# HybridBOSSE Manual (Improvements)

## Overview

HybridBOSSE (Hybrid Balance of System Systems Engineering) is a is a semi process-based, ground-up model that first estimates the engineering and physical calculations of a utility-scale hybrid (Solar + Storage + Wind) plant (> 1 MW), and then calculates cost estimates based on these engineering results. HybridBOSSE is semi-based on the LandBOSSE code architecture.

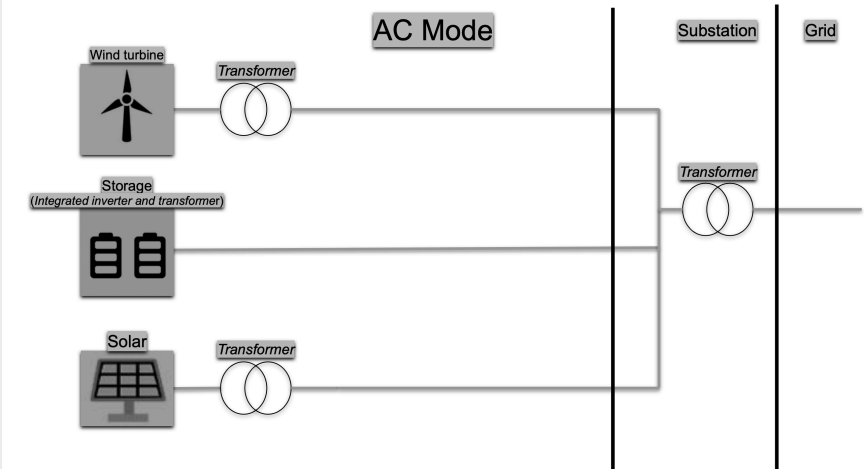
## Assumptions

- Substation costs are empirically estimated. (Not processed based)
- Shared collection cost is based off the shortest distance in between each manual placement node to each-other.
- Changing project modes, changes substation type (AC/DC) and cable types as shown in the images below. which directly affects substation costs.

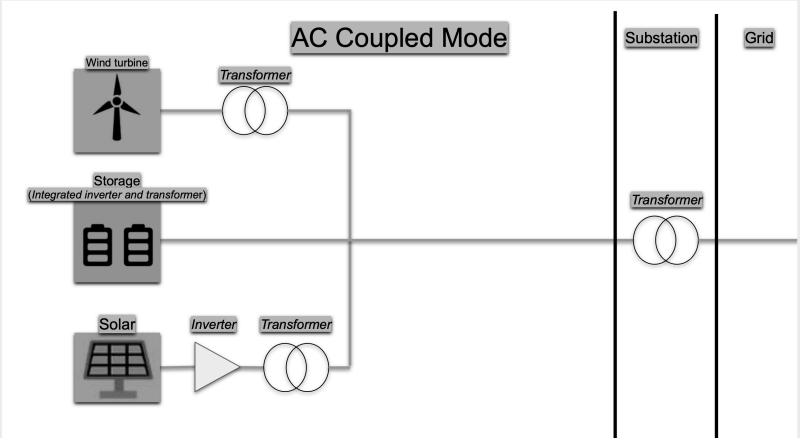
## Improvements

Project Modes:

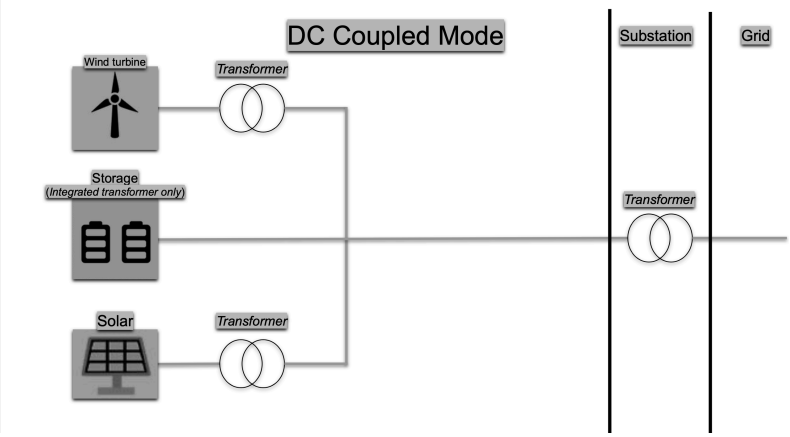
- AC mode (HybridBOSSE's previous running mode) [1]



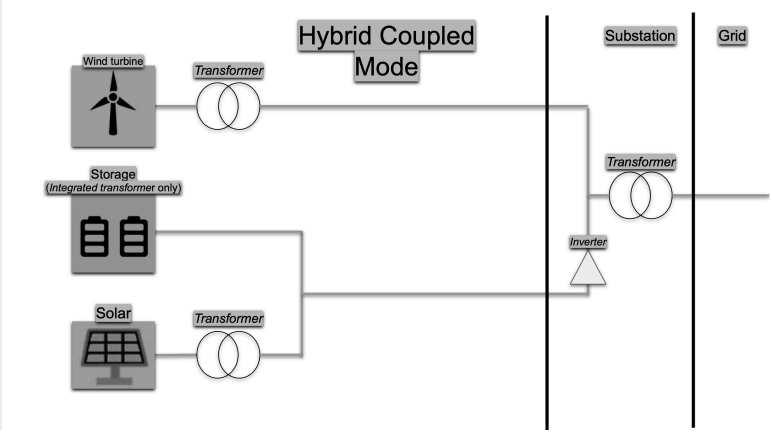

- AC coupled mode [2]




- DC coupled mode [3]




- Hybrid coupled mode [4]




Shared collection costs:

- As seen above, shared collection costs can be clearly seen in AC mode versus AC coupled mode.
- Shared collection costs can be turned off to have each module run separately as hybridBOSSE once did.

