INTERNATIONAL SOLAR ALLIANCE

Module Outline

BUSINESS MODELS AND FINANCING

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Relevance and Background

Solar PV applications range in size and utility, which led to the evolution of several business models to ensure that stakeholders play to their strengths, and to bring in new stakeholders if required.

The current effective business models, which have been widely reproduced, are being studied in this module.

In the second section on project financing, it was learnt that a combination of equity, debt, and subsidies along with government intervention is required to meet capital requirements and encourage private players to participate in funding solar PV. These have been described in detail within.

Theme – Financing
Competency – Business Models and Financing
Code of the Module – T04C09M25

Learning Outcomes

After the presentation, participants will be conversant with:

- General components of business models
- Contracting
- Common business models
- Developing business models
- Sources of project finance

Finally, the trainer can choose a case study from the selection provided, to elaborate business models relevant to their country.

Method of Delivery

Duration	Resource Code	Resource Delivery
45 min.	M25 L01	Lecture on Business Models and Financing
15 min.	M25 C01	Case Study

M25 L01: Lecture Presentation

The MS PowerPoint presentation will introduce the need for various business models for solar PV projects. The presentation then discusses the major components of solar PV business models and various options available for each component. Subsequently the common business models and selection of business models are presented followed by major contracting needs of a solar PV project.

The presentation will then discuss financing aspects including the major sources of finances.

M25 C01: Case Study

The trainer is recommended to demonstrate business models for solar PV deployment from within the country or the region. A link to a few case studies is provided at the end of the document.

Key Topics to be Covered

1 Major Components of Solar PV Business Models
2 Contracting
3 Common Business Models
4 Developing a Business Model
5 Financing of PV Projects

Table of Contents

1 Major Components of Solar PV Business Models

Considering the numerous solar PV applications and their consumer profiles, the success of solar PV applications depends on the business models selected for the deployment. The major components of a business model are (i) Ownership (ii) Revenue and (iii) Grid Interaction. Different business models can be developed with a combination of options, as given below:

1.1 Ownership

A **Consumer**, as the name suggests, is the full or partial consumer of the energy generated from the solar PV system. A **Generator** operates the solar PV system to generate the energy. An **Owner** is the one who legally owns the solar PV system. There are four different ownership models:

- A single entity can be the Consumer, Generator and Owner. The solar PV system is deployed for self-consumption. Such a model is called the self-owned model or capital expenditure (CAPEX) model. The consumer can also sell surplus energy to other Consumers or utilities.
- The Generator and the Owner can be a single entity. Here a solar PV unit is deployed with the purpose to sell energy to utilities or Consumers directly.
  - For utility-scale projects, such entities are called Independent Power Producers (IPPs).
  - For distributed renewable energy (DRE), such entrepreneurs are called Renewable Energy Service Companies (RESCOs). This model is also referred to as Build-Own-Operate (BOO) model.
  - Investors like Pension Funds also act as the Owner and the Generator in solar PV projects under this model. Investors depend on specialized O&M agencies for operations of the projects. This ownership model is also known as the Investor model.
- The Generator, Owner and the Consumer can be three different entities. The Owner deploys the solar PV unit for the purpose of leasing to the Generator, who then operates the solar PV unit to generate and sell energy to the Consumer or utilities.
- Utilities can also own solar PV plants to supply generated energy to their Consumers. Such projects are usually referred to as Utility-owned projects.

There are more examples, world over, of the first two models.

There can also be a transfer of Ownership of the solar PV plant within the lifetime of the project:

- **Build-Operate-Transfer (BOT)** – The Generator (IPP or RESCO) develops the project for a pre-agreed period and then transfers it to the Consumer or utility, or government-owned institutions [under the private-public partnership (PPP) framework]. The Generator will recover the project costs through the sale of energy.
- **Lease–Develop–Operate (LDO)** – The Generator builds the solar PV unit with the capital of the Owner. The Generator then operates the unit for a pre-agreed period for self-consumption or sale of energy to a Consumer or utility. During this period the Generator pays for the lease to the Owner. At the end of this period, the Generator transfers the unit to the Owner. This model is usually deployed by Financial Institutions.

Solar PV projects, especially DRE, can be developed under ownership structures other than the abovesaid ones. These are mostly Community-owned or Consumer Co-operative-owned.

