The Green Yard Scheduler: An Innovative Decision Tool to Enhance the Sustainability of Container Terminals

The Green Yard Scheduler (GYS), a decision support tool that is being developed by Brunel University London in the work package WP5 (Green Scheduling and Sustainability of Operations) of the PortForward project, optimizes container terminal operations by prioritizing environmental sustainability alongside terminal productivity in collaboration with the Port Authority of Vigo and LEITAT Technological Center. Vigo container terminal is the designated project use case of WP5, and serves as the main platform for the integration, and offline/online testing of the GYS (*Figure 1*).


Figure 1: (From top left to right): 1) Vigo container terminal yard, 2) Reach stacker, 3) Rubber tyred gantry crane, 4) Quay cranes (Source: *Termavi*)

The main novelty of the GYS is the implementation of "green scheduling", the integration of environmental considerations as explicit objectives into the conventional scheduling to analyze the trade-off between the operational performance and sustainability of a system. In line with the principles of green scheduling, four key objectives have been identified concerning the design and development of the GYS:

- Increase the productivity of the container terminal and remove operational bottlenecks.
- Reduce the carbon footprint of the terminal.
- Integrate with the terminal operating system.
- Harmonise container yard operations.

The GYS involves three interactive optimization modules: container pre-marshalling, container positioning, and yard crane scheduling (*Figure 2*). Each module works as a problem solver for a specific yard operation by considering interrelated sustainability and performance-oriented objectives.
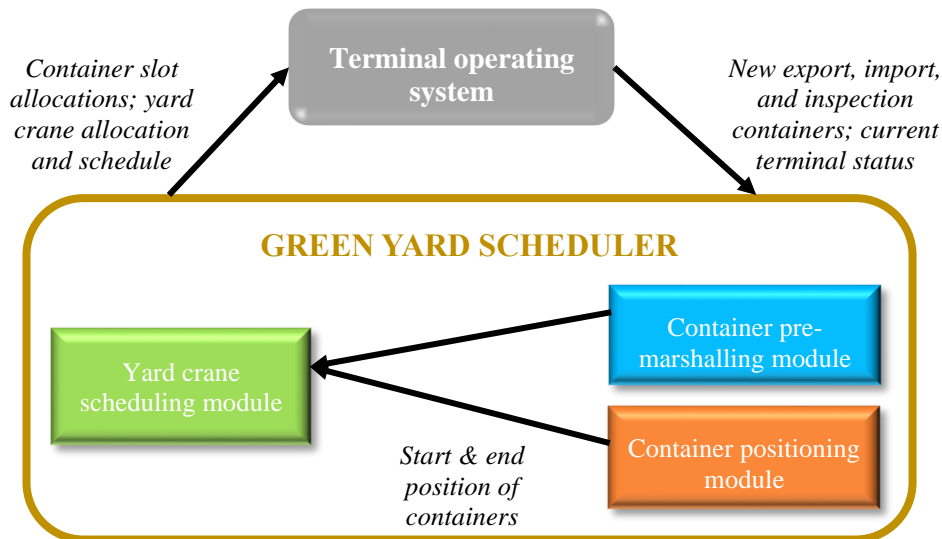
Figure 2: Architectural diagram of GYS

The GYS is connected to the terminal operating system (TOS) to ensure a smooth exchange of information between the two platforms. It pulls the module input parameters (e.g. the yard occupation status, the position of the yard equipment and the list of pending operations, etc.) from the TOS. On the opposite stream, the GYS outputs (e.g. container slot allocations, yard crane schedule) are sent to the TOS as instructions for terminal operations planning.

A graphical user interface (GUI) for the GYS is being developed in addition to the built-in optimization modules (*Figure 3*). The GUI plays a key role in the user - scheduler interaction by enabling the user to run the modules, visualize the results, and execute selected planning decisions. Presentation of the decision alternatives available to the user with their anticipated outcomes and their trade-off is one of the key features of the GUI.
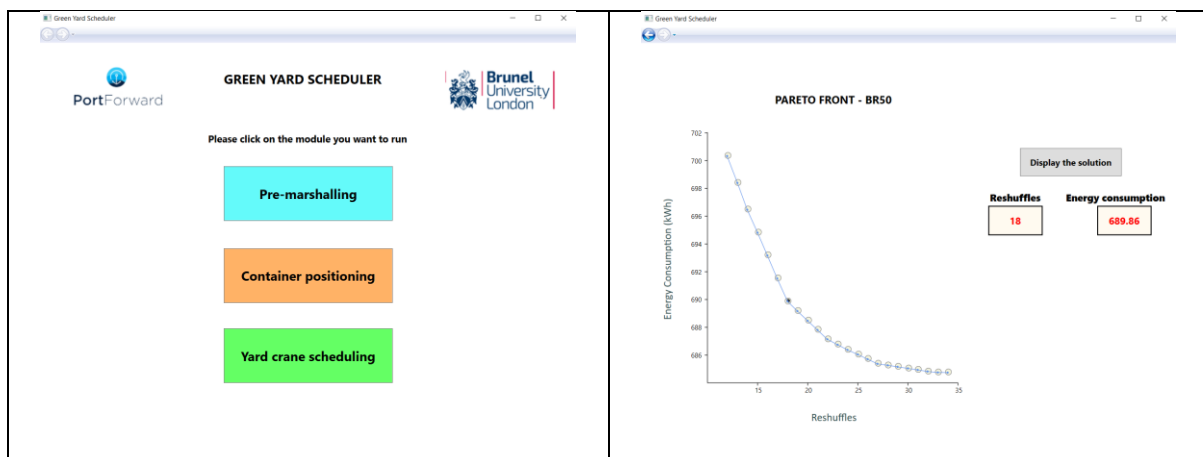
Figure 3: Screenshots of the GYS Graphical User Interface

Future steps in the development of GYS

- Completion of the (beta version) GYS solvers and GUI
- Testing and implementation in Vigo container terminal
- Finalizing the stable version of the GYS
- Development of the stand-alone, cloud-based platform for the use of other container terminals

Learn more about GYS on OR Society's annual conference.

About the project

PortForward is a project funded under H2020 MG-7.3-2017 topic: "The Port of the Future". The project proposes a holistic approach towards smarter, greener and more sustainable port ecosystems

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