socio-economic
  - Technical
  - Legal and Commercial
  - Organizational
  - Political

IRENA Project Navigator includes:

- All 6 RETs: wind, solar, hydro, biomass, geothermal, ocean energy
- Different finance types: grants, loans, equity
- Project sizes: from individual use to utility scale projects
- Global scope: all geographical regions

IRENA Project Navigator's Dimensions

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Technical Concepts

Regional Adaptations

RE Funds Database

The Technology Dimension

- Each of the renewable energy technologies (solar, wind, hydro, biomass, geothermal, ocean energy), which we support as IRENA, are exposed to specific but differing **risks** during their lifetime from project identification till plant decommissioning.

- The technical **diversity** and the different project conditions imply varying project designs and especially varying financing concepts.

- The technical feasibility study ensures that all the **technical requirements** are fulfilled, and that the chosen technology could be used in an effective and efficient way. However the technical impact and the technical aspects for the financing of the project are obviously not sufficient reflected through technical feasibility study.

- Through all the stages of the development of RET-projects all the related stakeholders, the technical, economic, commercial, organizational and political framework as well the financing of the project needs to be considered.

- In this context, the project development guidelines will address the **technical aspect** of RET and their **impacts** in conjunction with a range of **non-technical** factors for the elaboration of bankable project proposal.

The Regional and The Financial Dimension

The Regional Dimension

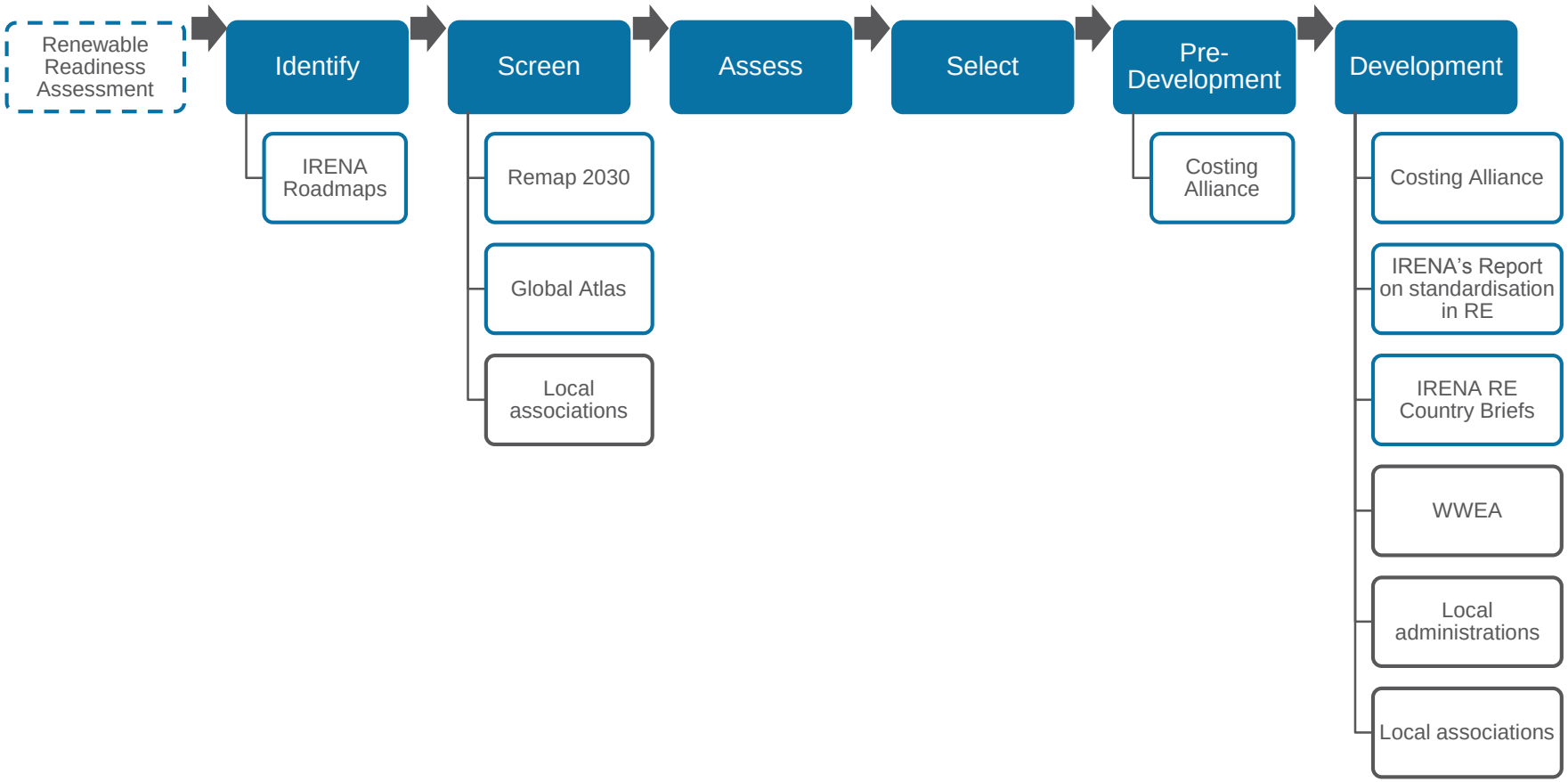
- Regional adaptations are very important to the Navigator as it improves the accuracy of project planning
- Country-specific regulation, politics and economics are key points to be considered in developing a RE project
- A first adapted version of the Navigator is for Small Island Development States (SIDS) and West Africa, to be followed by Latin America Caribbean and MENA region

The Financial Dimension

- The Financial Navigator will enable project developers to access funds for the RE projects according their own funding requirements, depending on the technology, the region/country and the scope/size of the project
- Different finance types: grants, loans, equity

The Project Navigator is a modular approach

The Project Navigator uses a modular approach and can be linked to many activities inside of IRENA as well as outside of the organization.



Focal groups
How they benefit from the Navigator

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Member Countries

- Compliance with stakeholders requirements
- Higher quality of RET projects
- Lower implementation costs
- Understandable administrative processes
- Efficient administration
- Capacity building

Project Developers

- Best practices
- Identification of needs/gaps
- Easier and faster funding opportunities
- Higher quality of RET projects

Municipalities

- Capacity building
- Spread social awareness
- Decision-making and investment participation

Academia

- RET project planning guidance
- Input for curriculum development
- Capacity building

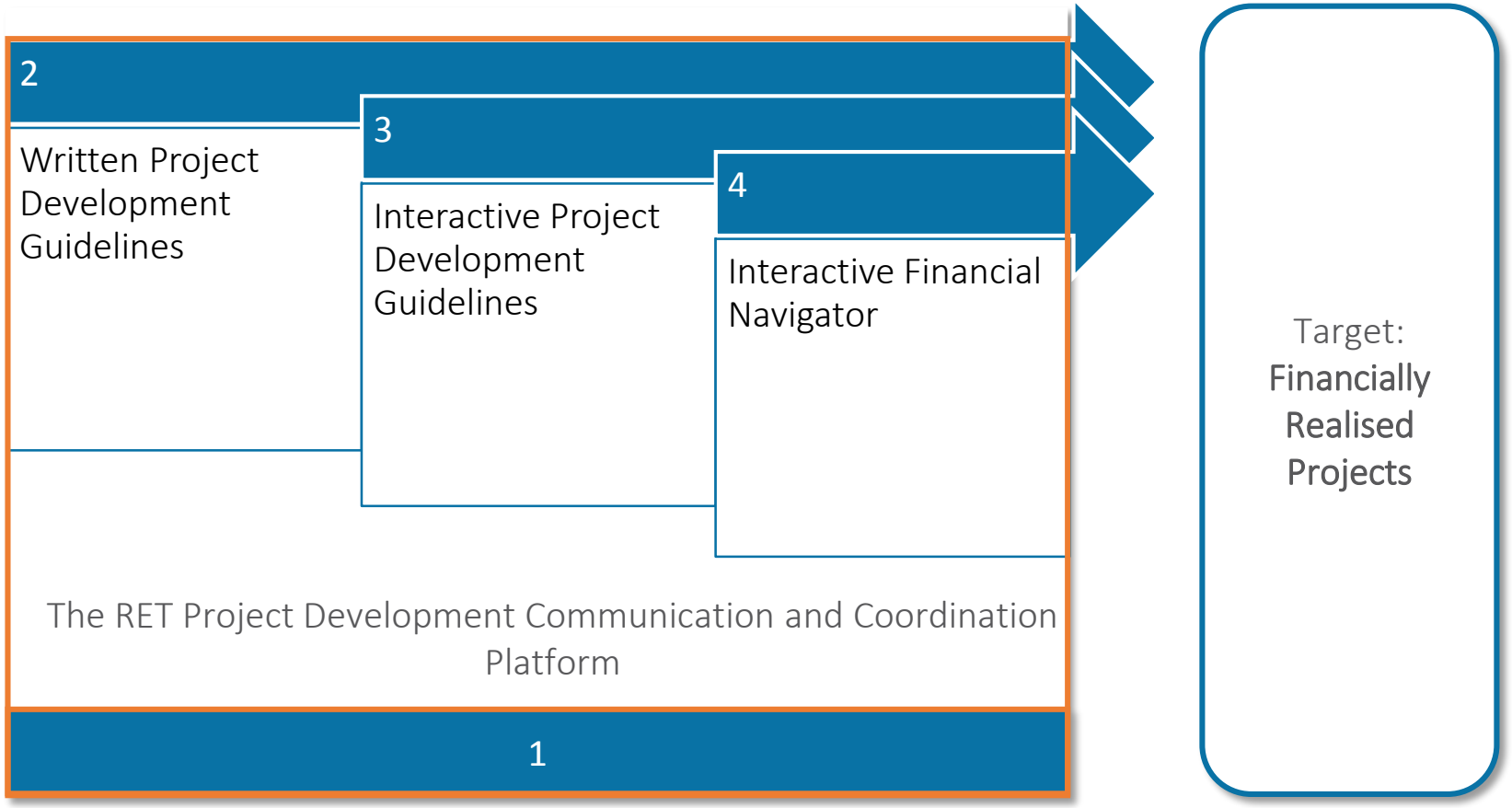
Financing Sector

- Easier and faster project evaluation
- Identification of bankable projects

Sources:
UN Photo/ Eskinder Debebe
UN Photo / Evan Schneider
UN Photo / Mark Garten

Concept & Design

The "four integral parts"



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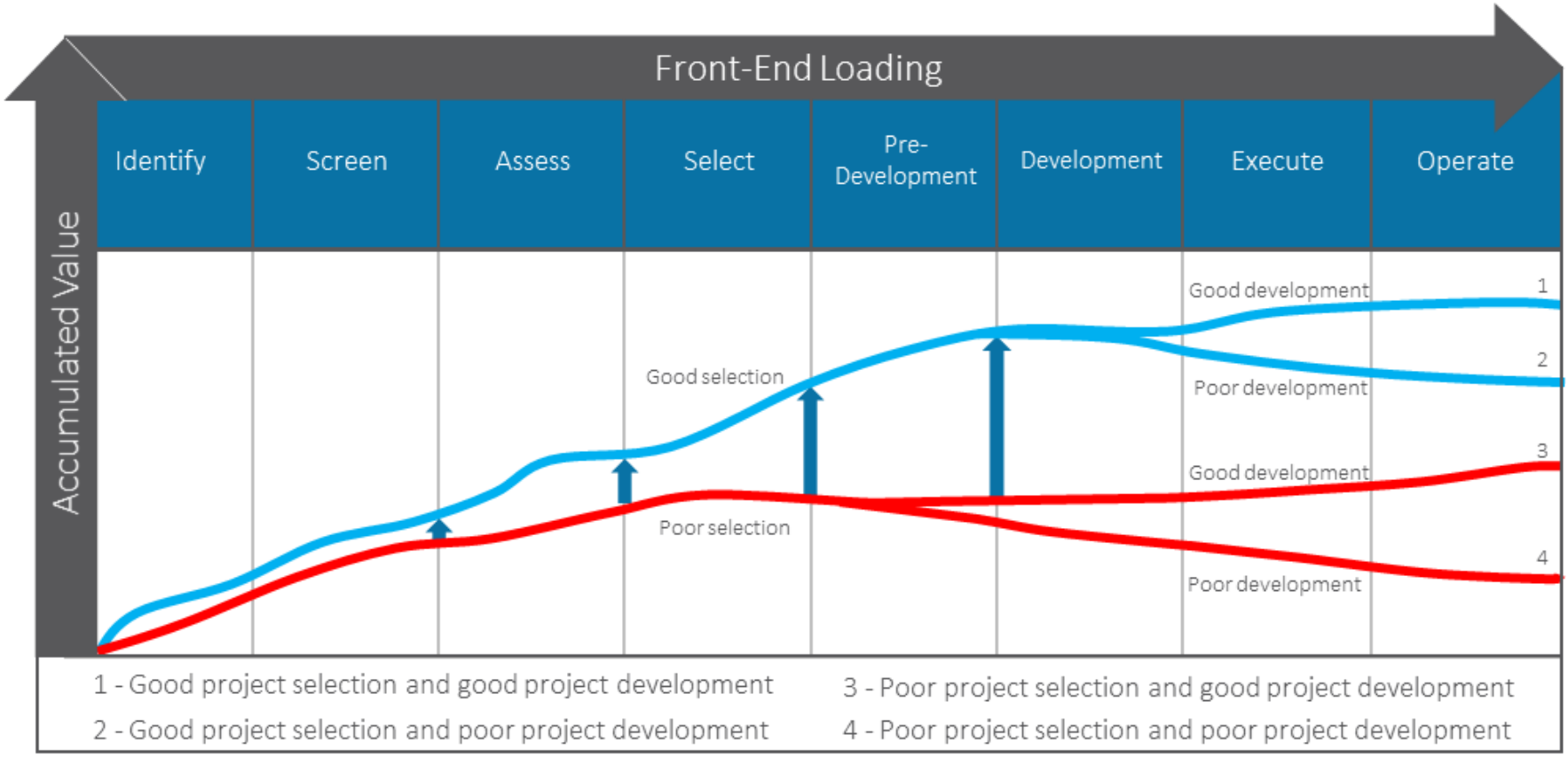
THE RET PROJECT DEVELOPMENT PROCESS

