



# Economic Fibre Supply Model (EFSM) for Ontario

## Model Development and Framework

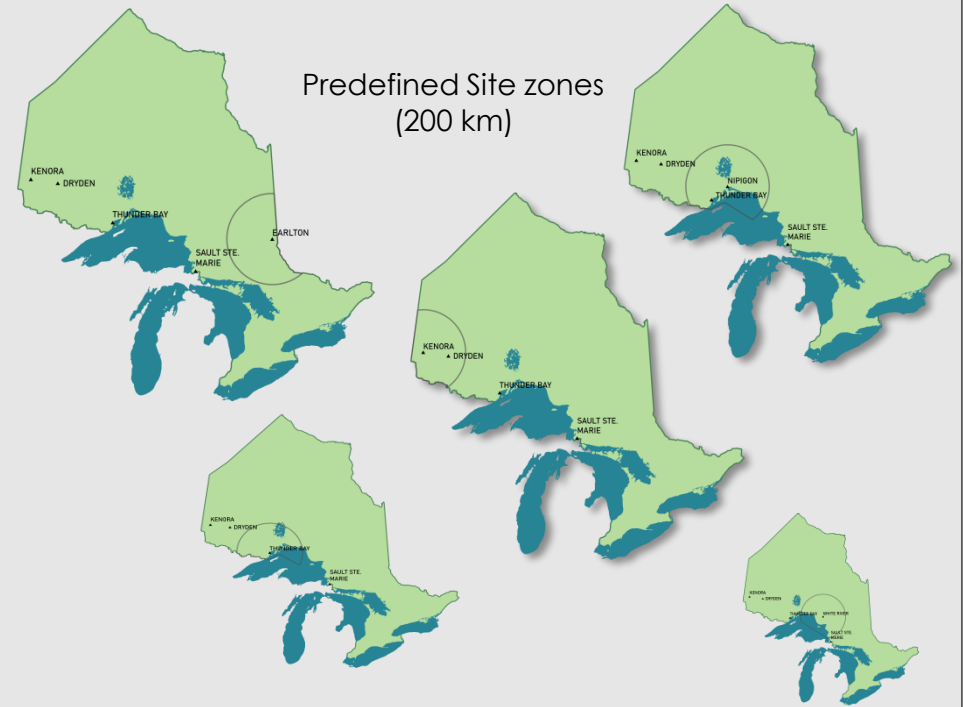
Nextfor Forest Innovation Workshop

Toronto

February 27, 2020

# EFSM Application Scope

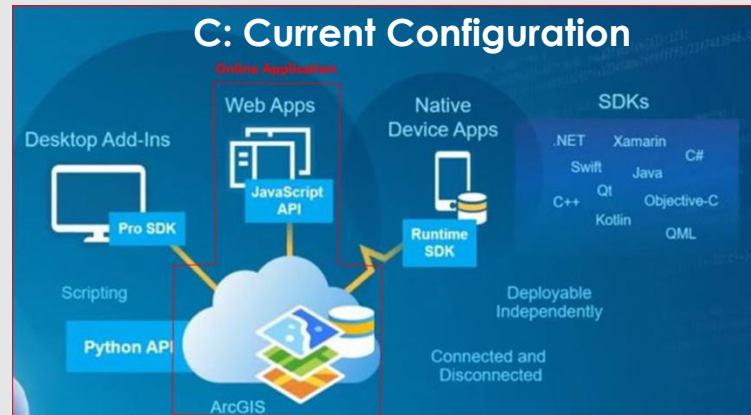
- **Objectives**
  - Scalable
  - Extendable
  - Cost effective
  - Framework to allow for rapid development and testing
- **General Comments**
  - Pre-defined zones (i.e. economic centres)
    - Sites can be added or dropped as required
  - Not a wood supply model
  - Implements ESRI Technology stack