1.2 Revenue Models

Revenue from a solar PV unit can be generated from:

- **The Sale of Energy** – The sale of energy is the most common revenue model for solar PV projects. A large majority of solar PV applications, both Utility-scale solar and DRE, are deployed under the sale of energy revenue model.
- **For a Utility**-scale solar project developed under this model, the Generator sells energy to a utility or a Consumer(s).
- **For a DRE project, the Generator sells energy to one or more Consumers.**
- **Savings** – Under the self-owned models, the savings due to the solar PV unit for the Consumer-Owner is the revenue for the project.
- **The Sale of Services** – This is mostly deployed for DRE applications and is possible when solar PV is designed for a specific purpose like pumping or light charging. Under these models, the Generator is paid for the provision of services using solar energy rather than solar energy itself. For example, farmers can pay the Generator for the hours of water supply or volume of water supply.
- **Other Sources** – The Generator can earn revenue from the sale of certificates generated from the solar PV projects. Carbon credits, tax certificates and renewable energy certificates (RECs) are a few examples.

A project can also earn revenue from a combination of two or more of the above-said revenue streams. For example,

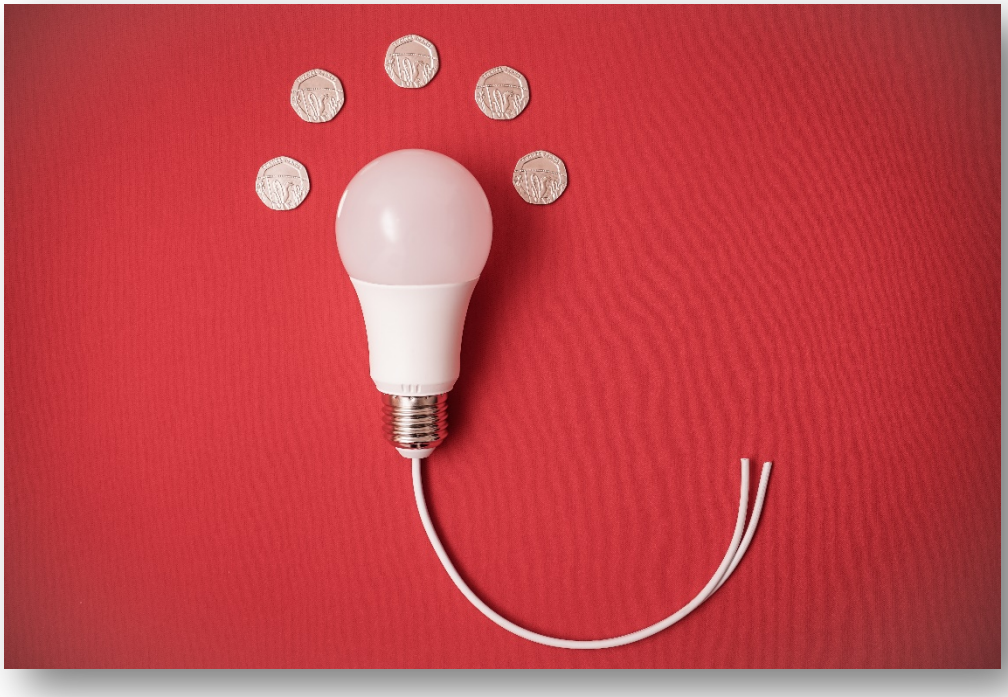
- Surplus energy for a DRE project can be sold to the utility through a net billing arrangement.

- Generators can earn revenue (for utility-scale solar) from the sale of energy to the Consumer or utility and from the sale of carbon credits/certificates.

1.3 Grid Interaction Models

Solar PV projects that do not sell energy to the utility, would need to interact with the grid to supply energy to the non-co-located consumer, and for banking and sale of surplus energy to the utility. The arrangements for such interactions are:

- **Open Access** – The Generator connects the solar PV project with the grid to supply energy to the Consumer who is not co-located and but is connected to the grid at a different location. The utility acts as a carrier of energy between the Generator and the Consumer and provides open-access services for this purpose to both parties.
- **Net Metering** – Net metering is usually provided to the Consumer for co-located DRE projects such as SRT. The Consumer injects the surplus generation into the grid to bank the surplus energy with the utility. The Consumer withdraws the banked energy from the grid as and when needed. For this, utility allows a bi-directional flow of energy between the grid and the Consumer.



- **Net Billing** – Net billing is usually provided to the Consumer for co-located DRE projects like SRT and solar pumps. The Consumer injects the surplus generation into the grid to sell the surplus energy to the utility[1], allowing a bi-directional flow of energy between the grid and the Consumer.

[1] Grid needs to be energized for all PV generation, not only surplus injection. The surplus energy cannot be banked with the utility when the grid is not in a charged state.