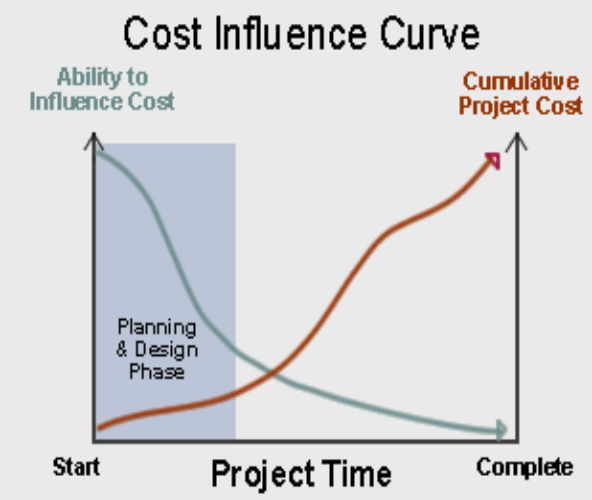
Value Creation through the Project Development

- *Are we doing the right project? Are we doing the project right?*



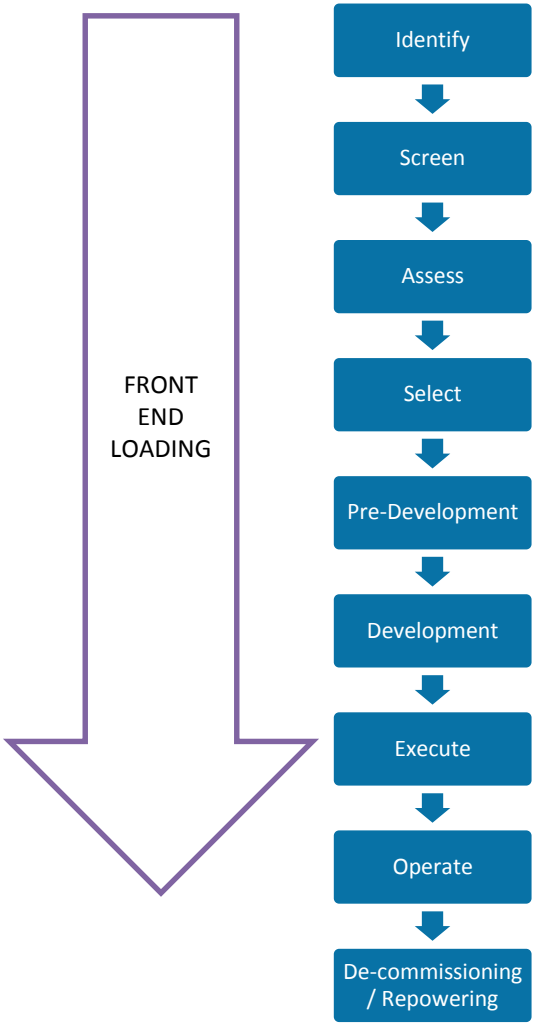
Sources:
- adapted from Woodside, Shaping up for Growth

Front End Loading



Front-end-loading (FEL) defining the dimensions of the business opportunity, as well as the working relationships of the project's key stakeholders, early in the project.

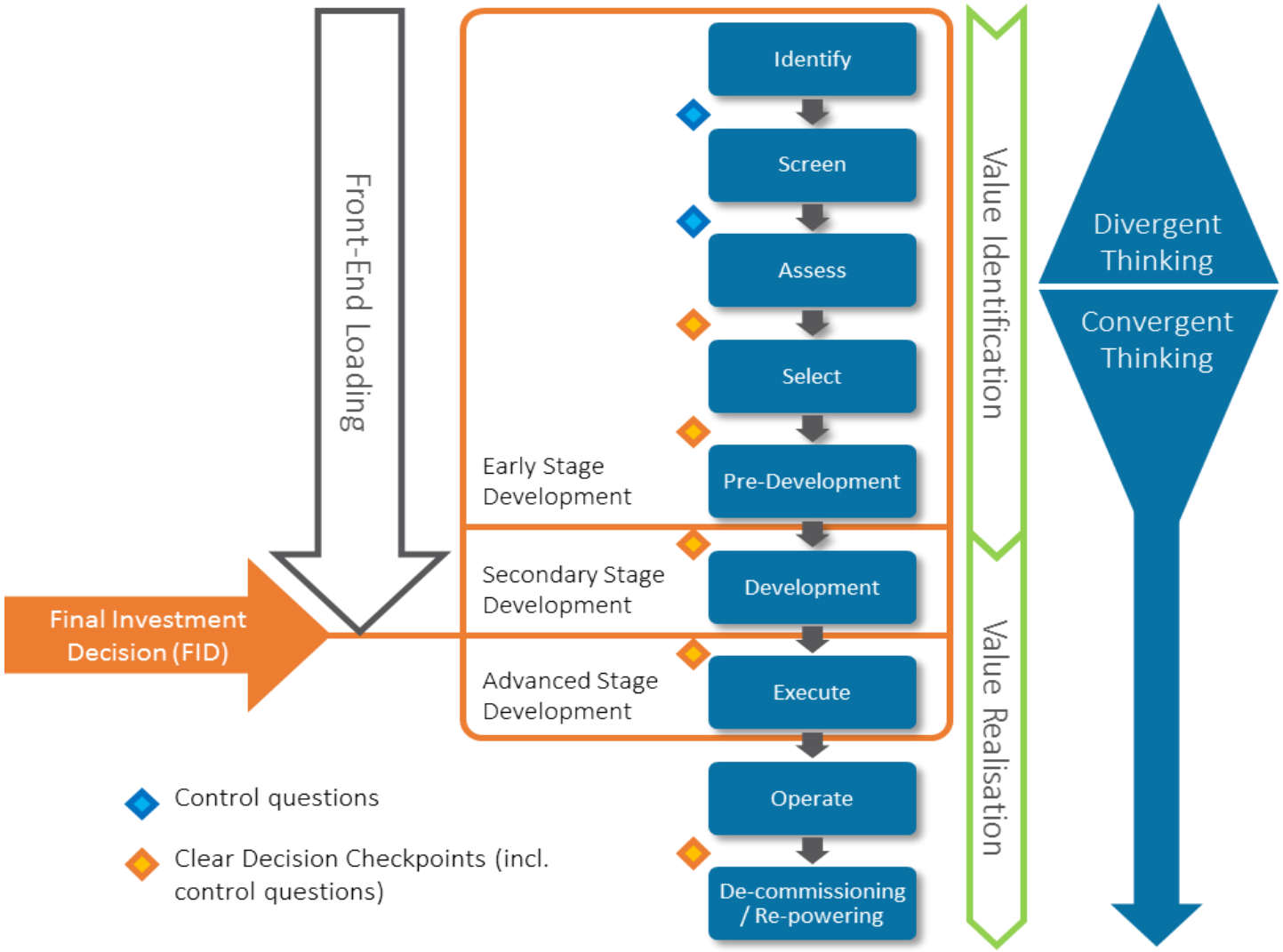
FEL reduces project risk. FEL dramatically increases critical information early to position the project for success. Front-End-Loading practices fully exploit the window of time in which it is relatively inexpensive to shape the project's outcome (blue rectangle in the Cost Influence Curve visual).



➔ The costs incurred during the FEL are difficult to bear because they are very risk exposed. In fact, investors have up to this point no certainty about the course and the feasibility of the project. A Loan financing for the FEL Costs is not feasible and this represents a major disadvantage for the initiation of the project.

Sources:
- http://www.3houses.com/frontendloading.htm - (THREE HOUSES CONSULTING LLC) – (October04,2012)
- http://www.investopedia.com/terms/f/front-endload.asp#axzz29SncLFJ`0 – (October04,2012)

Process Overview



Early Stage Development

Phases	Objectives	Key Decisions	Decision Committee	Control Questions	Key Deliverables
Identify	• Identify opportunity frameworks, suitable business models & understand what we get into				
Screen	• Identify those projects or activities that may cause potential significant impacts and determine potential value of alternatives • Obtain preliminary project information			• Do we understand the risks and opportunities? • Can we enter? • Can we make it work? • Have we looked wide enough?	Portfolio of different project options
Assess	• Look wide, understand what are feasible Options	Opportunities and alternatives	Project opportunity manager		
1 ***Select***	• Concept selection. • Focus on and evaluate best and "doable" options	Generate and select the preferred opportunity (alternatives) realization concept	Project supervisory board	Have we selected the optimal solution?	Valuation Report
2 ***Pre-Development***	• Obtain relevant project data for preparation of technical concept and contractual structure	Approve pre-development plan	Project supervisory board	How viable is that business opportunity we are planning to pursue?	Pre-development report
3 ***Development***	• Final scope, cost, schedule and obtain project execution funding	FDI approval based on bankable information memorandum	Project Supervisory Board	• Is everything in place to ensure success? • Are implementers ready to execute and operate?	Business Proposal Package
4					

Phases description structure

➔ **To assure an uniformly view over all phases of the RET-project development process, we use the following structure:**

- Definition
- Objectives / Action Plan
- Tools
- Examples & case studies

The tools proposed for each step of the RE project development process I

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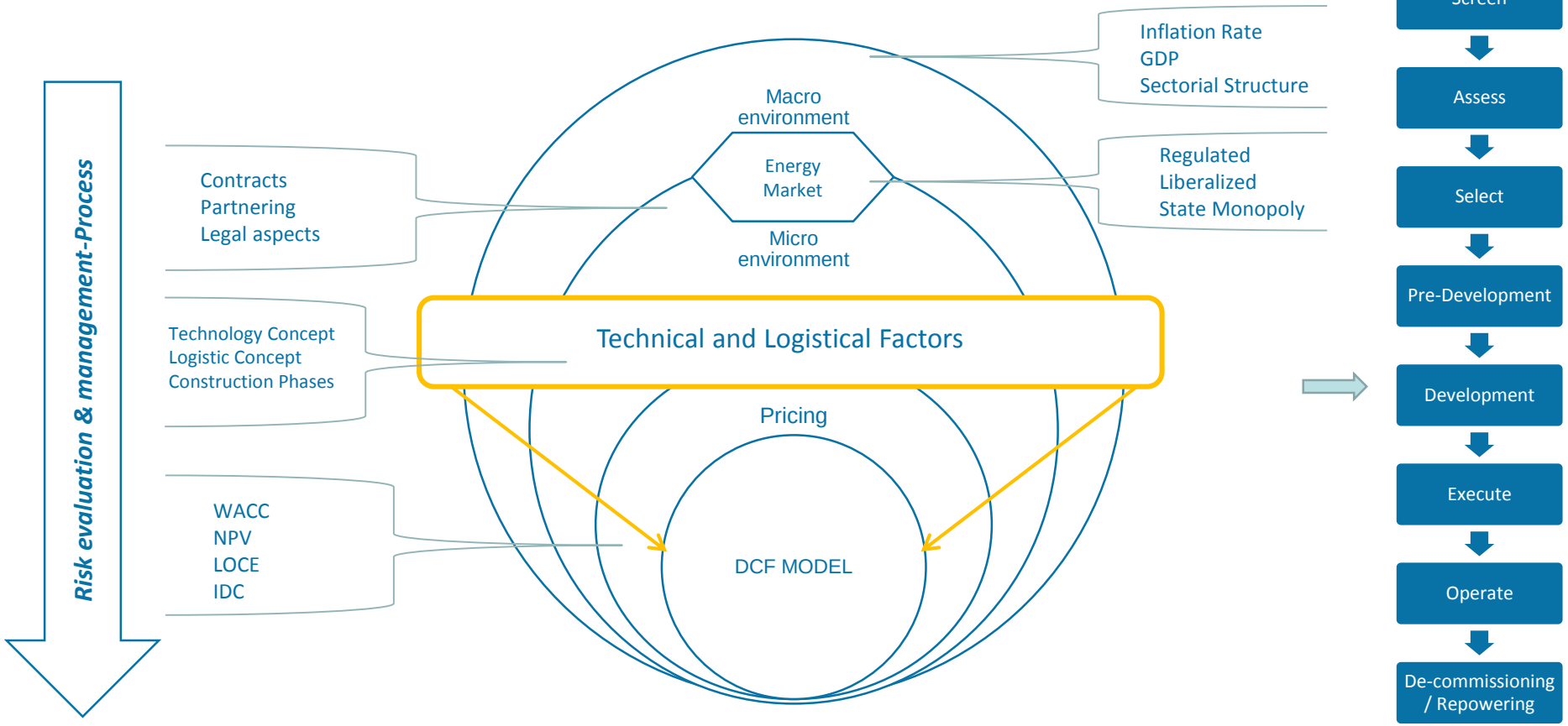
Identify	• Identification checklists
Screen	• SWOT matrix, SCOPE, PRIMO-F, PESTEL planning models
Assess	• Self-scoring test, Critical Path method
Select	• Ranking scheme, Selection Spreadsheet templates
Pre-Development	• Stakeholders Impact matrix, TECOP model, Critical Success factors, Project profiles templates, viability checklist
Development	• Analysis Overview