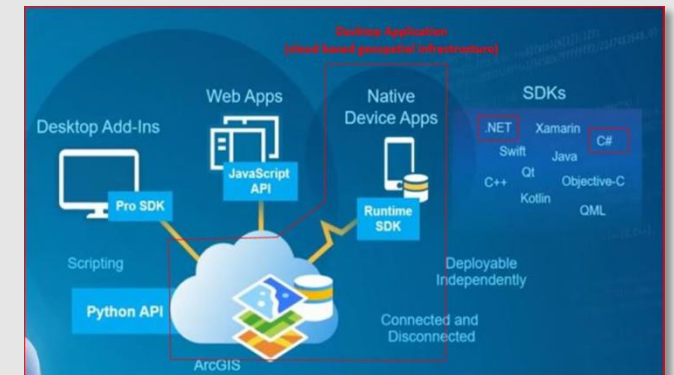
A



C: Current Configuration



B



# Economic Fibre Supply Model (EFSM) Components



AUTHORITATIVE DATA  
SOURCES



DATA MODEL



APPLICATION

# Authoritative Data Sources

- Land Information Ontario (LIO):
  - Reference data (lakes, streams, administrative boundaries etc.),
  - **2008 Forest Resource Inventory (FRI)** and eFRI
  - **Ontario Road Network (ORN)** and **MNRF Roads**;
- Canada's National Forest Inventory (NFIS):
  - High Resolution Forest Change for Canada
    - Forest Basal Area 2015
    - Forest Lorey's Height 2015
    - **Forest Gross Stem Volume 2015**
    - Forest Total Aboveground Biomass 2015
- FP Innovations
  - Northwestern Ontario forest fibre costing (Info Note)
    - **Harvesting (roadside) cost (\$/m<sup>3</sup>)**
    - **Haul cost (\$/m<sup>3</sup>/km)**
    - Restricted to members and partners of FPInnovations

Table 2. Northwestern Ontario roadside cost calculated with Procalc

Costing input <sup>a</sup>	Cut-to-length		Full-tree		
	Harvester	Forwarder	Feller-Buncher	Grapple Skidder	Roadside Processor
Hourly cost (\$/SMH)	167	124	160	125	157
Utilization rate (%)	75	60	75	80	75
Hourly cost (\$/PMH)	222	206	213	157	209
Productivity (m <sup>3</sup> /PMH) <sup>c</sup>	20.3	24.6	48.7	22.2	25.2
Annual productivity (m <sup>3</sup> )	30 450	29 520	73 050	35 520	37 800
Cost (\$/m <sup>3</sup> )	10.93	8.38	4.38	7.06	8.29
Roadside cost (\$/m <sup>3</sup> )	19.31 <sup>b</sup>		19.73		

<sup>a</sup> SMH: Scheduled machine-hour, PMH: Productive machine-hour. Assumes operating on single shift for total of 2000 SMH/year.  
<sup>b</sup> Crown timber charges vary per Sustainable Forestry Licence (SFL) and species/product and need to be added to delivered costs (usually ranges between \$2/m<sup>3</sup> and \$11/m<sup>3</sup>). Other related cost such as supervision, scaling, cruising, machine floating, and road maintenance can vary between 7 to 10 \$/m<sup>3</sup> and need to be accounted for in the delivered cost.  
<sup>c</sup> Using FPI Procalc default productivity for clearcut mixedwoods and assuming an average skidding distance of 150 m.

Table 3. Costing elements for the transport of logs, tree length and wood chips

Costing input <sup>a</sup>	Tree-length haul truck	Self-loader	B-train chip van
Hourly cost (\$/SMH)	117	122	122
Utilization rate (%)	90	90	90
Hourly cost (\$/PMH)	130	136	136
Loading/Unloading/Waiting time (hrs) <sup>b</sup>	1.5	1.75	1.5
Net load (m <sup>3</sup> )	49.5	47	48
Cost of loader (\$/m <sup>3</sup> ) <sup>c</sup>	1.26		