2 Contracting

Contracting is carried out between the involved entities to formalize relationships and outline the legal obligations each entity owes to the other and differs for each project type. The following are the most used agreements for solar PV projects:

- **Utility-Scale and DRE Projects**
  a. Power purchase agreement (PPA) – PPAs are signed between the Generator and the Consumer, or the utility, for the sale of energy generated by the project.
  b. O&M agreement – These agreements are signed between the Owner (or the Generator) and the O&M agency for carrying out O&M of the project.
- **For Utility-Scale Projects (Only)**
  a. Open access agreement – These agreements are signed between the Generator, Consumer and the utility for wheeling and banking the energy from the solar PV project to the Consumer by the utility.
  b. Lease agreement – This is signed between the Owner and the Generator to lease the project to the latter.
- **For Only DRE Projects (Only)**
  a. Gross metering agreement - The Consumer sells the entire energy generated to the utility and is signed by both parties for the connectivity and sale of energy.
  b. Service agreements – These are signed between the Generator and the Consumer for the sale of service using solar PV projects.
  c. Net metering agreement – These agreements are signed between the Consumer and the utility for banking of the surplus generation and the billing of net imported and exported energy.
  d. Net billing agreement – This is signed between the Consumer and the utility for the sale of the surplus generation and adjustment in the billing to the consumers.

3 Common Business Models

Few business models have been successfully used to deploy solar PV projects across the world. These models are listed below.

- Utility-scale projects include utility-owned projects, IPPs selling energy to utilities or directly to consumers, or developed by consumers for self-consumption.
- DRE projects include off-grid solar rooftop (SRT) projects using the CAPEX model, grid-connected using the CAPEX model (with net metering or net billing or gross metering), RESCO models for SRT projects, mini-grids, standalone solar pumps under the CAPEX model (also with net metering/net billing), and solar pumps using the RESCO mode.

4 Developing a Business Model

Business models need to be selected based on the local conditions, application, and socio-economic status of the stakeholders. Factors influencing the selection of the major components of a business model are:

- **Utility-Scale Solar**

a. Ownership Model

- In a few countries, the utilities supplying electricity to the consumers also own and generate energy. In such cases, solar PV projects will be owned by the utilities.
- In countries where the distribution and generation are carried out by different entities, solar PV projects may be owned by the utilities or IPPs.
- Large electricity consumers can save from consuming energy from solar PV, and a few of them are motivated to invest in and own solar PV projects. Investment tax credits are another motivation for such consumers.
- Few of the large consumers prefer to purchase solar energy from the IPPs as they want to avoid the onus of operations and risks of solar PV projects.

b. Revenue Model –

- For utility-scale models, the revenue model is usually the sale of energy to a utility or a Consumer.
- The sale of carbon credits, RECs and investment tax credits are sources of secondary revenue.

c. Grid interaction - All the energy generated by the solar PV project is injected into the grid for sale to the utility or wheeling to the consumer.

- **DRE**

a. Ownership model

- RESCOs take up those projects which meet their requirements:
  - Large DRE projects (100 kW and above capacity) as they are viable for O&M.
  - Consumers with high credit ratings as the payments from such consumers are prompt and secure.
  - Consumers with high energy costs as the success of a DRE project can reduce their energy costs
- Consumers prefer to own DRE when,
  - The savings from DRE are high,
  - They have the necessary wherewithal for the operations,
  - RESCOs are not available, and
  - They want to take benefits of investment credits and rebates whenever available.

b. Revenue Model

- The sale of energy is preferred when the electricity is used for running several appliances or is supplied to several consumers (in the case of mini grids).
- The sale of services is preferred when the consumer demand is for the services rather than the energy, and the prevailing market is developed to provide such services. For example, solar pumps when replacing diesel pumps follow the same revenue model as diesel pumps by renting on an hourly basis.

c. Grid Interaction

- Several DRE appliances are off grid, i.e., have no access to the grid.
- Solar rooftop plants deployed in premises with negligible energy requirements are deployed under the Gross Metering framework.
- The Net Metering or Net Billing arrangement is preferred when the energy generated cannot be consumed immediately due to the difference in the consumption profile and solar generation. In case a choice is available with the generator/consumer between these models, Net Billing is preferred only when the tariff received for excess energy is high and nearer to the retail tariff.

5 Financing of PV Projects

A solar PV project is funded by three major sources – (i) Equity (ii) Debt, and (iii) Capital Subsidy and Grant. The Owner of the project is responsible for the arrangement of the funds from all the sources and can be an individual person or a registered commercial entities like proprietorship firm, partnership firm, private company, and public company.