The tools proposed on each step of the project development process II

- **Development analysis process overview**



Sources:
- Own development

3

RE PROJECT DEVELOPMENT

EXAMPLE TOOLS FROM PROJECT NAVIGATOR

EXAMPLE TOOLS FROM THE PROJECT NAVIGATOR TOOL:

STAKEHOLDER ANALYSIS

Pre-Development

- ***Definition:***

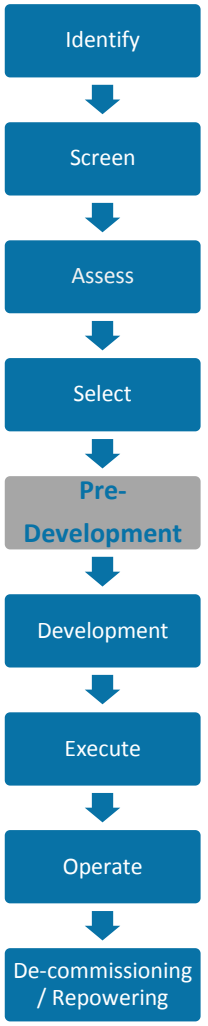
The Pre-Development phase establishes the project requirements and concept and provides the basis for the project budget and its approval.

- ***Objectives / Action Plan:***

  - Obtain relevant project data for preparation of technical concept and contractual structure

    - ✓ **Stakeholder analysis**
    - ✓ TECOP-Assessment
    - ✓ Critical Success Factors (Critical Chain)
    - ✓ Brief Project Profile
    - ✓ Viability analysis

  - ➔ "Starting the project Pre-Development by analyzing the stakeholders and their context helps ensure that the project is adapted to the needs and capacities. But in many cases it is useful to start with the problem in order to identify all the stakeholders concerned."



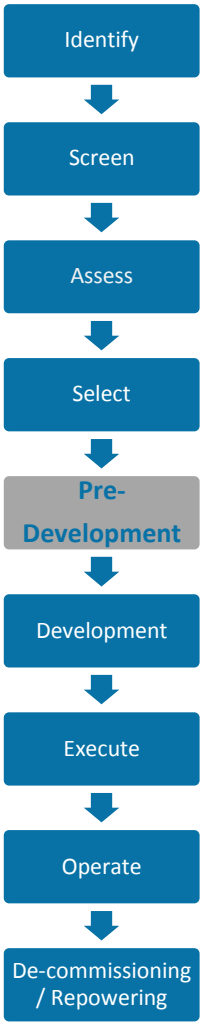
Source:
- Adapted from: U.S. Department of Health and Human Services(HHS).2009?. *HHS Facilities Program Manual (Volume I)*
- Adapted from: International Labour Organization/International Training Centre(ILO/ITC). 2010. *Project Design Manual.* P. 25

Stakeholder Analysis

The Stakeholder Management Process

In order to manage stakeholder relationships one must:

- Identify the stakeholders.
  - ✓Internal stakeholders: Staff, staff association, management
  - ✓External stakeholders: Government, other agencies, NGOs, etc.
- Analyse their attitudes to, and potential need for involvement in the project. It might be useful to summarise this with a Stakeholder Power/Impact Matrix.
- Establish a strategy to ensure that a consistent, appropriate and cost-effective approach is adopted across the project, perhaps formalized as a **Stakeholder Management Strategy**.
- Identify potential approaches to engage, manage relationships and communicate (both ways) with each stakeholder.
- Select the approaches that are likely to be cost-effective, proportionate and affordable , perhaps formalized as a **Communications Plan** (see below), and build them into the Project Plan as appropriately resourced, scheduled activities.
- Execute the plan, monitor its effectiveness and revise it as necessary.

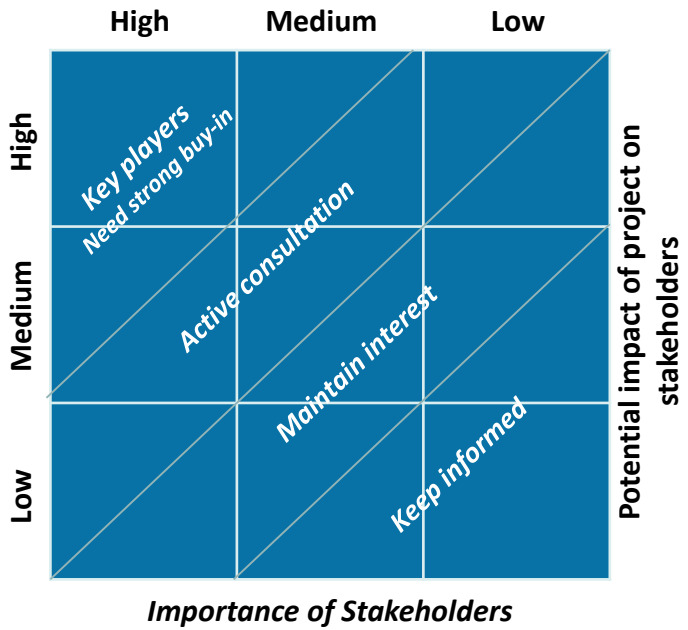


Source:

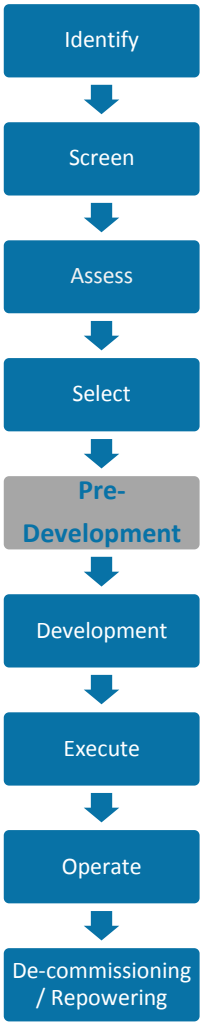
- Adapted from: United Nations Development Programme(UNDP):Stakeholder Analysis .October 07, 2012 <http://ppmtoolkit.undp.org/1c_Stakeholder_Analysis_Tool.cfm>

Stakeholder Analysis

- ***Tools:***
  - **Stakeholder Power/Impact** Matrix



- In general, high influence indicates that you need to involve the person/group in some way. The people or groups that require the most attention are those with great influence who are opposed to the project. You can consider, for example:
  - ✓ Involving them for information only;
  - ✓ Consulting with them;
  - ✓ Directly involving them in decision making; and/or
  - ✓ Involving them as co-researchers and/or co-actors.
- Proper communication on a project is also critical to successfully managing stakeholders' expectations. They need to be kept well-informed of the objectives and provided with regular progress reports.



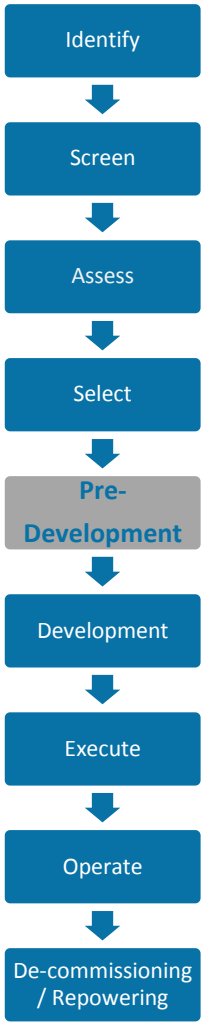
Source:
- Adapted from: Department for Business Innovation and Skills(BIS).2010. *Guidelines for Managing Projects*, P.24

Stakeholder Analysis

- ***Tools:***
  - **Analysing the Stakeholders (Part 1)**

- For each stakeholder, consider:
  - What is their interest in the project?
  - How important are they to the project?

- Will you be changing such things as:
  - The way they work (e.g. new processes, information or technology)?
  - Their attitudes (e.g. to customers, suppliers, employers, the public)?
  - The speed/productivity of their work?
  - The people they work with and/or communicate with?
  - Their level of accountability/responsibility/authority?
  - The timing of events in their working day, or its duration?
  - The working environment or the location(s) of their work?
  - Which aspects of the project might they wish to/try to influence in some way?
  - How much power do they possess to influence the project in some way? (The **Power/Impact** matrix may help clarify this analysis)
  - Are they mostly for or against the project?

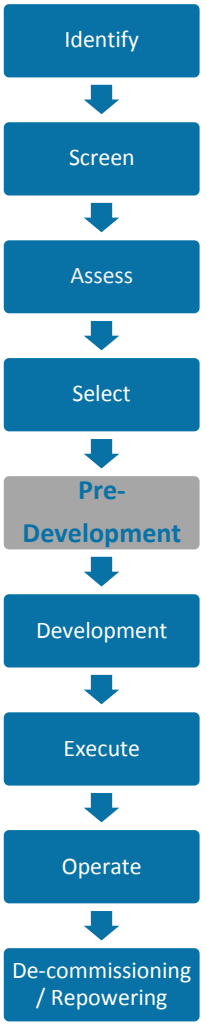


Source:
- Adapted from: Department for Business Innovation and Skills(BIS). 2010. *Guidelines for Managing Projects* P.25

Stakeholder Analysis

- ***Tools:***
  - **Analysing the Stakeholders (Part 2)**

- Will they be involved in:
  - Setting/reviewing the strategy direction that triggered the programme/project?
  - Acting as a project 'Champion' or 'Ambassador' for the change it will bring about?
  - Specifying the project's outcome, benefits, scope, objectives and priorities?
  - Specifying project products/deliverables?
  - Changing the way their organisation operates to cater for the outcome of the project?
  - Using project deliverables after the project?
  - Supporting and/or maintaining project deliverables after the project?
  - Providing specialist skills for the project (e.g. law, IT, policy, project management)?
  - Providing non-human resources (e.g. funding, accommodation, equipment, facilities)?
  - Providing information/opinions/advice?
  - Taking decisions affecting the direction of the project (e.g. change requests)?
  - Checking the quality of the project's deliverables/outputs?



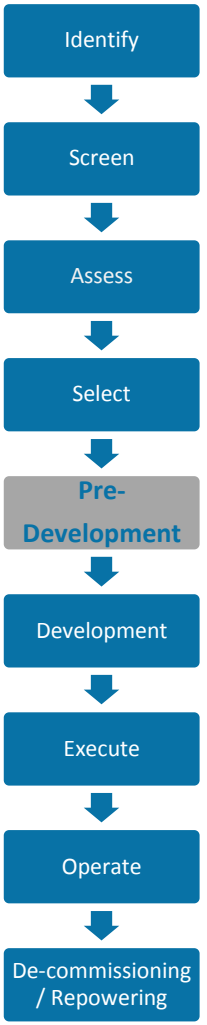
Source:
- Adapted from: Department for Business Innovation and Skills(BIS). 2010. *Guidelines for Managing Projects* P.25

Stakeholder Analysis

- ***Tools:***
  - **Analysing the Stakeholders (Part 3)**

- Make sure it is established:
  - Who is the key day-to-day contact from within the stakeholder organisation and who in the project will be responsible for managing the relationship with them?
  - Who from within the stakeholder organisation will be the person to whom to direct issues that cannot be dealt with on a day-to-day level. Who will be responsible for such escalation?
  - Which aspects of the project are of most interest to a particular stakeholder (A **Stakeholder Interest Map** that relates stakeholders to the aspects of the project that are likely to be of most interest to them may help clarify this analysis)

- Decide how best to involve stakeholders:
  - Should they be actively involved in directing the project (e.g. as Senior Responsible Owner, Project Board/Steering Group member)?
  - Should they be involved as a member of the project team doing specialist work to create the deliverables?
  - Should they be involved in Quality Assurance/Quality Control activities?
  - Should a "Stakeholder Interest Group" be formed to keep them informed and canvass their opinions?
  - Keep them informed on a regular, formal basis?
  - Send them information on an *ad hoc* basis as events occur?
  - Make them aware of where information about the project can be obtained should they require it (e.g. from the internet, intranet, document repository)?