<sup>a</sup> SMH: Scheduled machine-hour, PMH: Productive machine-hour  
<sup>b</sup> Self-loaders use 60 min for loading and 45 min for unloading; TL and B-train vans use 50 min to load and 40 min to unload.  
<sup>c</sup> Assumes \$70/SMH, utilization of 75%, \$93/PMH, productivity of 74 m<sup>3</sup>/PMH = \$1.26/m<sup>3</sup>

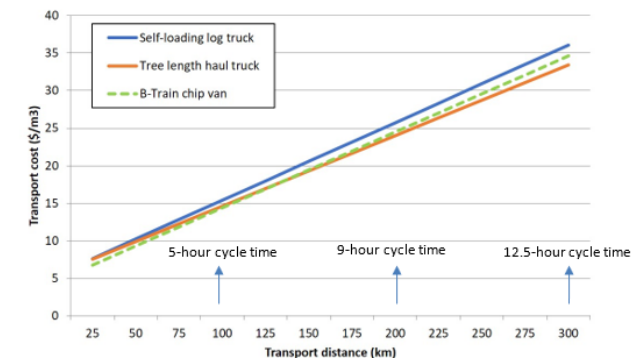
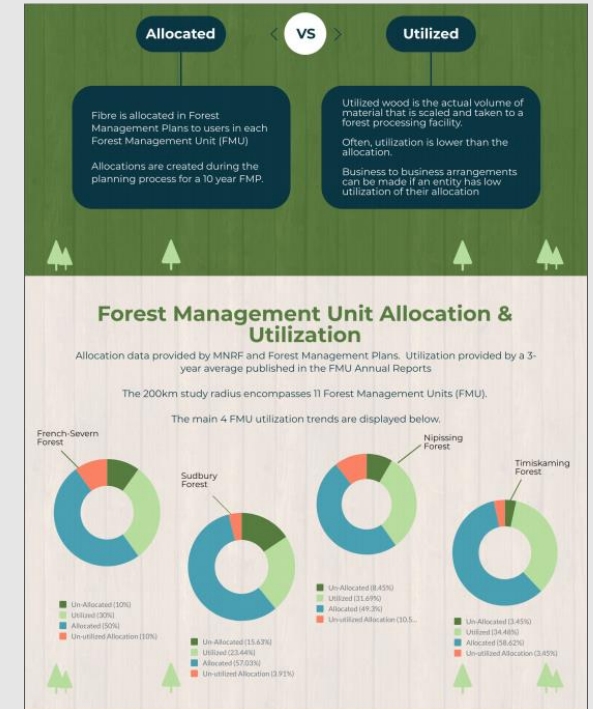
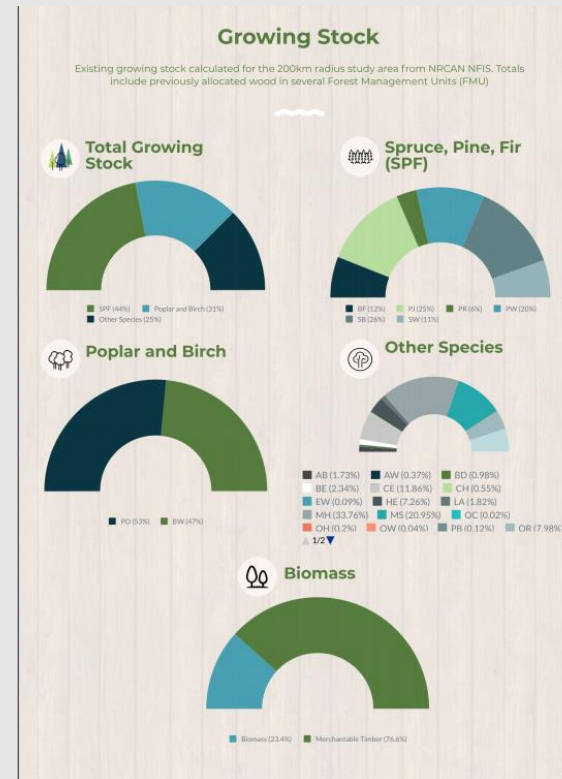
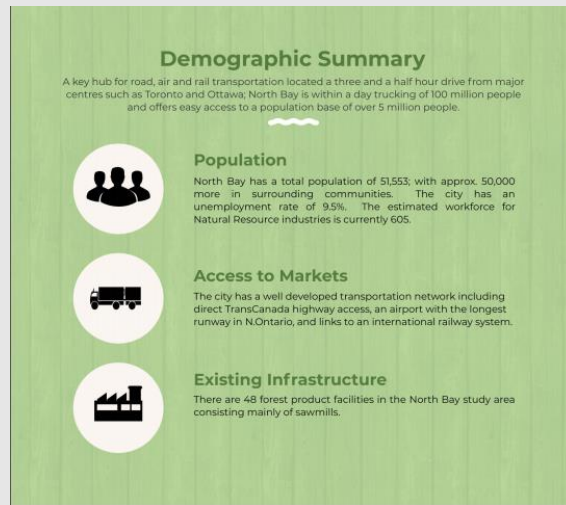
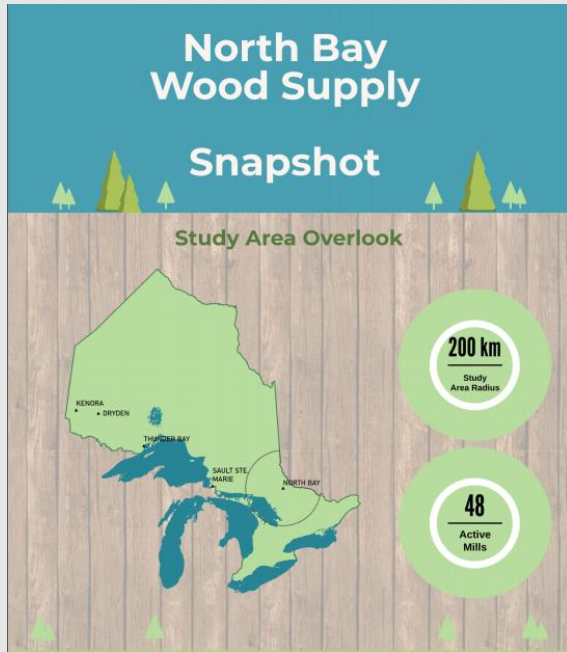