5.1 Equity

- Individual persons, generally, invest in DRE for self-consumption or sale of energy under Gross Metering. They use their own capital as equity.
- Partnership and Proprietorship firms deploy solar PV for self-consumption or for sale of energy to the utility or Consumers, i.e., RESCOs/IPPs. They use the surplus capital generated from the other businesses/projects of the firms or fresh equity capital brought in by the partners/proprietors for the development of the project.
- Companies deploy solar PV for self-consumption or for sale of energy to the utility or Consumers, i.e., RESCOs/IPPs. Companies generally rely on surplus capital for deploying solar PV for self-consumption. IPPs and RESCOs rely on various sources of equity. These include capital of private shareholders, public shareholders, private equity funds and pension funds. IPPs and RESCOs also use Special Purpose Vehicles and Joint Ventures to source equity capital from different sources for different projects.

Owners use different metrics for assessing a project for investment. Individual persons and small firms use simple metrics like payback period. Large companies use complex metrics like internal rate of return (IRR) on equity. Projects, for investment, should meet the internal hurdle rates of the Owner. The hurdle rates or expectation rate vary for projects depending on their risk profiles. Projects for self-consumption, or sale to utilities and Consumers with high credit ratings are low on risk and hence have low hurdle rates. Other projects would need higher returns for investment.

5.2 Debt

Individuals prefer commercial banks for sourcing debt for solar PV projects due to the accessibility and lower interest rates among the available sources. Individuals also borrow from non-banking financial companies (NBFCs). Low-ticket projects or products are funded by micro-finance institution (MFIs). NBFCs and MFIs tend to have shorter repayment periods and higher interest rates compared to commercial banks.

During the initial phase of RE development, debt availability for projects is usually low. The same is reflected in the high cost of debt offered to RE projects by the lenders vis-à-vis conventional power and other infrastructure projects. To make cost of debt at par with or lower than conventional power and infrastructure projects, the governments in their respective countries could,

- *Establish and fund a dedicated NBFC for lending to RE projects,*
- *Encourage NBFCs and commercial banks to lend to RE projects with relaxing lending norms,*
- *Mandate NBFCs and commercial banks through lending quota for RE projects, and*
- *Work with multi-lateral and bi-lateral agencies to mobilize low-cost debt capital.*

Projects with Owners and Buyers having high credit ratings are preferred for lending at attractive terms and conditions. The cost and availability of debt increases and decreases respectively for other projects. To encourage lending to such projects, government, and multi-lateral and bi-lateral agencies use instruments like partial credit risk guarantee and interest rate subvention.

5.3 Subsidies and Grants

Subsidy and grants are used to:

- Improve affordability of solar products and projects which are capital intensive.
- Reduce the cost of energy by –
  - Capital subsidies to reduce the project cost for the owners.
  - Interest rate subvention to reduce the cost of debt.
  - Viability gap funding to bridge the gap between the cost of solar energy and other sources like utility power.

Case Study

Innovative Business Models and Financing Mechanisms for PV Deployment in Emerging Regions by International Energy Agency (https://iea-pvps.org/wp-content/uploads/2020/01/IEA-PVPS_Task_9_-_Innovative_PV_Business_Models_for_Emerging_Regions.pdf).

The linked document above lists six case studies for several DRE Solar PV models from across the world. One or more of these case studies can be used to discuss different business models and their design/application.

Reading Material

1. *Business Model Scenarios and Suitability: Smallholder Solar Pump-based Irrigation in Ethiopia by IWMI (http://www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/PDF/pub172/rr172.pdf). This document refers to the business models for solar pumping in Ethiopia.*

2. *What ownership models are used for mini-grids? by USAID (https://www.usaid.gov/energy/mini-grids/ownership/models). The webpage refers to ownership models for mini-grids.*

3. *Rooftop Solar: Business Models by The Sustainable Partnership for Rooftop Solar Acceleration in Bharat (SUPRABHA) (https://solarrooftop.gov.in/knowledge/file-58.pdf). The presentation discusses common and upcoming business models for solar rooftop projects.*

4. *Photovoltaics Business Models by National Renewable Energy Laboratory, Berkeley (https://www.nrel.gov/docs/fy08osti/42304.pdf). The document presents several business models for solar rooftop.*

5. *Business Models to Realize the Potential of Renewable Energy and Energy Efficiency in the Greater Mekong Subregion by Asian Development Bank (https://www.adb.org/sites/default/files/publication/161889/business-models-renewable-energy-gms.pdf). The document refers to business models for solar PV projects.*