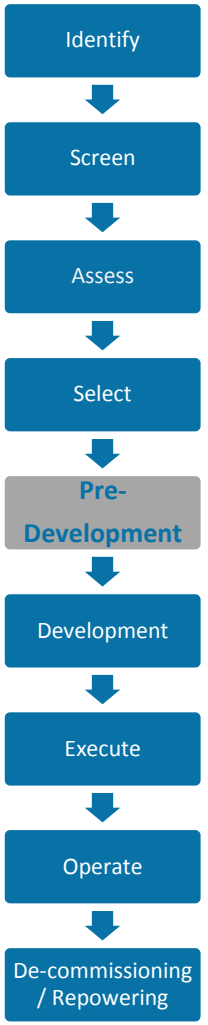


Source:
- Adapted from: Department for Business Innovation and Skills(BIS). 2010. *Guidelines for Managing Projects* P.25-26

Stakeholder Analysis

- **When to Conduct Stakeholder Analysis?**

Timing is an important factor in the implementation of Stakeholder Analysis (SA) to assure the use of the results for policy formulation. In most cases, SA should precede the finalising of reform proposals. In the early stages of policy formulation, SA can help gauge the likelihood of acceptance and sustainability of anticipated policy reforms. By initiating SA prior to the introduction of the reform and continuing to modify the policy proposal during the design process, potential obstacles to implementation and results can be avoided. When used at the right time and in conjunction with other tools, such as qualitative political economy analyses and social impact assessments, a Stakeholder Analysis can inform task team strategies to overcome opposition, build coalitions and channel information and resources to promote and sustain proposed reform.



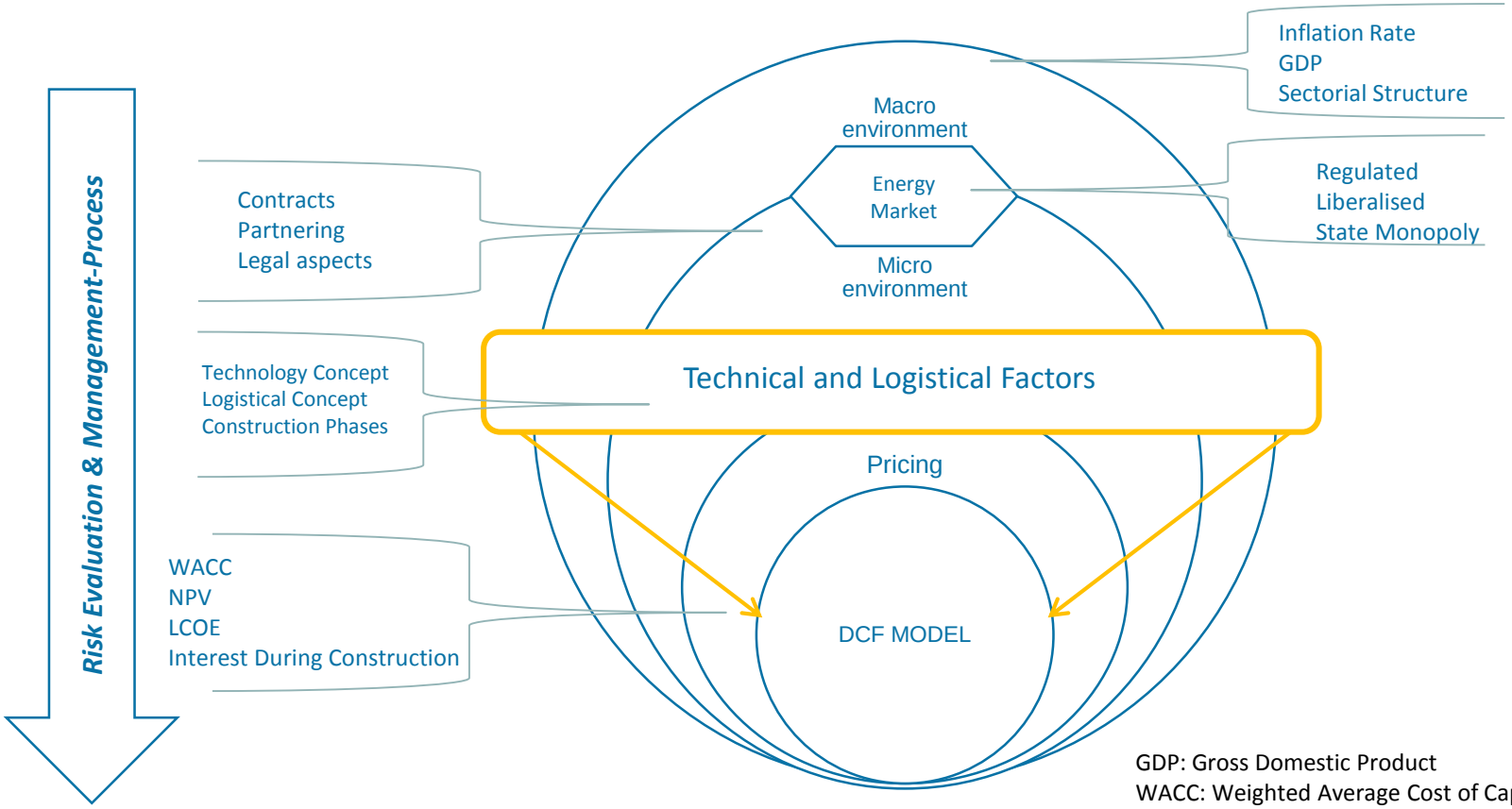
Source:
- Adapted from: World Bank. March 11, 2013 <http://www1.worldbank.org/publicsector/anticorrupt/PoliticalEconomy/stakeholderanalysis.htm>

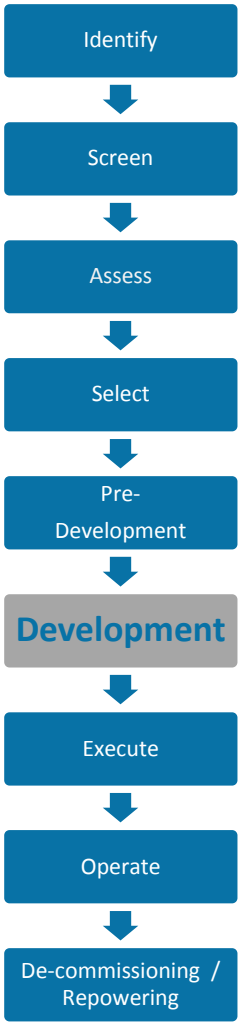
EXAMPLE TOOLS FROM THE PROJECT NAVIGATOR TOOL:

RISK MANAGEMENT

Development

- ***Tools:***
  - **Development Analysis Process Overview**



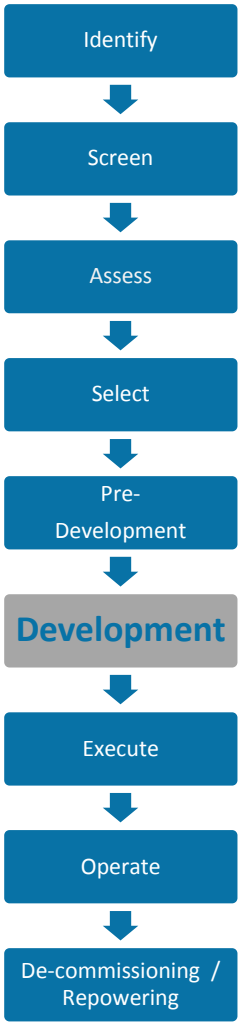


GDP: Gross Domestic Product
WACC: Weighted Average Cost of Capital
NPV: Net Present Value
LCOE: Levelised Cost of Energy
DCF: Discounted Cash Flow

Risk evaluation & management

The method consist of the following elements, performed in the following order:

1. Identify, characterize, and assess threats
2. Assess the vulnerability of critical assets to specific threats
3. Determine the risk (i.e. the expected likelihood and consequences of specific types of attacks on specific assets)
4. Identify ways to reduce those risks
5. Prioritize risk reduction measures based on a strategy



Sources:

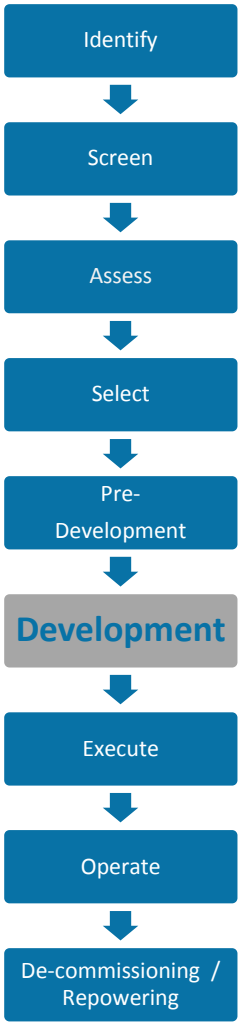
Wikipedia: Risk Management Method. April 1, 2013. April 04, 2013 <http://en.wikipedia.org/wiki/Risk_management#Method>

Risk evaluation & management

The International Organization for Standardization (ISO) identifies the following principles of risk management

➔ Risk management should:

- create value – resources expended to mitigate risk should be less than the consequence of inaction, or (as in value engineering), the gain should exceed the pain
- be an integral part of organizational processes
- be part of decision making process
- explicitly address uncertainty and assumptions
- be systematic, structured and timely
- be based on the best available information
- be tailorable (appropriate to the organization and to the organization's stakeholders, context and risk profile)
- take human and cultural factors into account
- be transparent and inclusive
- be dynamic, iterative and responsive to change
- facilitates continual improvement and enhancement
- be continually or periodically re-assessed



Sources:

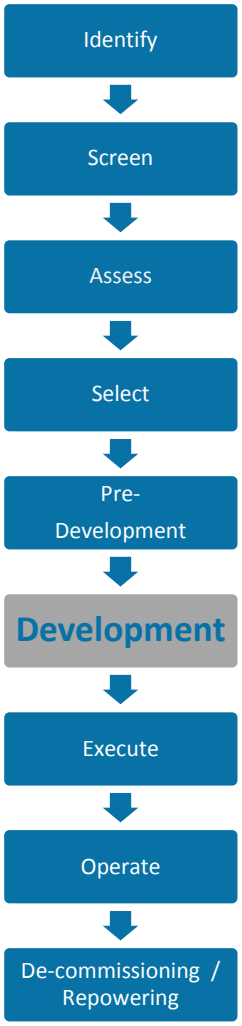
- Adapted from: InConsult 2009. *ISO 31000 Overview and Implications for Managers.* P. 3-7
- Adapted from: Wikipedia: Risk Management Method. April 1, 2013. April 04, 2013 <http://en.wikipedia.org/wiki/Risk_management#Method>

Risk evaluation & management

- **Process**:

- Completion risk
- Operating risk
- Market and revenue risk
- Monetary risk
- Increase of the interest rate risk
- Force majeure
- Resource risk
- ...

...