Figure 2. Transport costs according to transport distance.  
 \*Distances assume 10% operational gravel road, 25% primary gravel roads and 65 % paved roads

# Authoritative Data Sources

- Ministry of Natural Resources and Forestry (MNR):
  - Forest Management Plans (FMP), **Allocated harvest versus Planned Allowable Harvest Areas**
  - Annual Reports,
  - Forest inventory yield curves
- Statistics Canada, Municipalities (i.e., North Bay)



# Economic Fibre Supply Model (EFSM) Collaboration



AUTHORITATIVE DATA  
SOURCES

- Data to support:
  - Fiber availability by tree species, physical tree component (i.e., stemwood, branches, top, etc.)
  - Related costs (harvesting, handling costs, transportation to mill)
  - Transportation modelling
  - Annual updates
    - Allocation

# EFSM DATA MODEL

- Based on ESRI's Technology stack
  - ArcGis Online
    - Cost effective
    - Cloud based
    - Secure environment
    - Mapping capabilities
    - Public and password protected
      - Public access – free
      - Password - \$\$\$
        - Named user – Viewer
        - Named user – Publisher
    - Configurable app templates:
      - Operations Dashboard
      - Web App Builder
      - ArcGis Experience Builder
      - Storymaps (eventually)
    - Extensibility framework and custom widgets
      - JavaScript API

