ATSC 313 Case-study Modules under each of the Main Themes (Hydro power, Wind power, Solar power, and Synthesis).

In each of the Hydro, Wind, and Solar Themes, the first three modules (labelled Module A, Module B, and Module C) hold all the Learning Goal quizzes where students read and learn the material needed in the case-studies and, importantly, in the three mid-term exams and the final exam. In the final Synthesis Theme, the first two modules (labelled Module A and Module B) hold all the Learning Goal quizzes for this particular Theme and for questions in the final exam (there is no mid-term exam following the Synthesis Theme). Students are expected to complete all Modules A, B, and C in these main Themes.

In each of the Hydro, Wind, and Solar Themes, the three possible case-study selections are labelled Module D1, Module D2, or Module D3. In the Synthesis theme, the two possible case-study selections are labeled D1 or D2.

Important Note: Students review each of the **THREE** case-study Modules associated with each main Theme (**TWO** case-studies for Synthesis Theme) and select **ONE** case-study to complete and submit. Credit will be given to only the **ONE** case-study submitted by each student. Each student selects their own case-study to complete and submit.

ATSC 313 Case-study Modules **Hydro Theme**

Hydro D1: Run-of-river hydro plant selection

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as electricity prices from published sources.
Choose a re-analysis dataset and **generate** your own weather maps.
Interpret weather maps to **determine** precipitation at key sites.
Combine precipitation data and electricity prices to **estimate** net revenue for each site.
Compile info on costs for plant construction, maintenance, down time, etc.
Debug and **check** your work by **comparing** against a known generation site.
Rank the sites from best to worst and **select** the best site.
Justify your selection in a one-or-two paragraph summary.
Critique your answer based on the actual outcome and thoughts by experts.

Hydro D2: Hydro dam management for a predicted heavy rain event

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as weather maps and forecasts, and **interpret** them.
Design and **Code** a computer hydrologic **model** to calculate inflow and outflow to/from a reservoir
Utilize a precipitation forecast that best represents the approaching weather.
Make assumptions as needed to enable your decision making.
Weigh/contrast the issues to maximize both revenue and dam safety.
Run and **debug** your model for the specific weather and hydroelectric facility.
Decide how much water to release from the reservoir.
Justify your decision in a one-or-two paragraph summary.
Critique your answer based on the actual outcome and thoughts by experts.

Hydro D3: Financial report for a run-of-river hydro plant

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as weather maps and forecasts, and **interpret** them.
Design and **Code** a computer hydrologic **model** to calculate flow from rainfall and snowmelt.
Apply your computer model for runoff from rain and snowmelt.
Analyze forecast skill incorporating **bias-corrected** model forecasts.
Determine the time lag between precipitation and runoff.
Incorporate both volume flow rate and velocity in your **estimation** of power production.
Anticipate weather-related risks and hazards due to exceptional rainfall.
Select the best revenue estimate.
Justify your decision in a one-or-two paragraph summary.
Critique your answer based on the actual outcome and thoughts by experts.

ATSC 313 Case-study Modules **Wind Theme**

Wind D1: Severe weather damage to wind farms

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as weather maps and forecasts.
Interpret satellite images and weather maps to estimate thunderstorms locations and evolution.
Analyze soundings to **determine** atmospheric stability and thunderstorm indices.
Compile synoptic, mesoscale, and storm winds to **create** a mental picture of the situation.
Compose a report summarizing the events and analyzing the role of the atmosphere. **Critique** your answer based on the actual outcome and thoughts by experts.

Wind D2: Selection of location for a new wind farm

By the end of this module, you will be able to ...

Determine what weather info you need to address this issue.
Acquire available data such as wind climatology, topography.
Interpret maps of wind potential.
Analyze the effects of ridges, valleys, and isolated hills on wind-energy potential.
Describe how the boundary layer affects hub-height wind speed.
Compare the advantages and disadvantages of the three potential sites.
Compose a report **recommending** the best wind-farm location.
Justify your recommendation.
Critique your answer based on the actual outcome and thoughts by experts.

Wind D3: Wind power statistics, probability forecasting and energy trading

By the end of this module, you will be able to ...

Determine what weather and wind farm info you need to address this issue.
Acquire available data such as wind probability forecasts and spot energy prices.
Calculate frequency distributions for wind speed and wind power.
Fit a Weibull distribution to the wind speed data.
Explain the difference between power curves for wind turbines vs. wind farms.
Predict the expected annual power production for the wind farm.
Interpret probabilistic forecast graphs.
Decide whether to sell the anticipated excess power, based on the cost/loss ratio for your wind farm.
Explain your calculations and **justify** your recommendation to sell power or not.
Critique your answer based on the actual outcome and thoughts by experts.

ATSC 313 Case-study Modules **Solar Theme**

Solar D1: PV solar panel design for a Vancouver homeowner

By the end of this module, you will be able to ...

Determine what sunshine and solar panel info you need to address this issue.
Acquire available data such top-of-atmosphere incoming radiation and cloudiness climatology.
Critique the accuracy of various radiometers.
Code a program to **calculate** theoretical irradiance, and **compare** with measured irradiance.
Design the optimum PV system for the home.
Recommend to the homeowner whether a PV solar panel should be installed.
Critique your answer based on the actual outcome and thoughts by experts.

Solar D2: International site selection for a utility-scale solar power facility

By the end of this module, you will be able to ...

Determine what sunshine and solar panel info you need to address this issue.
Acquire available data including Global Horizontal Irradiation climatologies and PV specs.
Compare irradiation data at different international sites.
Design optimum solar panel spacing.
Calculate PV module efficiency and energy yield over a ten-year lifespan, including aging issues.
Consider other factors such as distance to transmission lines and inefficiency when hot.
Decide which site is optimum.
Justify your decision.
Critique your answer based on the actual outcome and thoughts by experts.

Solar D3: Farm-scale solar design, energy storage, and renewable-energy education

By the end of this module, you will be able to ...

Determine what sunshine and solar panel info you need to address this issue.
Acquire available data including Global Horizontal Irradiation climatologies and PV specs.
Identify cloud types by the visual appearance, and **relate** them to expected irradiance.
Interpret and **compare** satellite images and NWP forecasts of clouds.
Relate cloudiness to synoptic weather map features.
Explain how different cloud types cause different attenuation of insolation
Calculate energy yield & revenue, and **determine** the payback period for installing solar panels.
Estimate the effects of climate change on solar panel viability in the future.
Critique your answer based on the actual outcome and thoughts by experts.

ATSC 313 Case-study Modules **Synthesis Theme**

Synthesis D1: Scientific, social & political issues on electric-market deregulation

By the end of this module, you will be able to ...

Compare the advantages and disadvantages of a deregulated electricity market.
Compare the relative values of different generation sources, and their vulnerabilities.
Estimate the effects of reliability, dispatchability, transmission, trading, tariffs, etc.
Relate correlated fluctuations in hydro, wind, and solar generation to passage of lows and fronts.
Explain alternatives.
Compile the information and **write** a briefing paper that is clear, concise, jargon-free.
Recommend and **justify** the best course of action.
Counsel the politicians on the issues.
Critique your answer based on the actual outcome and thoughts by experts.

Synthesis D2: Write an article for a general-science website on the future of the electric grid in year 2050

By the end of this module, you will be able to ...

Determine what information you want to focus on in this article for the public.

Contrast electric generation growth with population growth, and **project** vulnerabilities.

Compile factors such as home vs. utility scale, smart electric grid, smart meters, energy shortages.

Propose your vision for the future, and be **creative**.

Justify your predictions.

Critique your answer based on the actual outcome and thoughts by experts.