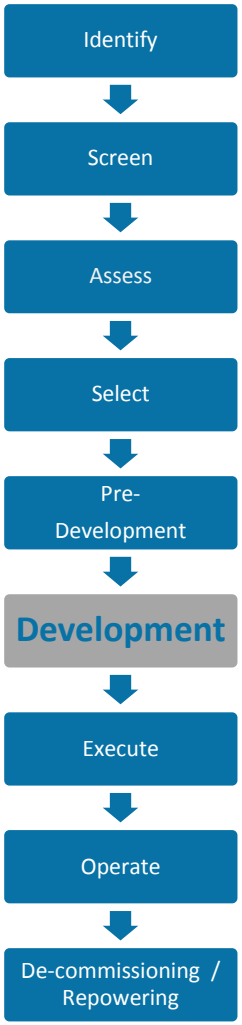


Sources:
- H_DA: Energy management - Student case studies (2012)

Risk evaluation & management

- Process

  Exp. : Operating risk (PV solar plan)



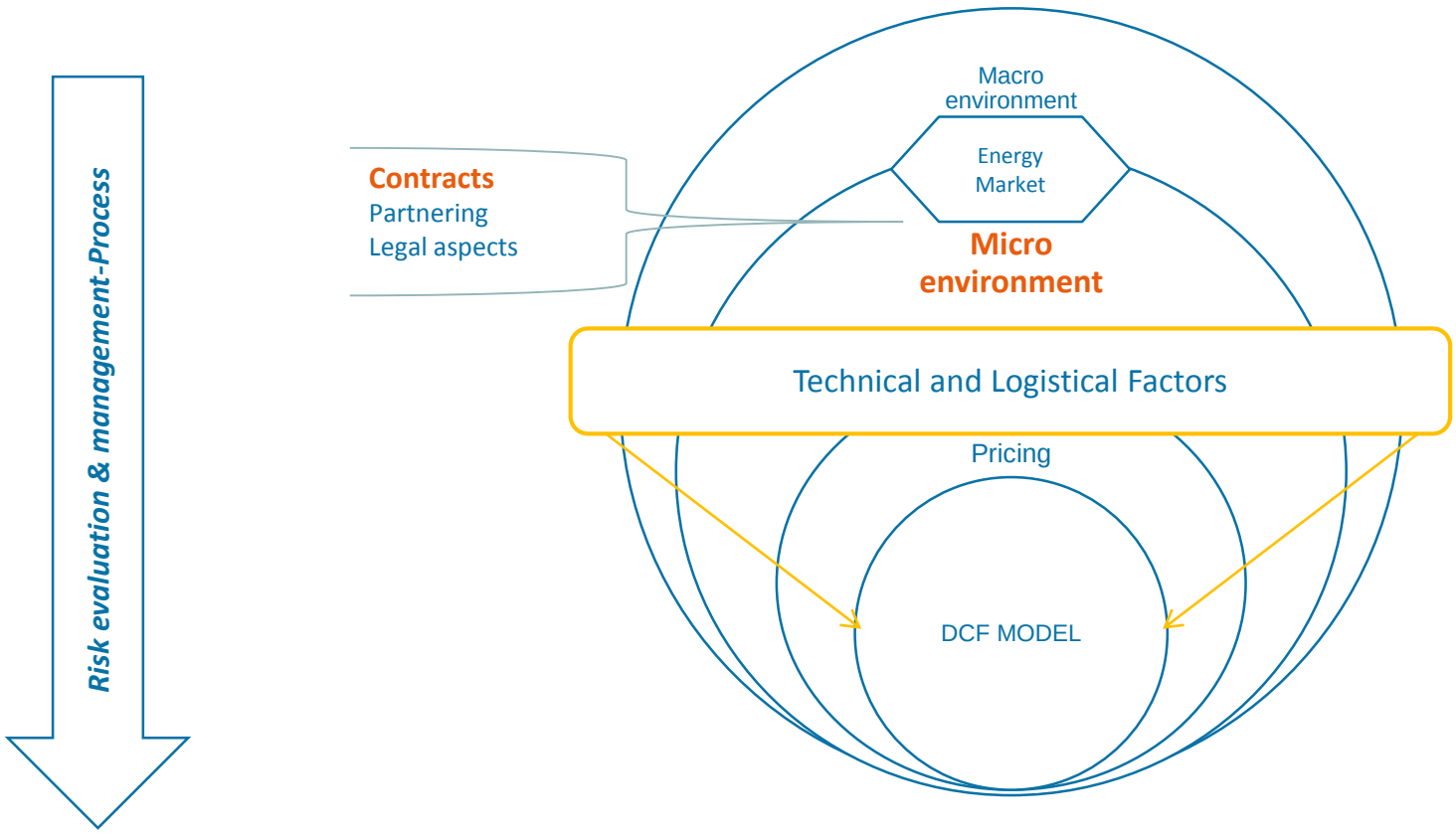
Sources:

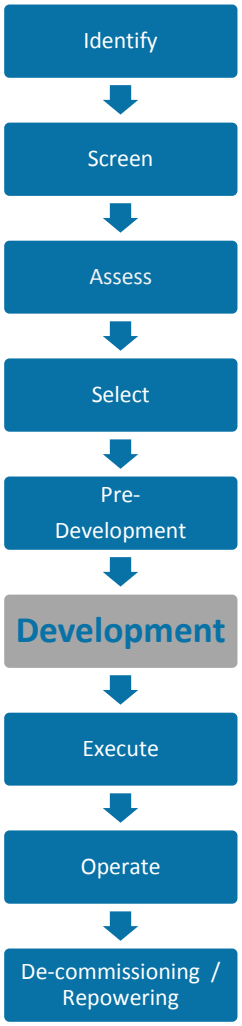
- H_DA: Energy management - Student case studies (2012)

EXAMPLE TOOLS FROM THE PROJECT NAVIGATOR TOOL:

POWER PURCHASE AGREEMENT

Development





Everything needed for the implementation of a project is arranged clearly for the parties that conduct the implementation.

→ All contracts must be ready to be signed after the development phase!

Contracts

- 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

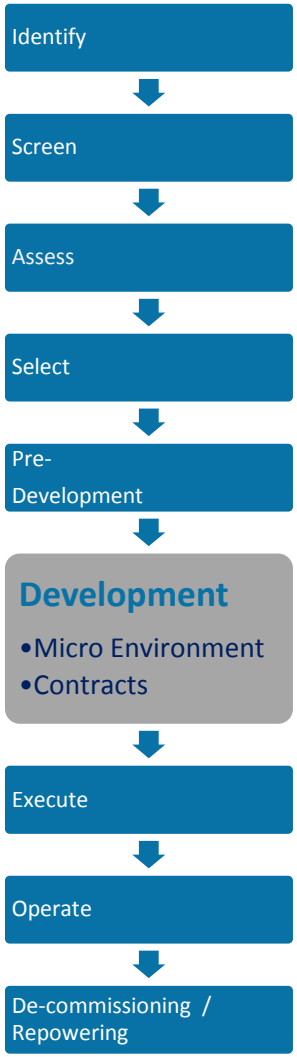
Sources:

- Adapted from: Windustry. May 17, 2013. http://www.windustry.org/community-wind/toolbox/chapter-13-power-purchase-agreement>

Power Purchase Agreement

A Power Purchase Agreement is one of the most important contracts, when it comes to planning renewable energy power plants. A PPA affords potential investors and financial institutions a sound legal guarantee. The lack of adequate legal safeguards increases risk, resulting in higher capital costs.

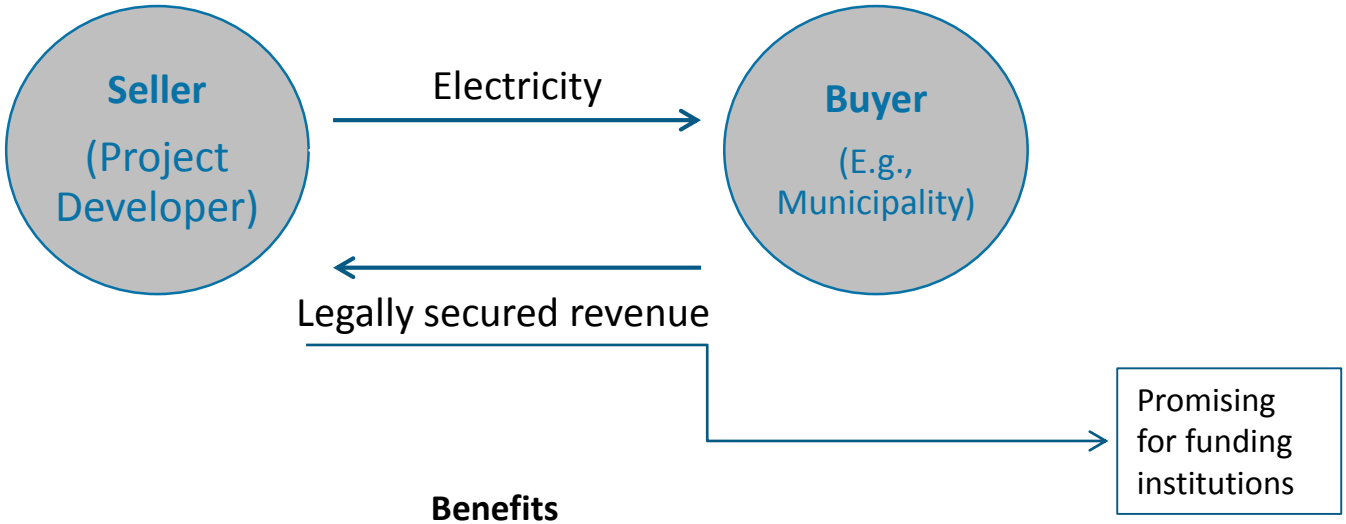
The agreement is established between the power producer that sells the electricity and the power buyer. Everything needed for the trade and transmission of electricity is determined. Some of the important aspects are the commercial operation date, schedule and volume of the electricity sale, power price, transmission and warranties.



Power Purchase Agreement

Focus on PPA:

- Long-term: 10- 20 years



Benefits

- Secures long-term revenue
  - → Lower risk
  - → Attractive to funding institutions
  - Especially in case of no feed-in tariffs
- Secured supply
- Cleary established and fixed costs
- No up-front costs for buyer
- Seller is responsible for equipment O&M costs

Often: combination of tax credits, rebates and carbon credits available to both parties

Sources:

- The Partnering Initiative: The Benefits and Risks of Partnering. March 12, 2013 <http://thepartneringinitiative.org/w/who-we-are/philosophy-and-approach/the-benefits-and-risks-of-partnering>

Power Purchase Agreement

Typical architecture of a PPA

1. Interpretation and defined terms
2. **Sale and purchase of energy**
3. Term
4. Currency, Payments and Billing
5. Pre-operation obligations
6. Interconnection
7. Metering
8. Operation and Maintenance
9. Mutual warranties and covenants
10. Defaults and termination
11. Force majeure
12. Indemnification and liability
13. Insurance
14. Resolution of disputes
15. Notices
16. Miscellaneous Provisions

Typical legal terms

- Why are they part of the Agreement?
- What is usually the content of each section?

Power Purchase Agreement

2. Sale and Purchase of Energy

Why: Ensure the utilities supply and the developers incoming cash flows

Standard content:

- **Sale to utility:**
  - **Take-or-pay**
  - **Net energy output**
- **As available Energy Take**
- **Sale to Developer**

Always include arranged percentage of variation!

- **Energy price**:

How a price formula works:

Components change → Power price adjusts after an arranged period of time

→ New Price = $Base\ Price\ (0.6\frac{New\ Pellet\ price}{Base\ pellet\ price} + 0.4\frac{New\ price\ Parameter\ x}{Base\ price\ parameter\ x}\ldots)$

Example: 1 (0.6* 1.2/1.0+0.4 * 1/1) =1.12

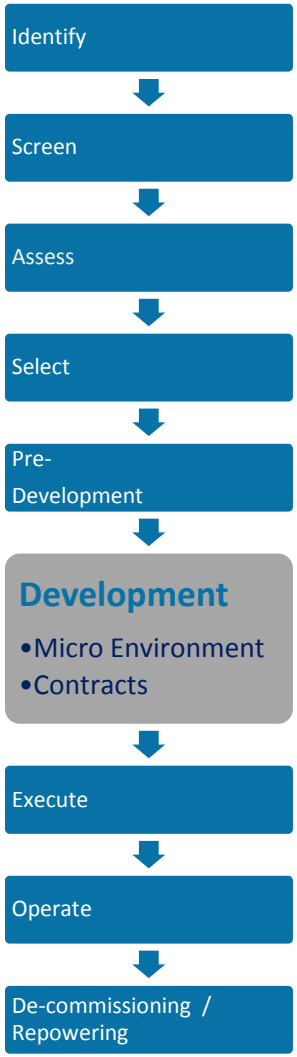
- Example for pricing in a PPA:

Component	Base Price (?USD/kWh)	Adjustment Basis (%)	Adjustment Frequency
Base Price (?/kWh)	2.9	1.5%/a	6 months
Base O&M Charge (USD/a)	2000	2%/a	
Fixed Energy Charge → Helps cover fixed costs (USD/a)	5000		

Power Purchase Agreement

The Most Important Clauses of Bankable PPAs (I)