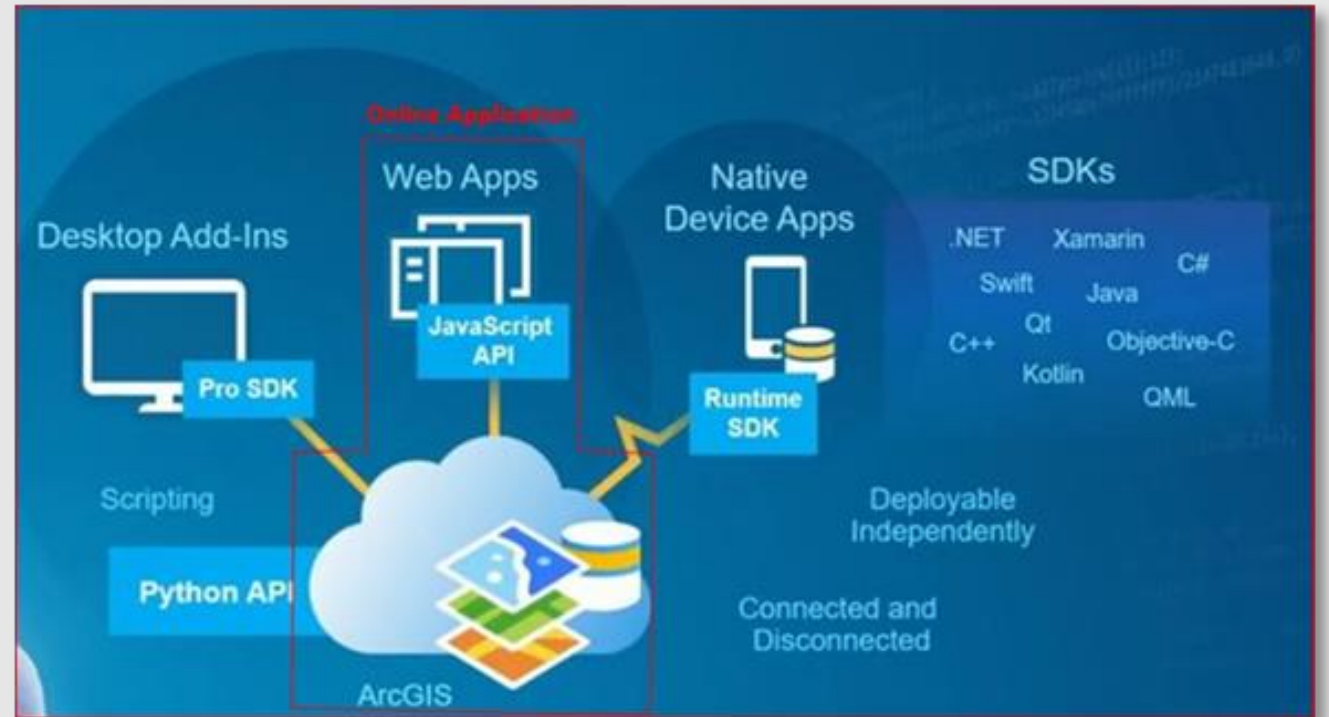
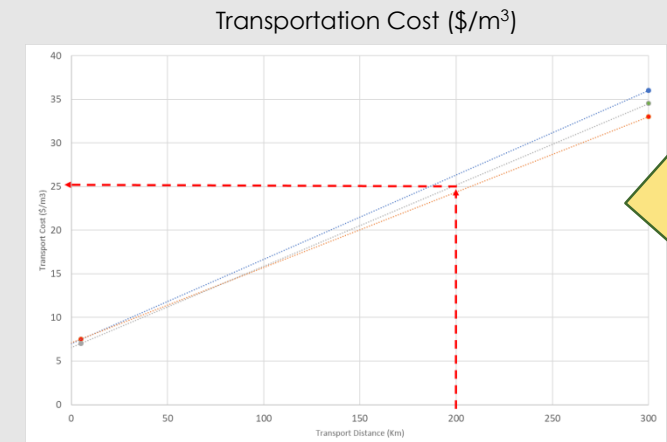
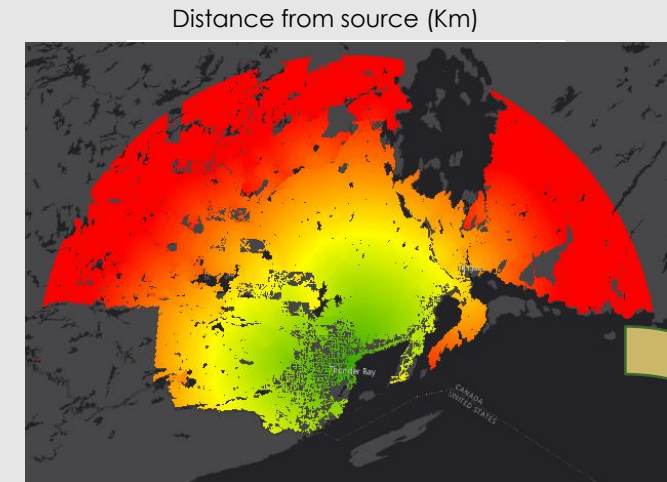