Manual placement:

- Manual placements of each module such as: wind, solar, storage, the substation; can be given a coordinate system in order to calculate the shortest distance of cabling as well as using different spaced setups.

Additional notes:

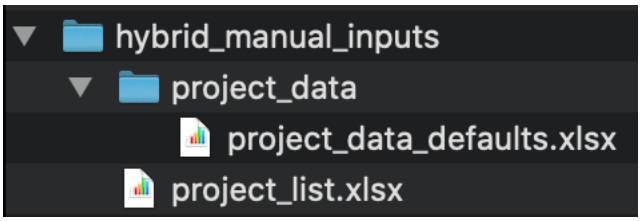
- Added a DC substation calculation (Empirically based)
- Started the process of creating hybridBOSSE level input files (Used for sharing)

## Inputs

The inputs for this version of HybridBOSSE are built upon the original inputs of HybridBOSSE. The additional inputs are broken down by the list below

- Project_data
    - Additional sheets: cable_specs_ac, cable_specs_dc, collection_layout
- Project_list
    - "Collection mode" : [auto/manual]

There will be a set of test inputs included with this manual, important inputs to look for are: "collection_layout_file_name", `"collection_layout_path", "path_to_project_list",` and `"name_of_project_list"` as these are the inputs that select the folder location.




## Running HybridBOSSE

HybridBOSSE is currently located in the *hybrid_manual_improvements* branch of *HybridBOSSE* located at this git repository:https://github.com/parangat94/HybridBOSSE/tree/hybrid_manual_improvements.

HybridBOSSE can be run from *./HybridBOSSE/main.py*. The lines required to run StorageBOSSE are:

```
hybrids_scenario_dict = dict()
        #hybrids_scenario_dict = dict()
        # hybrids_scenario_dict = {
```

```
"project_name": ‘Hybrid_BOSSE',
"project_mode": 2,
"shared_interconnection": True,
"shared_collection_system": True,
"distance_to_interconnect_mi": 1.5,
"line_frequency_hz": 60,
"collection_layout_file_name": 'project_data_defaults',
"collection_layout_path": '/Users/ccampos/Desktop/'
'hybrid_manual_inputs/project_data',
"new_switchyard": True,
"grid_interconnection_rating_MW": 7.5,
"interconnect_voltage_kV": 15,
"shared_substation": True,
"hybrid_substation_rating_MW": 7.5,
"wind_dist_interconnect_mi": 0,
"num_turbines": 5,
"turbine_rating_MW": 1.5,
"wind_construction_time_months": 5,
"project_id": "ge15_public_dist",
"path_to_project_list": "/Users/abarker/Desktop/Hybrid Model/Code/bin",
"name_of_project_list": "project_list_ge15_dist_05",
"solar_system_size_MW_DC": 100,
"dc_ac_ratio": 1.2,
"solar_construction_time_months": 5,
"solar_dist_interconnect_mi": 5,
"storage_system_size_MW_DC": 50,
"storage_system_size_MWh": 5,
"storage_construction_time_months":5,
"path_to_storage_project_list": "/Users/abarker/Desktop/Hybrid Model/Code/
bin/StorageBOSSE/project_list_test.xlsx",
"storage_project_list": "project_list_test"
}
```

Or, you can read from the hybrid_inputs.YAML file:

```
hybrids_input_dict:
   project_name: 'Hybrid_BOSSE'
   project_mode: 1 # 1: Auto, 2: AC coupled, 3: DC coupled, 4: Hybrid coupled
   shared_interconnection: True
   shared_collection_system: True
   distance_to_interconnect_mi: 3
   new_switchyard: True
   grid_interconnection_rating_MW: 7.5
   interconnect_voltage_kV: 15
   shared_substation: True
   hybrid_substation_rating_MW: 7.5
   collection_layout_file_name: 'project_data_defaults'
```

```
    collection_layout_path: '/Users/ccampos/Desktop/hybrid_manual_inputs/
project_data'
    line_frequency_hz: 60
    # Wind farm required inputs
    wind_dist_interconnect_mi: 0    # Gets over-ridden when
'shared_interconnection' is True
    num_turbines: 100
    turbine_rating_MW:  1
    wind_construction_time_months: 5
    project_id: 'foundation_validation_ge15'
    path_to_project_list: '/Users/ccampos/Desktop/hybrid_manual_inputs/
project_data'
    name_of_project_list: 'project_list_ge15_dist_05'

    # Solar farm required inputs
    solar_system_size_MW_DC: 100
    dc_ac_ratio: 1
    solar_construction_time_months: 5   # Optional. Overrides Has a scaling MW
v. construction time relationship
    solar_dist_interconnect_mi: 5   # Gets over-ridden when
'shared_interconnection' is True

    # Storage required inputs
    storage_system_size_MW_DC: 50
    storage_system_size_MWh: 1
    storage_construction_time_months: 5
    path_to_storage_project_list: '/Users/abarker/Desktop/Hybrid Model/Code/
bin/StorageBOSSE/project_list_test.xlsx'
    storage_project_list: 'project_list_test'
```