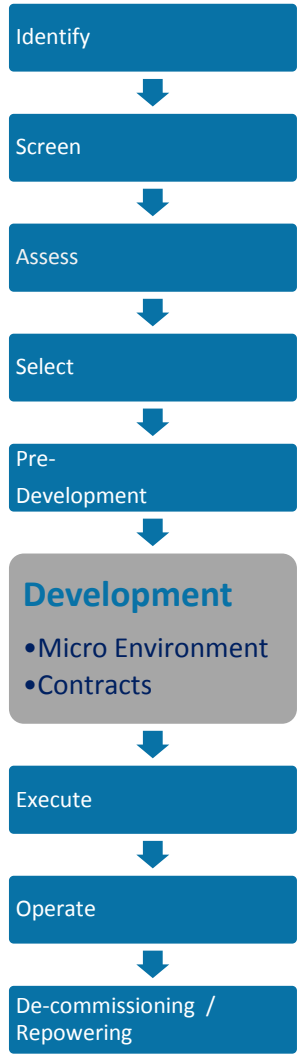
- **Dispatch Risk**
  - **Why:** To mitigate the risk that the offtaker may not dispatch the generating facility
  - **How**: `Take or Pay` or `Take and Pay` clauses
- **Fixed Tariff**
  - **Why:** To mitigate the risk of not covering the cost of operating the facility, repay the debt and provide a reasonable return on equity
  - **How**: The revenue of a PPA should be a fixed amount per kWh generated
- **Foreign Exchange**
  - **Why:** To avoid subjecting the power producer to currency risk
  - **How**: The PPA should be either denominated in or linked to an exchange rate of the currency of the power producer's debt
- **Change in Law/ Change in Tax**
  - **Why:** To avoid subjecting the power producer to currency risk
  - **How**: The PPA should be either denominated in or linked to an exchange rate of the currency of the power producer's debt
- **Force Majeure**
  - **Why:** To Protect the parties and their liabilities in case of unforeseeable events beyond their control



Power Purchase Agreement

The Most Important Clauses of Bankable PPAs (II)

- **Dispute Resolution**
  - **Why:** To solve problems and conflicts as fast and simply as possible under rules generally acceptable to the international community (e.g. UNCITRAL, LCIA, ICC)
- **Termination and Termination Payments**
  - **Why:** To mitigate the risk that the project is left with no access to the market
  - **How**: The PPA should limit the termination by the offtaker to significant events or, in case of transfer of facility to the offtaker, a termination payment equal to the bank debt and a return on equity, in case of the offtaker's default, shall be provided
- **Assignment**
  - **Why:** To improve and systematise communication between the power producer's lenders and the offtaker
  - **How**: The PPA should allow collateral assignment of the agreement to receive notice of any default and to cure such default
- **Offtaker Payment Support**
  - **Why:** To support the offtaker's payment obligations
  - **How**: Short term liquidity instrument, a liquidity facility and/or a sovereign guaranty
- **Transmission/ Interconnection Risk**
  - **Why:** To agree on which party bears the risk of connecting the facility to the grid and transmitting power to the nearest substation

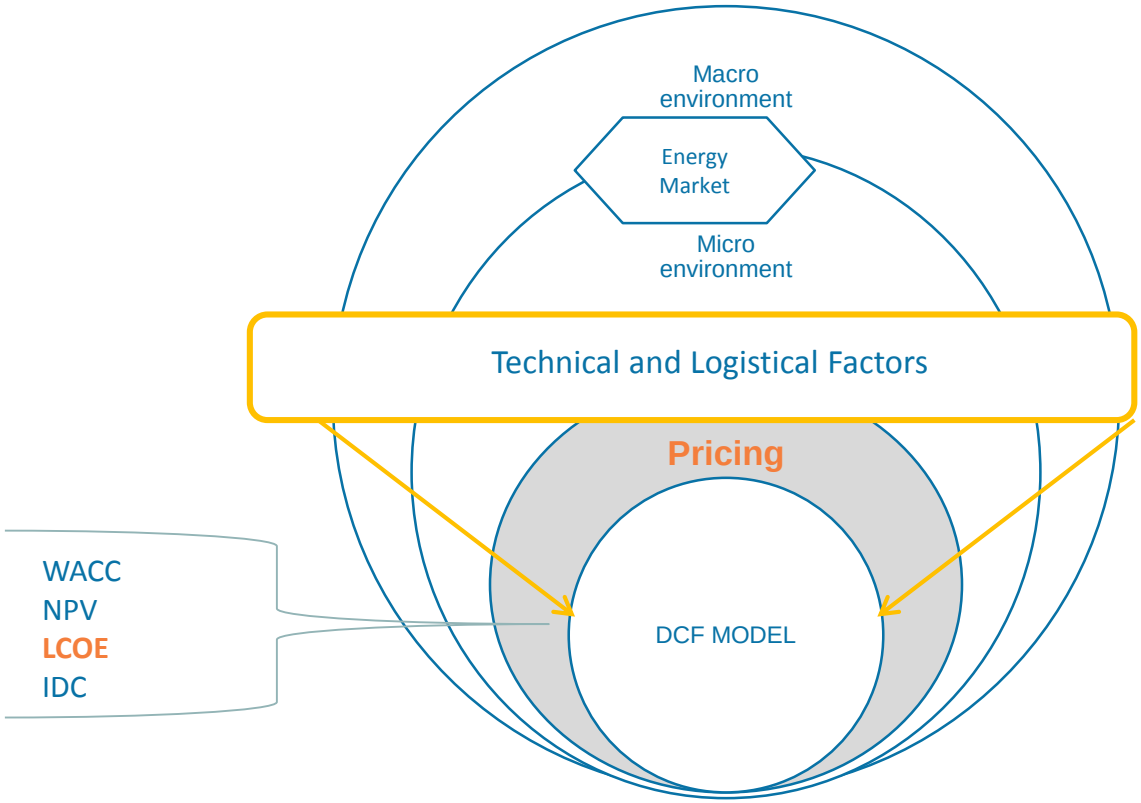


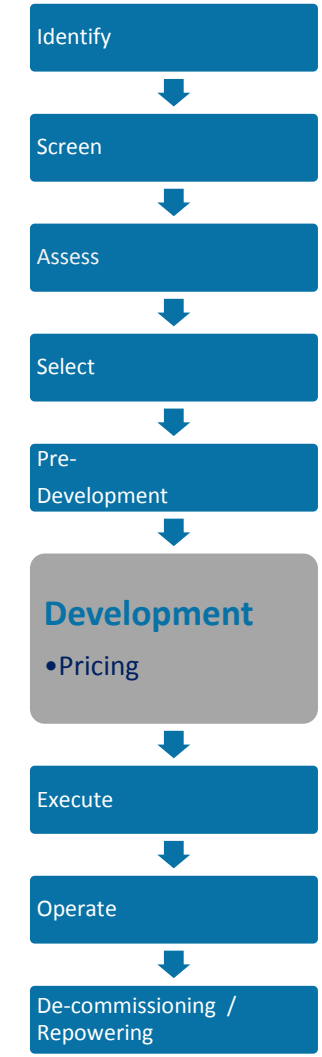
EXAMPLE TOOLS FROM THE PROJECT NAVIGATOR TOOL:

LEVELISED COST OF ENERGY

Development

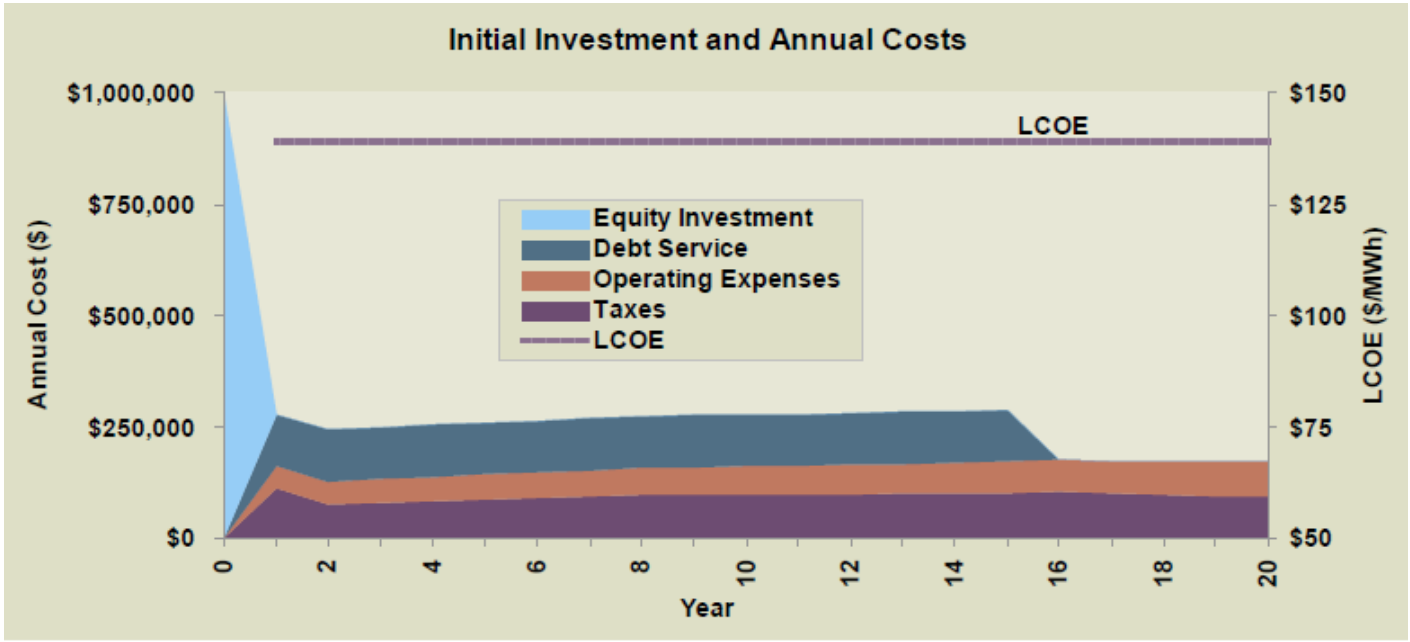
- ***Tools:***
  - **Development Analysis Process Overview**





Levelised Cost of Energy

- Levelised Cost of Energy (LCOE) is the constant unit cost (per kWh or MWh) of a payment stream that has the same present value as the total cost of building and operating a power plant over its lifetime.



Source: Black & Veatch

Identify
Screen
Assess
Select
Pre-Development
Development
- Pricing
- LCOE

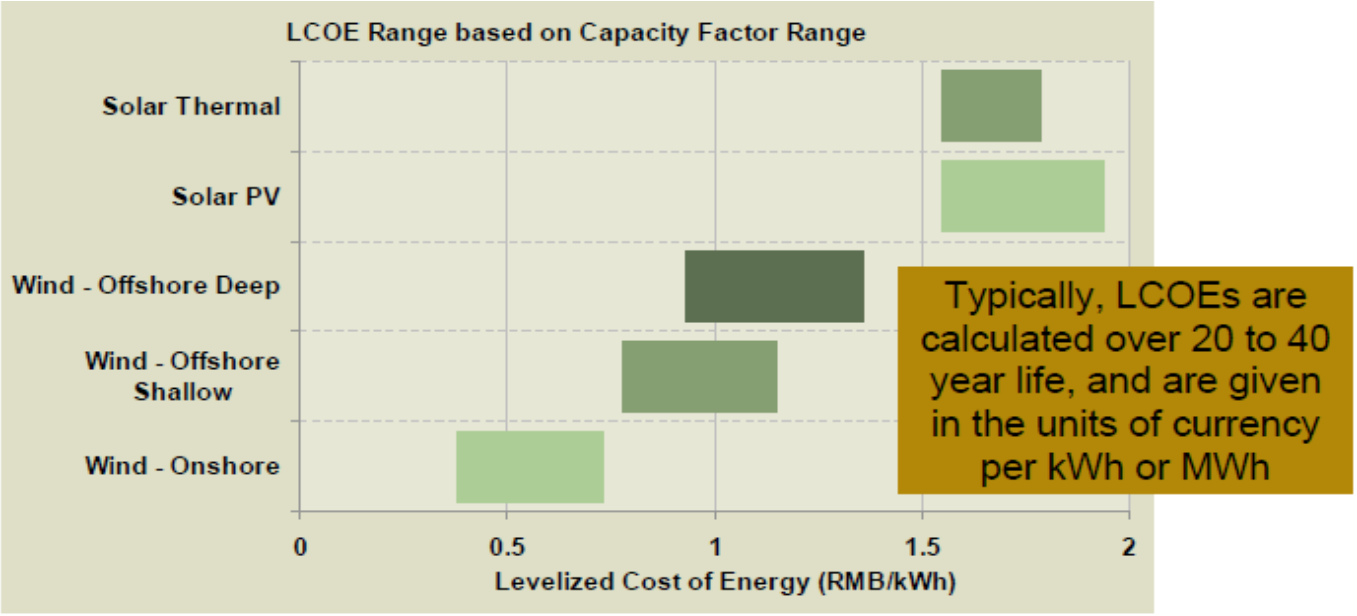
Execute
Operate
De-commissioning / Repowering

Source:
- Black & Veatch. *Levelized Cost of Energy Calculation, Methodology and Sensitivity.* P. 2

Levelised Cost of Energy

Why Use LCOE?

- Very useful in comparing technologies with different operating characteristics.
- The LCOE equation is one analytical tool that can be used to compare alternative technologies when different scales of operation, investment or operating time periods exist. For example, the LCOE could be used to compare the cost of energy generated by a PV power plant with that of a fossil fuel generating unit or another renewable technology.