Image modified from ESRI's 2019 Developers Summit Plenary

# Data model: Current Framework

- Growing Stock → species volume for each pixel
  - Forest Gross Stem Volume 2015 ( $\text{m}^3/\text{ha}$  estimate for each 30 m pixel)
    - Convert volume per hectare ( $\text{m}^3/\text{ha}$ ) to volume per pixel ( $\text{m}^3$ )
    - Partition volume by species (FRI 2008):
      - $157.3 \text{ m}^3/\text{ha} \rightarrow 14.4 \text{ m}^3$  per pixel  $\rightarrow$  Pj 50Pt 50  $\rightarrow$  Pj: **7.2**  $\text{m}^3$  Pt: **7.2**  $\text{m}^3$
- Transportation Surface → distance from mill (km) for each pixel
  - Distance from mill as the bird flies but “with barriers”
    - Around lakes (i.e., barrier)
    - Only uses existing roads through patent, conservation land and Indian reserves
- Haul cost → cost to get pixel volume to mill
  - Transportation distance \* transportation cost (FplInnovations) \* pixel volume
    - Haul cost (200km)  $\$25\text{m}^3 * \text{Pj } 7.2 \text{ m}^3 = \mathbf{\$180.00}$
- Harvest cost → roadside harvest cost per pixel
  - Harvest cost \* pixel volume
    - $\$19 \text{ m}^3 * \text{Pj } 7.2 \text{ m}^3 = \mathbf{\$136.80}$





# Sample Economic Fibre Supply Model Summary Output (1 of many)

Delivered wood cost (\$/m3)	Northern Ontario Planned Volumes ( m3/yr)		
	AAC SWD	AAC HWD	Total
\$ 35.00		87,209	87,209
\$ 40.00		572,120	572,120
\$ 45.00	180,297	609,762	790,059
\$ 50.00	1,057,673	286,972	1,344,645
\$ 55.00	1,138,848	70,192	1,209,040
\$ 60.00	356,872	84,053	440,925
\$ 65.00	114,306	320,175	434,480
\$ 70.00	469,794	85,863	555,657
\$ 75.00	374,258		374,258
\$ 80.00	11,557		11,557
Total Volme	3,703,604	2,116,345	5,819,949
WTD Avg	\$ 59.88	\$ 50.88	

# Economic Fibre Supply Model (EFSM) Collaboration



DATA MODEL

- Data to support:
  - Residual volume
  - Regional or local long term forecast models ( $\text{m}^3/\text{ha}/\text{year}$ )
  - Transportation model (cost surface)

# Economic Fibre Supply Model (EFSM) Collaboration



APPLICATION

- Third-party feature services
- Third-party analytics
- Custom widgets and storyboards



# Economic Fibre Supply Model (EFSM) for Ontario

Model Development and Framework

**Questions??**