Source: Black & Veatch

Identify
Screen
Assess
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Pre-Development
Development
- Pricing
- LCOE

Execute
Operate
De-commissioning / Repowering

Source:
- Black & Veatch. *Levelized Cost of Energy Calculation, Methodology and Sensitivity.* P. 3

Levelised Cost of Energy

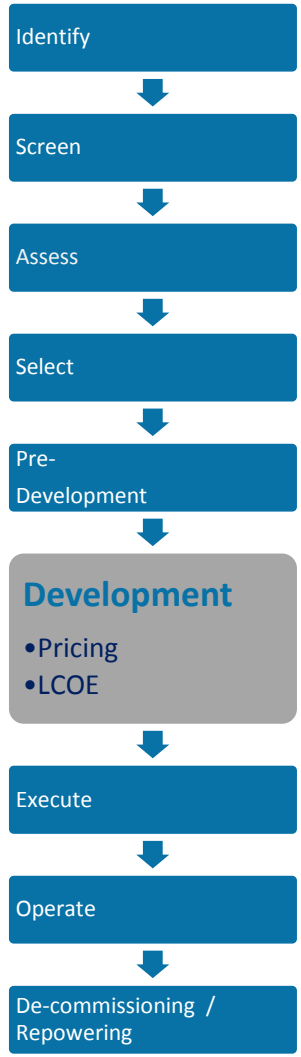
- **Levelised Cost of Energy (LCOE) Equation:**

$$LCOE = \frac{Total\ Life\ Cycle\ Cost}{Total\ Lifetime\ Energy\ Production}$$

$$LCOE = \frac{\sum_{t=1}^{n} \frac{I_t + M_t + F_t}{(1+r)^t}}{\sum_{t=1}^{n} \frac{E_t}{(1+r)^t}}$$

The approach used in the analysis presented here is based on a discounted cash flow (DCF) analysis. This method of calculating the cost of renewable energy technologies is based on discounting financial flows (annual, quarterly or monthly) to a common basis, taking into consideration the time value of money. Given the capital-intensive nature of most renewable power generation technologies and the fact that fuel costs are low or often zero, the weighted average cost of capital (WACC), often also referred to as the discount rate, used to evaluate the project has a critical impact on the LCOE.

I_t : *Investment expendirures in the year t*
M_t : *O&M expenditures in the year t*
F_t : *Fuel expenditures in the year t*
E_t : *Electricity generation in the year t*
r : *Discount rate*
n : *Life of the system*



Source:

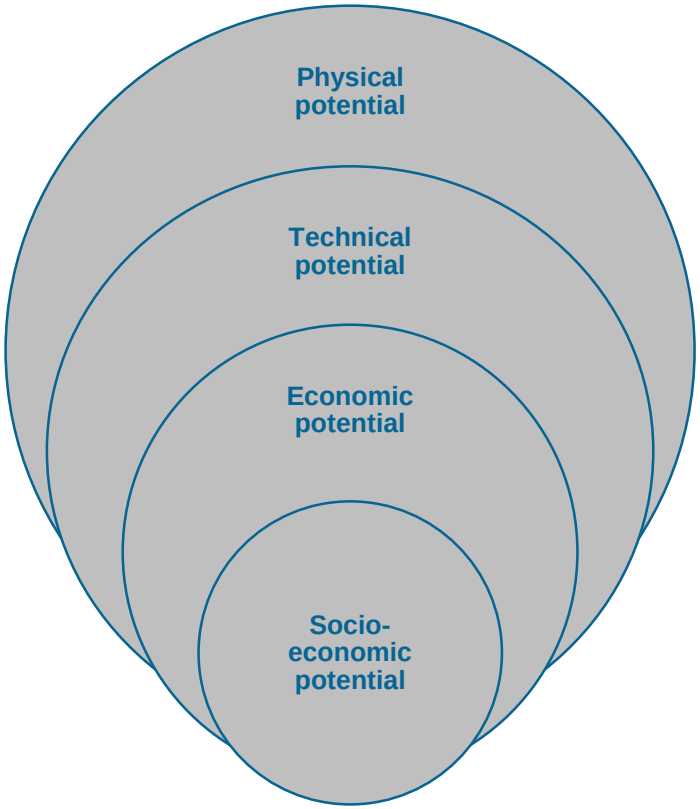
- IRENA Working Paper. 2012.*Renewable Energy Technologies: Cost Analysis Series, Volume 1: Power Sector* P.3

EXAMPLE TOOLS FROM THE PROJECT NAVIGATOR TOOL:

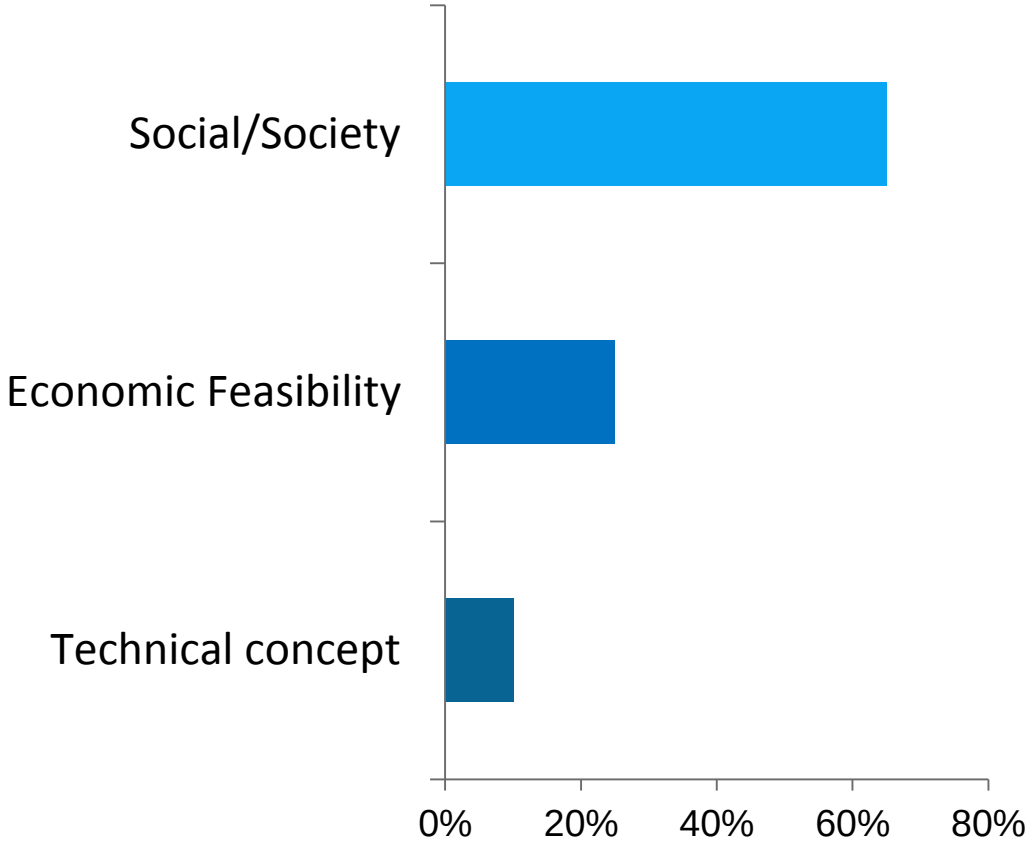
TECHNICAL CONCEPT ON-SHORE WIND POWER PLANT

Potential of RET projects

Potential of projects



Reasons for failing projects



Technical Concept

Importance of well conducted Technical Concept:

- Use the **right technical equipment for the specific circumstances** and current existing technical framework

  → Make **maximum use** of the investment:

  - O&M
  - Efficient technology→ Efficient harvesting of the power given in the wind
  - Long operating life

- **Funding Institutions** only want to invest in promising projects

  → Experts check it with due diligence

Problem and solution:

The structure and content of the technical concept varies strongly between the technologies.

→ Navigator can not give detailed universal solutions for all projects, <u>but</u>:

- Suggests the first required actions
- Provide advice and examples
- First overview on typical elements → Raise awareness of important factors/issues
- Suggest various service providers, consultants and experts can help to go more into detail when it comes to the single aspects of a technical concept.

Technical Concept
Wind On-shore

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Site & Resource Assessment

- Wind resource
- Local climate
- Available Area
- Land use
- Topography
- Land cover
- Geotechnics
- Geopolitics
- **Environmental impact assessment**

Technology Assessment

- Type, Structure and unit size of Turbines
- Rotor & Rotor Blades
- Electronic Equipment
- Electrical Control System
- **Mechanical Control System**
- Efficiency and Performance
- Training and Service Requirements
- DC/AC System
- Internal Wind Park Cabling

- Grid Connection
- Accessibility
- Traffic Management and construction

- Sufficient distance between Turbines
- Nacelle, Tower and Foundation
- Decommissioning

Logistic & Construction

Development

- ***Tools:***
  - **Environmental Impact Assessment**

Categories of environmental impact:

- Eco- System
- Health and comfort
- Culture

Impact on flora and fauna

→Differs with the vegetation and wild life of the given areas

- Flora: During construction or as a result of construction
- Wild life: Birds
  - Collisions with the turbine
  - Scaring birds off

  → Prevent troubles with the public

Source: http://cdn.greenoptimistic.com/wp-content/uploads/2012/04/turbines-birds.jpg

- Examine regional/local land-use plan→ Bird sanctuary/nature protection area? → Usually regulations regarding distances
- Does a directive on conservation of wild birds exist?
- Requirements like species protection assessment? → Field mapping of wild life, (Area for breeding, bird migration, endangered species…)

Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory & Practice*. Earthscan. London, 2007. P.155-160

Development

- ***Tools:***
  - **Environmental Impact Assessment**

Sound propagation

- Mechanical noise from nacelle
- Aerodynamic noise from rotor blades
- Emission vs. imission

→Strict regulations that differ between countries/states have to be met to get the needed permissions!

Shadows/ Reflections

- Flickering due to the blade's movement
- Moving from west to east during the day

➢ Map different zones for shadows and reflections to illustrate the impact

Visual impact on the landscape

- Individual opinion depends mostly on the local general view on wind power
- Turbines are visible up to a distance of 400 times the hub height

→ If the hub height is 80 m, one can see the turbine from a distance up to 32 km!

➢ Illustrate visual impact from different views in the area

➢ **Every country or state has different regulations and distances that have to be met!**

Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory & Practice*. Earthscan. London, 2007. P.158 - 166

Development

- ***Tools:***
  - **Environmental Impact Assessment Document**

Demanded by many countries for projects above a certain size.

- 2 or more possible options for siting, one of them the zero-option
- Present in a comparable way

Levels of impact described in the EIA Document:

1. Present situation
2. Impact (Change, consequences) — Construction, Operation, Restoration
3. Precautions

Levels need to be considered regarding all impacts

Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory & Practice*. Earthscan. London, 2007. P.260-264

Sources: http://csmres.co.uk/cs.public.upd/article-images/Single-turbine.jpg

Development

- ***Tools:***
  - **Environmental Impact Assessment Document**

The EIA document should include the following sections:

- Introduction
- Summary
- Project description
- **Consequences**
- Sound propagation
- Safety
- Nature
- **Visual impact**
- Recreation
- Cultural heritage
- **Comparative assessment**
- **Precautions**
- Conditions, follow- up and inspection
- Public consultation
- Sources
- Appendices

Consequences of each option on: health/safety, environment, recreation, cultural heritage and natural resources

Visual impact: Use photomontages to show how the turbine will look from different viewpoints in the area. Zones of visual impact can be calculated and shown on maps.

Comparative assessment: Underline the preferred option, backed by convincing arguments. The zero-option should describe the area in a 25-years window and not just the direct impact.→ Imply negative impact e.g. if power is not generated by wind, but by fossil fuels.

Precautions: What measures could be taken to minimize/prevent impacts mentioned in the sections?

Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory & Practice*. Earthscan. London, 2007. P.261-264

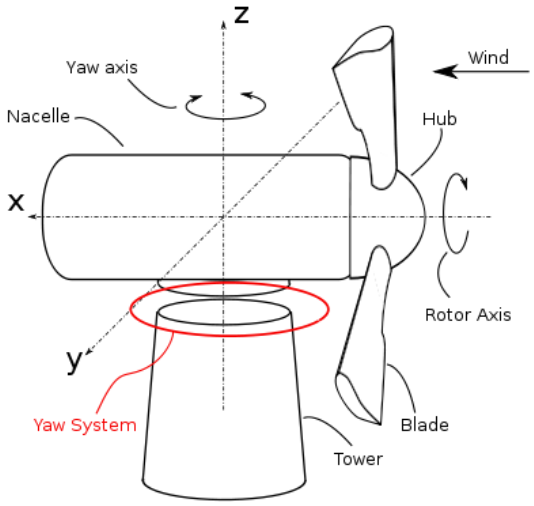
Development

- ***Tools:***
  - **Mechanical Control System-Operational Control**

Yaw system

- The rotor should always be perpendicular to the wind
- Wind vane shows what direction the wind is coming from
  - → Signal to yaw motor
  - → Turn the nacelle

Source: http://www.nordex-online.com/microsites/delta/content/turbine/features/nordex_yaw_system.jpg



Source: http://en.wikipedia.org/wiki/Yaw_drive

- Improves the power output → Evaluate: Additional investment costs and additional O&M costs in relation to optimised energy harvest
- Usually used for large-scale projects

Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory and Practice*. Earthscan. London,2007. P.95-66,111-113

Development

- ***Tools:***
  - **Mechanical Control System→ Operational Control**

Operational control: Rotor blade control

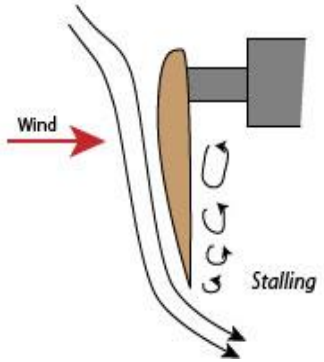
- Control system collects data about the wind speed from the anemometer to
  - Keep the rotational speed at a constant level→ keep the power generation at a constant level
  - Stop the turbine from rotating too fast in high speeds → Prevent damage

Stall controlled rotor blades:

Design of the blade

- uses angle that gives enough lift to get the rotor moving at small wind speeds
- creates turbulences in case of wind speeds above the nominal level

→ Blades can not be adjusted mechanically



Source: http://www.greenrhinoenergy.com/renewable/wind/wind_technology.php

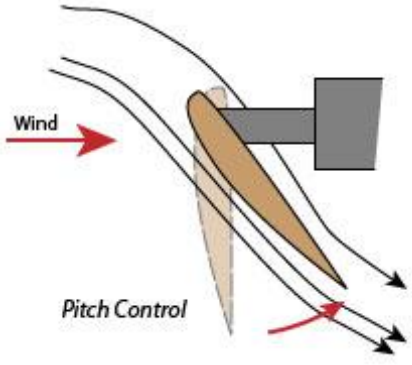
Pitch controlled rotor blades:

Signal by control system to turn rotor blades

- Turn blades to get rotor started at low wind speeds
- Wind speed above the nominal level?

→Blade turns out of the wind

→ Rotor stops moving

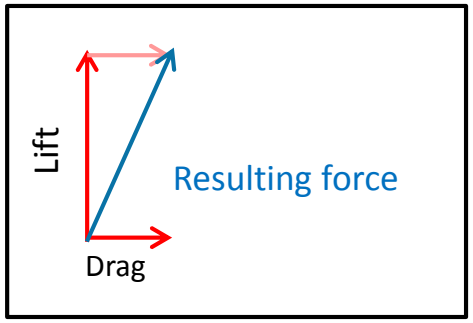


Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory and Practice*. Earthscan. London,2007. P.95-66,111-113

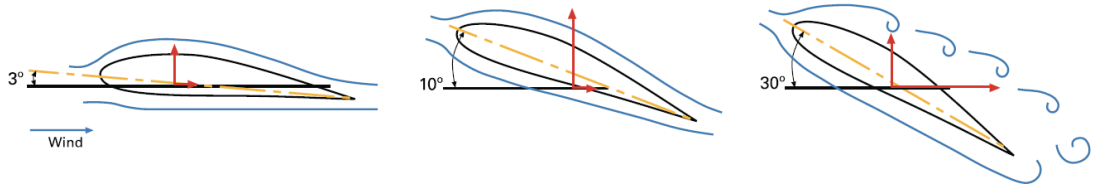
Source: http://www.greenrhinoenergy.com/renewable/wind/wind_technology.php

Development

- ***Tools:***
  - **Mechanical Control System→ Operational Control – Pitch controlled rotor blades**

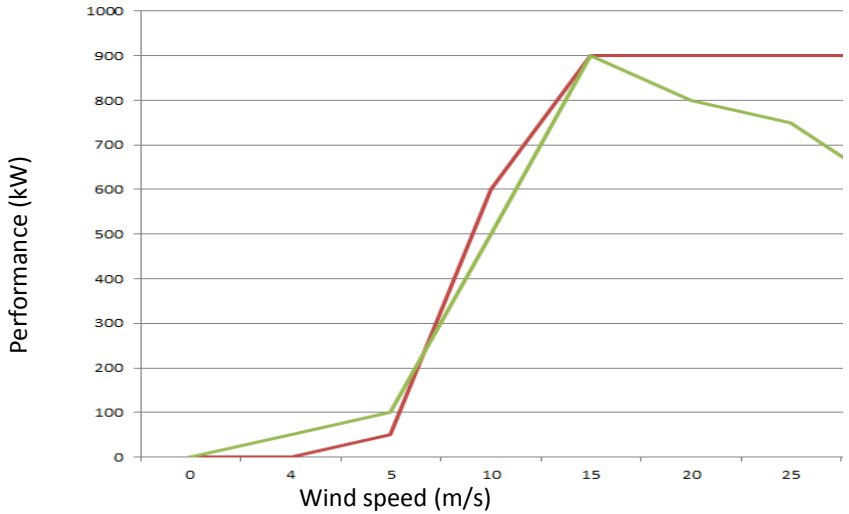


Optimize Lift-Drag ratio



Source: http://www.gurit.com/files/documents/2_aerodynamics.pdf

Adapt the angle of attack to keep the generated power at a constant level



Stall control
Pitch control

Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory and Practice*. Earthscan. London,2007. P.95-66,111-113

Development

- ***Tools:***

  - **Mechanical Control System → Operational Control**

Stall control vs. Pitch control

Advantages

- Rotor starts turning at low wind speed
- No control system needed

Disadvantages

- No control during operation
- Difficult to design
- Maximum performance can't exactly be forecasted
- After reaching its maximum the performance decreases

Advantages

- Blades can be turned to start at low speed
- Blade can turn out of the wind to stop the turbine
- The optimal rotational speed can be kept even in wind speeds above the nominal level
- When reaching its optimum the performance stays at a constant level
- In too high wind speeds blades turn out of wind to prevent damages

Disadvantages:

- Costs

- Optimization:

Additional costs vs. energy output

Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory and Practice*. Earthscan. London, 2007. P. 95-66, 111-113

Development

- ***Tools:***
  - **Mechanical Control System-Operational Control**

- **Surveillance**:
  - Temperature in Gearbox and Generator
  - Pressure in hydraulic systems
  - Vibration in machine components and rotor blades
  - Voltage and frequency in generator and grid

  In case of fault: Turbine stops and the system sends alarm to the operator

  → Restart

  → Repair

→ Data are saved to enable a detailed analysis later on

- **Operations follow up**:
  - The system collects, processes and presents data in readable form
  - Data: Wind speed; outages; production…

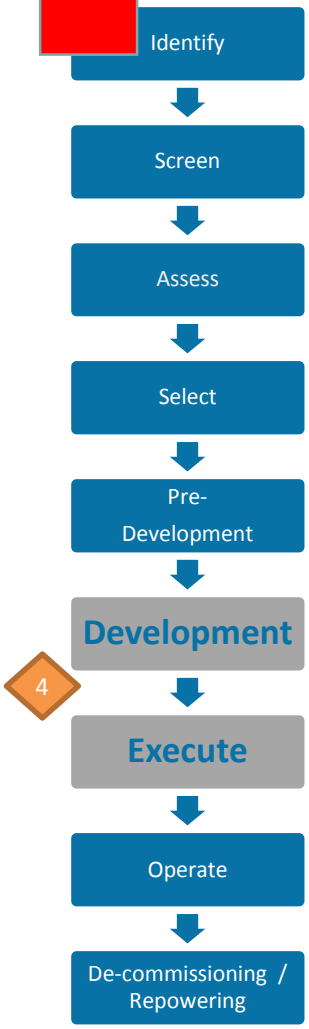
Sources:
Adapted from: Wizelius, T. *Developing Wind Power Projects, Theory and Practice*. Earthscan. London,2007. P.95-66,111-113

EXAMPLE TOOLS FROM THE PROJECT NAVIGATOR TOOL:

PROJECT PROPOSAL STRUCTURE

Development

- ***Key Decision:***
  - ✓ Final Investment Decision: Will you proceed with the project implementation?
- ***Control Question:***
  - ✓ Do you understand the economic environment related to cost and value creation of your project?
  - ✓ Do you understand the value implication coming from partnering, legal and commercial contracts of you project?
  - ✓ Do you understand the value implication coming from the technical concept of your project?
  - ✓ Did you select a funding institution?
- ***Key Deliverables:***
  - ✓ **Project Proposal**



Project Proposal

- Without project funding, most projects won't be executed. Writing a clear, thorough and targeted project proposal is therefore essential.

- A project proposal is a detailed description of a series of activities aimed at solving a certain problem. The proposal should contain a detailed explanation of the:

  - justification of the project;
  - activities and implementation timeline;
  - methodology; and
  - human, material and financial resources required.

- Once the groundwork has been completed, proposal writing can commence. The key decision to be made at this stage is the structure of the project proposal (content and length). The structure is determined by the nature of the project as well as by the funding agency's requirements. However, some common elements can be identified and should be always included.

- The information and documents completed throughout the groundwork and saved in the "Project Workspace" of the Project Navigator Platform will be of a great help while writing the project proposal.

Sources:
Adapted from: Nebiu, B. *Project Proposal Writing, Developing Skills of NGOS*. The Regional Environmental Center. Hungary, 2000. P. 7

Project Proposal Structure

1. Summary

What is all about?

2. Organizational Background and Capacity to Implement the Project

Does the organization have the capability to successfully implement the project?

This section should clearly demonstrate that the proposing organization has the experience, capacity, and commitment to implement successfully the proposed project. Among the issues to be covered in this section include:

- Nature of the proposing organization
- Purpose and core activities of the organization
- Organizational approach (philosophy) for project implementation
- Length of existence and project management experience
- Membership and affiliation to associations or umbrella groupings
- Legal status - registration with government approved authority
- Previous experience relevant to the proposed project

Sources:
Adapted from: Proposal Structure from GEF Fund

Project Proposal Structure

3. Project Objectives and Expected Results

What shall be accomplished and achieved?

This section should contain a clear and specific statement of what the proposed project will accomplish. Among the issues to address include:

- The problem statement or challenge the project is intended to address
- The primary objective and specific objectives of the proposed project
- The rationale (justification) for the project.
- The specific results that the project will produce.

4. Description of Project Activities

How is the project going to be implemented in order to meet the expected results?

Activity descriptions should be as specific as possible identifying what will be done, who will do it, when it will be done (beginning, duration, completion), and where it will be done. In describing the activities, an indication should be made regarding the organizations and individuals involved in or benefiting from the activity.

Note that weakness in this area may be a major reason for failure to receive funding as this is the actual component to be implemented as a project.

Project Proposal Structure

5. Implementation Plan and Time Frame

What is the sequence of the major activities and the implementation milestones of the project?

This section may be presented in graphical (table) form and can be attached as an annex. It should indicate the sequence of all major activities and implementation milestones, including targeted beginning and ending dates for each step. The Implementation Plan should provide as much details as possible, showing a logical flow of steps, indicating that all the things that must happen have been carefully thought through from the current to the end of project situation. Include in the Implementation Plan all required highlight reports, project reviews and evaluation activities.

6. Resources

What is required? Who shall contribute to that?

Describe how the stakeholder are being involved in

- Project planning and design
- Project implementation
- Project monitoring and evaluation to ensure efficiency and effectiveness in delivery.

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4

CURRENT STATUS AND NEXT STEPS OF THE PROJECT NAVIGATOR

Deliverables and expected added values

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- Deliverables:

Planned in 2014 (2 Regions and 2 RE Technologies)	***Outlook until 2015 (Global, all 6 RE Technologies)***
• 2 Technical Concepts : Solar PV and Small Hydro • Expert Workshops • 2 Pilot Projects • Completion of the Financial Navigator Data base • IT-Implementation of the Project Navigator and the Financial Navigator • Concept for the RET Project Development Communication and Coordination Platform (Online Platform)	• The RET Project Development Guidelines; • The Project Development Navigator; • The Project Financing Navigator; and • The RET Project Development Communication and Coordination Platform • 5 pilot projects

- Expected added Values:
  - More successfully realized RET Projects
  - Less stranded RET Project proposals
  - Effectively reduced costs for RET project development
  - Early access to RE financing sources
  - Higher transparency of financing requirements and procedures for RET Projects
  - Quality improvement and assurance for RET project development
  - Capacity building in RET project development skills

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5

INTRODUCTION TO THE IRENA PROJECT NAVIGATOR PLATFORM

http://navigatorbeta.irena.org

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Thank you for your attention !

rroesch@irena.org

Source materials

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